

POROUS PAVEMENT



POLLUTANT REMOVAL

Sediment	Low
Nutrients	High
Trash	High
Metals	High
Bacteria	Low
Oil and Grease	High
Organics	Low

DESCRIPTION

There are many types of pervious pavement on the market today. Numerous products and design approaches are available including special asphalt paving; manufactured products of concrete, plastic, and gravel; paving stones; and brick. It may be used for walkways, patios, plazas, driveways, parking lots, and some portions of streets subject to compliance with building codes. The material must be installed and maintained to manufacturers' specifications. These materials may not be allowed in certain areas. A professional engineer must design pervious pavement systems that will be supporting vehicular traffic.

ADVANTAGES

- Provide significant reductions in surface runoff and pollutant loading
- Can be designed with an underdrain in situations where infiltration is not feasible
- Reduces pavement ponding

LIMITATIONS

- Only applicable for low traffic volume areas
- To maintain effectiveness, porous pavements require frequent maintenance
- Easily clogged by sediments if not situated properly
- Extended rain can reduce the pavement's load bearing capacity

GENERAL CONSTRAINTS AND SITE CONCERNS

When designing pervious pavement systems, the infiltration rate of the native soil is a key element in determining the depth of base rock for the storage of stormwater or for determining whether an underdrain system is appropriate. Traffic loading and design speed are important considerations in determining which type of pervious pavement is applicable. Pedestrian, Americans with Disabilities Act accessibility, aesthetics, and maintainability are also important considerations depending on pavement use.

Pervious pavements shall not be used on sites with a likelihood of high oil and grease concentrations. These site uses include vehicle wrecking or impound yards, fast food establishments, automotive repair and sales, and parking lots that receive a high number of average daily trips (> 1,000). Runoff from unpaved areas should not be directed toward pervious pavement due to the potential for sediment loads to clog the pavement.

MULTIUSE OPPORTUNITIES

Pervious pavement is highly versatile and can be used in replacement of impermeable asphalt in many situations.

DESIGN SPECIFICATIONS

CONSTRUCTION CONSIDERATIONS

Installation procedures are vital to the success of pervious pavement projects, particularly pervious asphalt and concrete pavement mixes. The subgrade cannot be overly compacted with the inclusion of fine particulates or the void ratio critical to providing storage for large storm events will be lost. Weather conditions at the time of installation can affect the final product. Extremely high or low temperatures should be avoided during construction of pervious asphalt and concrete pavements.

SOIL SUITABILITY

Pervious pavement systems are appropriate for all soil types, but will require underdrain systems for soils that do not infiltrate well (less than 0.5 inch per hour). There shall be no less than 3 feet of undisturbed infiltration medium between the bottom of the base rock and any impervious layer (i.e., hardpan, solid rock, high groundwater levels, etc.), unless an underdrain system is used.

DIMENSIONS AND SLOPES

Minimum/maximum dimensions and other specifications are product specific and shall comply with manufacturers' recommendations. Slopes shall be less than 10 percent in all cases.

SIZING

Porous pavement should be designed to capture at least the water quality design storm event for its tributary area. The remaining storm volume bypasses the BMP and can be routed to another treatment or infiltration BMP or to the conventional stormwater conveyance system.

1. The prediction of the rate of infiltration of water through natural soils is related to soil type, porosity, degree of compaction, moisture content, and field capacity. This complexity governs soil drain times and has made the development of a single comprehensive model to predict drain times in actual porous pavement applications difficult. However, determining drain time is the key element in designing the size of porous pavement systems. The depth of the subbase can be determined by:

$$H_d = E \times t_d / r$$

Where:

H_d = Depth of reservoir layer (in).

t_d = Detention time (hr).

E = Soil infiltration rate (in/hr).

r = Void ratio.

The required porous pavement surface area can then be computed by:

$$A_s = V / (r \times H_d)$$

Where:

A_s = Porous pavement surface area (ft²).

V = Water quality volume (ft³).

2. Specifications. The cross-section typically consists of four layers. A description of each layer is presented below.
3. Asphalt Layer. The surface asphalt layer consists of an open-graded asphalt mixture ranging from depths of 2 to 4 inches depending on required bearing strength and pavement design requirements. Porous pavements contain approximately 16 percent voids, compared to 3 to 5 percent for conventional pavements allowing runoff to quickly infiltrate.

