PERMEABLE PAVING SYSTEMS

Permeable paving (also known as pervious or porous pavement) are surfaces that allow water to pass through voids in the paving material or between pavers while providing a stable, load-bearing surface. This allows stormwater to filter through the soil below the paved surface, reducing the numerous environmental issues associated with water runoff. Just as drinking water can be filtered to remove impurities, the soil particles filter rainwater percolating through soil on its way to surface waters and to groundwater aquifers. This important step in the natural process of water purification is bypassed when rainwater falls on impermeable pavement surfaces or roofs and is carried directly through storm drainage systems into waterways. Pollution carried in rainwater runoff is another concern, especially in urban areas. Stormwater flowing across streets, parking lots and sidewalks pick up contaminants associated with air pollution particles, spilled oil, detergents, solvents, dead leaves, pesticides, fertilizer, and bacteria from pet waste. Natural filtration of water through soil is the simplest way to control these pollutants, and is a direct advantage of permeable pavement.

CONSIDERATIONS

APPLICABILITY
Permeable paving systems are appropriate for parking areas, parking lots, drive aisles, private alleys, sidewalks, courtyards and plazas.

INSTALLATION
Permeable paving systems must be designed and installed in accordance with the manufacturer's specifications. These specifications and details must be included with the site plan submittal to the Development Services Center.

GRADING
In order to optimize water infiltration through the permeable paving system, the slope of the surface area should range from 0.5 percent to 2 percent.

SPACING
When designing a permeable paving system utilizing Open Jointed and Open Cell Paving Blocks (pavers) as described below for parking spaces above the minimum number required, the permeable area shall have a minimum perviousness of 10 percent. If a permeable paving system is being designed for stormwater management purposes, additional criteria will need to be met in accordance with applicable City and State regulations.

MAINTENANCE
The overall maintenance goal for a permeable paving system is to prevent clogging of the void spaces within the surface material. The surface must not be sealed or repaved with non-porous materials if it is to continue to function and to be counted towards meeting the maximum allowed parking requirement. Sand and salt must not be applied to areas with porous pavements. Depending on the system, occasional sweeping or vacuuming of debris will be required to ensure the void spaces do not clog. Educational signage should be used wherever porous pavement is installed as a teaching tool for the public and as a reminder of maintenance obligations.

LANDSCAPING
The most important landscaping objective for porous pavements is to ensure that its drainage area is fully stabilized, thereby preventing sediment loads from clogging the pavement.

ACCEPTABLE MATERIALS

There are many options for permeable paving materials: porous concrete, pervious asphalt, open joined and open cell paving blocks. Examples provided herein are meant as a representation of products available, not an endorsement of a specific product or manufacturer.

POROUS CONCRETE: There are a number of alternate names for porous concrete including permeable concrete, porous pavement, and pervious concrete. All of the names basically mean the same thing; porous concrete is a form of concrete which is permeable, rather than solid. Porous concrete is designed to trap water and allow it to percolate through the concrete to the ground below. Pervious concrete uses the same materials as conventional concrete, with the exceptions that the fine aggregate (sand) typically is eliminated entirely, creating a substantial void content.

- **Advantages:** Used in place of conventional concrete decreases the total amount of runoff leaving a site, promotes infiltration of runoff into the ground, reduces the amount of pollutants carried to a storm drain or waterway, and aids with reducing peak runoff velocity and volume. Porous concrete is applicable to many light-duty uses, including overflow parking areas, residential street parking lanes, parking pads in parking lots, sidewalks, golf cart and bike paths, and emergency access lanes. With proper maintenance, including regular vacuuming of the surface to prevent clogging by sediment, porous concrete can have a minimum service life of 20 years. It also comes in a range of colors, and it can be made with recycled materials including recycled concrete rubble. This flexibility and potential for recycling makes it an ecologically friendly and aesthetically pleasing building material.

- **Disadvantages:** Permeable paving is not ideal for high traffic/high speed areas because it has lower load-bearing capacity than conventional pavement. Nor should it be used on stormwater "hotspots" with high pollutant loads because stormwater cannot be pretreated prior to infiltration.

PERVIOUS ASPHALT: A typical porous pavement has an open-graded surface over an underlying stone bed. The water drains through the porous asphalt and into the stone bed, then, slowly, infiltrates into the soil. If contaminants were on the surface at the time of the storm, they are swept along with the rainfall through the stone bed. From there they infiltrate into the sub-base so that they are subjected to the natural processes that cleanse water.

