UF UNIVERSITY of FLORIDA
IFAS Extension

Permeable Surfaces

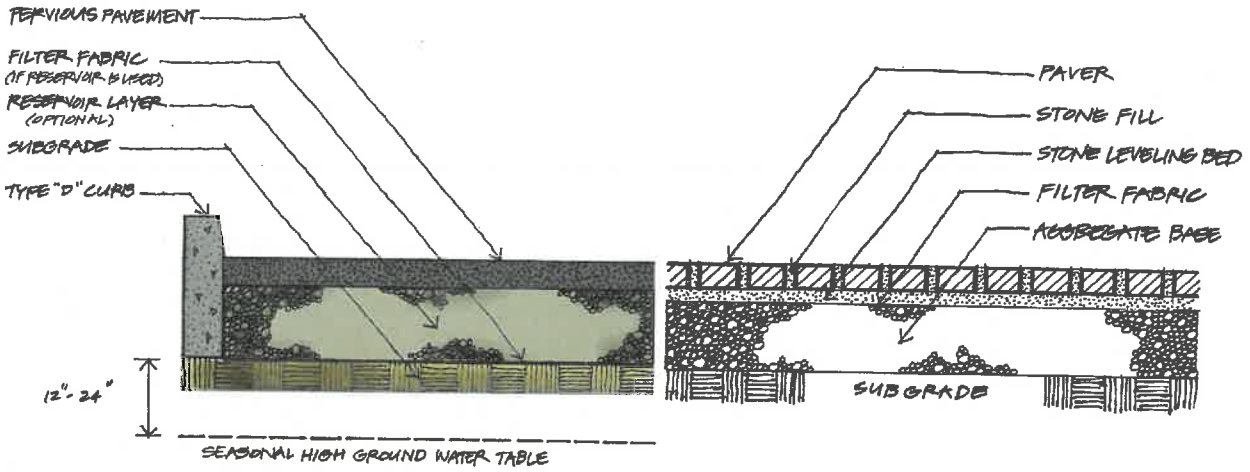


Illustration of two types of pervious surfaces, pervious paving (left) and pervious pavers (right). Although the permeable surfaces are different, they are each layered on the same type of aggregate base and underlying sub base.

Definition:

Permeable surfaces consist of a variety of types of pavement, pavers and other devices that provide stormwater infiltration while serving as a structural surface.

Objectives:

Permeable pavements function similarly to sand filters, in that they filter the water by forcing it to pass through different aggregate sizes and typically some sort of filter fabric. Therefore, most of the treatment is through physical (or mechanical) processes. As precipitation falls on the pavement, it infiltrates down into the storage basin where it slowly is released into the surrounding soil.

Overview:

Permeable, or pervious, pavers refer to unit (block, plastic grid) or poured (concrete) paving systems that incorporate permeable or semi-permeable materials overlaying a gravel storage layer. They are infiltration-based, volume control IMPs that substitute pervious for impervious surfaces, minimizing flooding and pollutant loads in stormwater runoff. They can be used for roads, driveways, walkways, patios, etc. and rainwater can be conveyed to exfiltration tanks or cisterns beneath the permeable pavers. Permeable pavers are most effective when used in conjunction with other LID treatment train IMPs (e.g., vegetated swales, cisterns, or exfiltration tanks).

There are several types of pervious paving materials, including permeable interlocking concrete pavers (PICP), concrete grid pavers (CGP), pervious (porous) pavements (PC & PA), and plastic reinforcing grids (PRG). According to the Florida Concrete Products Association, Florida has been a leader in the adoption of pervious pavement, with hundreds of applications across the state. Installation and maintenance of permeable pavers tends to be more labor and time intensive than that for concrete or asphalt paving. Additionally, vacuum sweeping is required as part of routine maintenance to prevent void space clogging.

Applications

- Parking lots
- Low traffic streets
- Walkways
- Driveways

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Water Protection Benefits:

Water conservation implications – As with green roofs and cisterns, permeable pavers can reduce stress on potable water resources by acting as a component of a treatment train for capture, storage, and reuse of stormwater.