4. Top Filter Layer. This layer consists of a 0.5-inch-diameter crushed stone to a depth of 1 to 2 inches. This layer serves to stabilize the porous asphalt layer.
5. Reservoir Layer. The reservoir subbase consists of 1.5 to 3-inches crushed stone. The depth of this layer depends on the desired storage volume, which is a function of the soil infiltration rate, void spaces, and in colder climates the depth of the frost line, but typically ranges from 2 to 4 feet. The reservoir layer should be designed to drain completely in 48 to 72 hours.
6. Bottom Filter Layer. This layer serves to stabilize the reservoir layer and is the interface between the reservoir layer and the filter fabric covering the underlying soil. It consists of a 2-inch-thick layer of 0.5-inch crushed stone.
7. Filter Fabric. It is very important to line the entire trench area, including the sides, with filter fabric prior to placement of the aggregate. The filter fabric serves a very important function by inhibiting soil from migrating into the reservoir layer and reducing storage capacity.
8. Underlying Soil. The underlying soil should have an infiltration capacity of at least 0.1 inch/hour, but preferably greater than 0.50 inch/hour. Soils at the lower end of this range may not be suited for a full infiltration system.
9. Construction Practices (adapted from Schueler, 1992).
 - a. All adjacent areas should be stabilized to prevent any sediment from washing onto the pavement surface, leading to premature clogging.
 - b. The subgrade shall be prepared as required while limiting undue compaction; permeability must be maintained. Equipment with tracks or over-sized rubber tires shall be used; DO NOT use vehicles with standard rubber tires.
 - c. The reservoir base course shall be laid in lifts over the base filter course and lightly compacted. The base courses should be kept free of all dirt and debris during construction.
 - d. The asphalt layer shall be laid directly over the top filter course in one lift. The laying temperature should be between 240 and 260 degrees. The ambient temperature should be above 50 degrees.
 - e. Compaction should take place when the surface is cool enough to resist a 9-Mg roller (class equivalent of a 10-ton roller). One or 2 passes is all that is required for proper compaction. Any more may reduce porosity.
 - f. Transporting of the mix to the site shall be in clean vehicles with smooth dump beds that have been sprayed with a nonpetroleum release agent. The mix should be covered during transport to limit cooling.
 - g. After final rolling, no vehicular traffic of any kind should be permitted on the pavement until cooling and hardening has taken place; no sooner than 6 hours, but preferably a day or two.

OPERATIONS AND MAINTENANCE

INSPECTION AND MAINTENANCE ACTIVITIES SUMMARY	
ROUTINE MAINTENANCE	<ul style="list-style-type: none"> • Regular sweeping shall be implemented for porous asphalt or concrete systems. The surface shall be kept clean and free of leaves, debris, and sediment. The surface shall not be overlaid with an impermeable paving surface • Overflow devices shall be inspected for obstructions or debris, which shall be removed upon discovery. Overflow or emergency spillways shall be capable of transporting high flows of stormwater to an approved stormwater receiving system. • Vegetation and large shrubs/trees that limit access or interfere with porous pavement operation shall be pruned. • Fallen leaves and debris from deciduous plant foliage shall be raked and removed. • Poisonous, nuisance, dead, or odor producing vegetation shall be removed immediately. • Grass shall be mowed to less than 4 inches and grass clippings shall be bagged and removed. • Irrigation shall be provided as needed. • Spill prevention measures shall be exercised when handling substances that can contaminate stormwater. A spill prevention plan shall be implemented at all nonresidential sites and in areas where there is likelihood of spills from hazardous materials. • Access to the pervious pavement shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles if applicable. • Obstacles preventing maintenance personnel and/or equipment access to the porous pavement shall be removed. • Standing water creating an environment for development of insect larvae shall be eliminated. • Holes in the ground located in and around the pervious pavement shall be filled and compacted.
MAJOR MAINTENANCE	<ul style="list-style-type: none"> • Sources of erosion damage shall be identified and controlled when native soil is exposed near the overflow structure. • Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic. • Source control measures prevent pollutants from mixing with stormwater. Typical nonstructural control measures include raking and removing leaves, street sweeping, vacuum sweeping, limited and controlled application of pesticides and fertilizers, and other good housekeeping practices.