- **Advantages:** Porous asphalt used in place of traditional impervious paving materials decreases the total amount of runoff leaving a site, promotes infiltration of runoff into the ground, reduces the amount of pollutants carried to a storm drain or waterway, and aids with reducing peak runoff velocity and volume. It is appropriate for pedestrian-only areas and for very low-volume, low-speed areas such as overflow parking areas, residential driveways, alleys, and parking stalls.

- **Disadvantages:** Permeable paving is not ideal for high traffic/high speed areas because it has lower load-bearing capacity than conventional pavement. Nor should it be used on stormwater "hotspots" with high pollutant loads because stormwater cannot be pretreated prior to infiltration.

OPEN JOINTED AND OPEN CELL PAVING BLOCKS: These pavers are solid units of concrete, brick, plastic or stone laid side by side. They can bear traffic loads and are shaped to produce openings that are filled with porous aggregate or turf that allows for infiltration of stormwater.

BLOCK PAVERS: This material can be used to create a porous surface with the aesthetic appeal of brick, stone, or other interlocking paving materials. They are most often used for driveways, entryways, walkways, or terraces.

PLASTIC GRID SYSTEMS: High strength plastic grids (often made from recycled materials) are placed in roadway areas. Some are designed to be filled with gravel on top of an engineered aggregate material, while others are filled with a sand/soil mixture on top of an aggregate/topsoil mix that allow grass to be planted on the surface.

- **Advantages:** Paving blocks have a long useable life, are relatively easy to install and provide good infiltration. Most plastic paver material is flexible so it can adapt well to shrink/swell and freeze/thaw conditions. Most commercially available plastic paver material is made from recycled material, an added environmental plus. The grids provide a support structure for heavy vehicles, and prevent erosion. After heavy rains, the grids act as mini holding-ponds, and allow water to gradually absorb into the soil below.
- **Disadvantages:** Some pavers are sensitive to deformation in the base or sub-grade and do require a thick base to prevent "heaving." In cold climates where areas need to be plowed for ice or snow removal, blocks may catch and cause damage to the blocks and/or plow.

BICYCLE PARKING

Planning for alternative modes of transportation can reduce the use of the automobile to alleviate congestion, improve air quality, and contribute to a healthy and livable Virginia Beach. The 2009 Virginia Beach Master Transportation Plan focuses on the relationship between land use development and transportation needs. Bicycles as a mode of transportation require less space on streets, less room for parking, are emission-free, and promote a healthy and active lifestyle. Secure bicycle parking is a necessary part of a multi-modal transportation network that includes bikeways, trails, and public transit. Leaving a bicycle unattended even for short periods can result in damage or theft. Finding a bike rack that doesn't work or isn't conveniently located makes for a frustrating experience. The lack of a secure parking space keeps many people from using their bikes for transportation.

The City Zoning Ordinance for Off-Street Parking Section 203b(12-14) now states that all development in the apartment, office or business districts requiring twenty five or more parking spaces shall have a minimum of five bicycle spaces. Each additional fifty parking spaces above the first twenty five shall require one additional bicycle space. Fifty percent of the required bicycle spaces shall be indoors or covered in accordance with the City of Virginia Beach Landscaping Guide, with the exception of parks and ball fields. The following information is to guide developers in selection and location for bicycle parking to fulfill this requirement.

LONG-TERM VERSUS SHORT-TERM BICYCLE PARKING

Bicycle parking can be divided into two categories: long-term (Type 1) and short-term (Type 2). Long-term parking is intended for use over several hours or overnight. It includes bicycle racks in an enclosed, covered, controlled access area. Short-term parking is intended for use from a few minutes to several hours. It includes bicycle racks in a public, easily accessible location that may or may not be covered.

CRITERIA FOR GOOD BICYCLE PARKING

Accessibility, Convenience, Safety and Security are necessary for a successful bicycle parking system.

ACCESSIBILITY

Bicycle parking will only be used if cyclists and their bikes can access it. Bike parking should be located at ground level or accessible from ground level (ramps, elevators) without obstacles like stairs or sleep slopes. When bicycle parking is not in a highly visible location, way-finding signage is recommended. Bicycle parking near sidewalks shall allow sufficient passage for pedestrians (6 feet) and comply with all ADA standards. Bike racks should not impede pedestrian traffic flow to board and egress mass transit vehicles. Bicycle parking and bikes should not obstruct the visibility triangle. To ensure adequate space for bikes and maneuverability in and out of the parking area, racks shall be placed at least 3 feet away from a wall or other vertical surface.