Stormwater implications – Interconnected void spaces in permeable paving materials (surface, base, and subsurface) allow for infiltration and stormwater percolation to underlying soils, reducing runoff volumes, peak flows, and pollutant loads and facilitating groundwater recharge.

Design Keys

- Low traffic areas
- Sandy soils
- Shallow slopes (<5°)
- Low water table
- Retention
- Detention
- Reduce runoff volume
- Reduce pollutant loads

Design Considerations:

Permeable surfaces are appropriate for both residential and commercial land uses and new construction and retrofit projects. Permeable pavers are most suitable for use in low traffic areas with sandy soils, shallow slopes (<5°), and a low water table (i.e., seasonal highs 24" or more beneath paver base). Water will only fill the permeable pavers to the lowest elevation of the surface, and on a slope it could exit the pavement cell through the lower end. Permeable pavers are therefore not recommended for slopes.

Permeable pavements are typically not as strong as traditional cement or asphalt pavements. Permeable pavement is composed of asphalt or concrete without the finer particles that are normally found in the cement mix. The finished product is a strong pavement with a matrix of large pore spaces. The pavement can be designed to provide percolation rates from 5.6 to 18.5 gallons per minute per square foot. Before the pavement is installed, the soil surface is over-laid with a layer of geo-textile fabric and then a layer of stone aggregate. The aggregate forms a reservoir for retention and enhances infiltration capacity. It is crucial for underlying soils to have an infiltration capacity of >0.5 in/hr. for the pavement to function properly. It is also important to restrict heavy truck traffic to avoid damage. Although traffic of heavy weight vehicles (garbage trucks, fire engines, tractor-trailers) can be accommodated, construction due to excavation and materials increases substantially.

Operations and Maintenance:

Clogging is the main source of permeable pavements not functioning as well as they should. Large particles trap smaller and smaller particles, reducing the infiltration rate. Sediments can be deposited by vehicle traffic, foot traffic, wind blown sediments, or be transported by runoff.

If clogging occurs in porous pavement and the surface infiltration rate is reduced lower than the rainfall rate, then either water will pond or runoff will be produced. Therefore, periodic maintenance is required for continued functioning. Maintenance should include vacuum sweeping at least four times a year, followed by high-pressure hosing to free pores in the top layer from clogging. Potholes and cracks can be filled with patching mixes unless more than 10% of the surface area needs repair. Spot-clogging may be fixed by drilling half-inch holes through the porous pavement layer every few feet. Estimated cost of maintenance is approximately $200 per acre per year, which would include four inspections with appropriate jet hosing and vacuum sweeping treatments.

HOA or Regulatory Considerations:

The porosity of the paving material does not determine the amount of credit received in stormwater permitting, so selection is generally based on cost and aesthetics.

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These interlocking concrete pavers were used on the driveway at the model home of the Madera subdivision in Gainesville.

Credits in Green Building Certification Programs:

- FGBC-Home Standard (S-17 maintain pervious surface area)
- Florida Yards & Neighborhoods (stormwater runoff: mulch, bricks, flagstones, gravel, or other porous surfaces used on walkways, patios or drives)
- LEED for Homes (SS 4.1 permeable lot)
- LEED for Neighborhood Development Pilot (GCT Credit 9: Stormwater Management)
- NAHB Model Green Home Building Guidelines (1.3.5 Manage storm water using low-impact development when possible)

Relative Costs:

The amount and type of materials as well as site preparation largely determine the final cost of paver installations. Typical construction costs vary from $5 to $10 per square foot. The necessity for deeper drainage/storage basins (typically driven by increased load or frequency of vehicles use) will increase the cost substantially. Though permeable pavement is more expensive than conventional pavement, it can be cost competitive when it reduces the size of, or eliminates, the need for curb and gutter conveyance systems and large stormwater retention ponds.

References and Resources:

Pervious Concrete Pavements: The Environmentally Friendly Choice (Concrete Network):

http://www.concretenetwork.com/pervious

Watershed Benefits of Permeable Pavers (Low Impact Development Center, Inc.)

Credits

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This fact sheet was produced with funding from The Elizabeth Ordway Dunn Foundation

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