CONVENIENCE

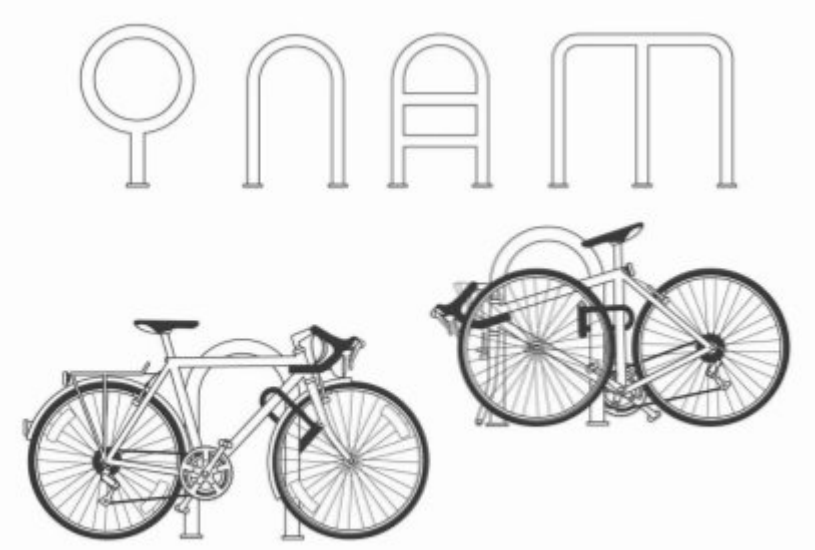
Cyclists are most likely to use bicycle parking when it is close to their destination. Installing racks far from an entrance may encourage cyclists to lock their bike to a tree or piece of street furniture that is closer. Bicycle parking should be placed within 50 feet of the building entrance that cyclists use. Where there is more than one building on a site, or where a building has more than one main entrance, the parking shall be distributed to serve all buildings or main entrances. Wherever possible, situate bike racks close to bikeways and trails.

SAFETY AND SECURITY

Safety and security measures must be considered to encourage use of bicycle parking facilities. Racks and lockers should be made from high quality materials and firmly secured to the ground, floor, or wall of a well-lit area. Racks should be adequately anchored to discourage displacement or removal. Concrete is the preferred surface for maximum security, though other surfaces may also be appropriate. Short-term parking should be located in a busy, public area to increase informal surveillance, and long-term parking should be located in a separate access-controlled area. Adequate lighting must be installed for visibility at the bike parking site and any pathways to and from this area.

ACCEPTABLE TYPES OF RACKS

Secure bicycle parking allows the frame and one wheel to be locked to the rack when both wheels are left on the bike. A simple inverted U-rack is attractive, easy to use, and highly secure. The rack should provide two-point support of the bicycle and have no sharp edges. The rack should be usable by bikes with no kickstand and by a wide variety of sizes and types of bicycles. Racks that only secure the front wheel are not acceptable.



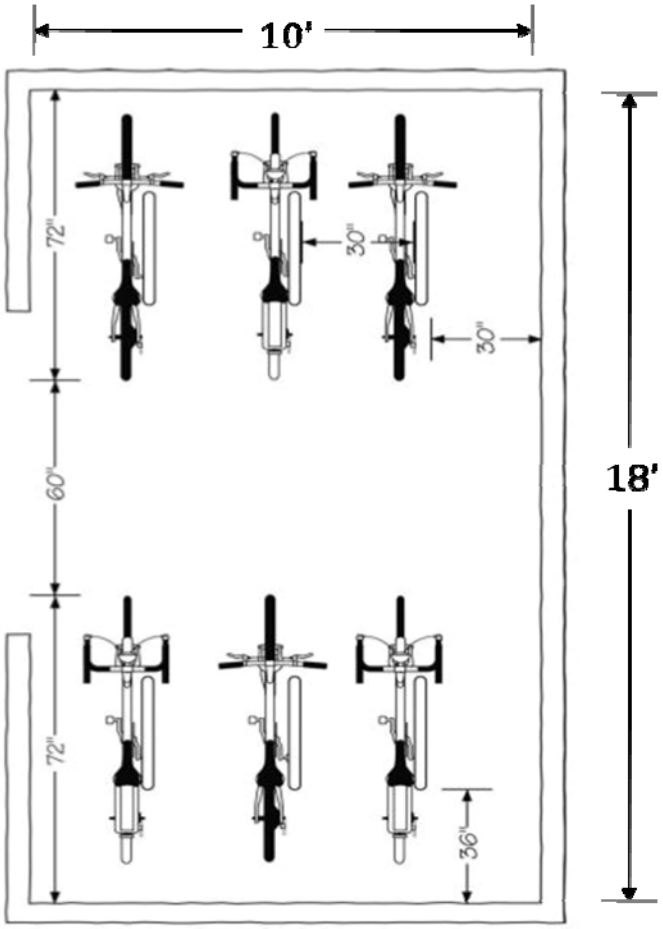
Left: Examples of acceptable two-point support designs. *Graphic from Las Cruces Proposed Bicycle Parking Design Standards.*

Preferred materials:

Galvanized steel with powder coating requires little maintenance and provides a smooth surface that will not scratch or damage bicycle frames

Materials to avoid:
Wood, soft metals, untreated metals, cast components that are brittle and may crack on impact. For rack designs that have welded sections avoid materials like stainless steel that have weak welds.

BICYCLE PARKING DIMENSIONS
Adequate space is necessary to accommodate bicycles and maneuvering in and out of the bike parking area. At least 30" is required and 36" is recommended between bike racks placed side-by-side, and 60" is recommended between racks placed end to end. One inverted U-Rack counts as two parking spaces. Three feet is the suggested distance between a planted area and the outermost edge of a bike rack.



Left: A 10'x18' vehicular parking space can accommodate 6 inverted U-racks (12 bicycle parking spaces).
Graphic from Las Cruces Proposed Bicycle Parking Design Standards.

www.downtownmedford.com

COVERED BICYCLE PARKING

Prolonged exposure to precipitation can rust a bike's frame and components; Ultraviolet rays from the sun deteriorate a bike's soft seat and tires, as well as making the bike uncomfortable to ride on hot days. Covered bicycle parking will encourage use by cyclists who value their bicycle. **Covered spaces can be stand-alone structures, roof overhangs, awnings, lockers, or bicycle storage spaces within buildings and parking garages.** The cover must be permanent and secure. Overhead clearance should be at least 7' to allow for maneuverability. Covers that are too high do not protect from rain, sun, and snow. The covered structure must use similar construction materials as the main building and be aesthetically complimentary to surrounding architecture and design elements. If freestanding, the structure must be at least 150 square feet and comply with all local building codes including drainage regulations. Several companies sell prefabricated bicycle shelter structures that fulfill City requirements.

www.pp.msu.edu

BICYCLE LOCKERS

Bicycle lockers are individual storage units that are weather protected, enclosed, and operated by a controlled access system that may use keys, swipe card, or an electronic key pad located on the door. Cyclists can securely store their bike, helmet, and gear. Many models hold two bicycles, and have access doors at opposite ends of the locker. On average, one standard car parking space can accommodate five bicycle lockers, depending on the locker design. Stackable models can double bicycle parking capacity; however, the top lockers provide limited access to cyclists who cannot or choose not to lift their bike into the top locker unit. Bike lockers require a level, clean, surface and clearance for the door to easily open and close. Bike lockers are best placed away from sidewalks and areas with high pedestrian traffic. Like all bicycle parking, bike lockers should be placed close to building entrances, in a well-lit area with regular security surveillance.

www.streetsblog.org

SUGGESTIONS

Increase the use of your bike facility by incorporating non-required services and infrastructure into your bicycle parking system. Include a local bike map in the covered structure to encourage use and visibility. Integrate other environmentally-friendly elements like permeable paving into the bike parking design. Incorporate a bike station that includes maintenance, gear storage lockers, and concessions into your bike parking plan. Consider converting a parking space for one automobile to a parking space for multiple bicycles. Innovative bike parking ideas will be reviewed on a case-by-case basis.

Left: A simple plaza rack like this one that does not require drilling provides secure parking for 6 bicycles without damaging expensive paving materials. *Graphic from Las Cruces Proposed Bicycle Parking Design Standards.*