Best Management Practices Fact Sheet

Porous Concrete

PURPOSE: Porous concrete 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.

Developing land for residential, commercial and industrial use carries the detrimental effect of vastly increasing the amount of impervious surface area as land is paved to create roads and parking lots. During a storm, runoff flows over impervious pavement, picking up pollutants such as dirt, grease and oil, and transports these contaminants to streams and storm sewer systems.

In response to this issue, designers developed porous paving systems that allow runoff to pass through the pavement into a stone reservoir, before infiltrating the soil below to recharge the groundwater supply. With proper installation and maintenance, porous paving allows for infiltration of up to 80% of annual runoff volume. Additionally, studies indicate that porous concrete systems can remove up to 65% of undissolved nutrients from runoff and up to 95% of sediment in runoff.

The design for application of porous concrete consists of at least three layers: a two to four-inch layer of porous concrete, a one to two-inch filter layer of half-inch crushed aggregate, a 12-inch minimum reservoir layer of one to three-inch aggregate, and an optional layer of filter fabric. Porous concrete consists of a mix including Portland cement, uniform open-graded coarse aggregate, and water. The void space of porous concrete ranges between 15% and 22%, compared to a three to five percent void space in conventional concrete. The concrete itself provides for some pretreatment of runoff. The crushed aggregate filter layer aids with removing some pollutants. Runoff is stored in the reservoir bed, a highly permeable layer of open-graded clean-washed aggregate with at least 40% void space. The filtered runoff then percolates through the uncompacted soil base into the groundwater supply.

Porous concrete is placed using forms, then leveled with a screed. No finishing is required, and jointing is optional. *Take care not to overwork the surface.*

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.

VARIATIONS: Installing a berm at the edge of porous paving keeps off-site runoff and sediment from entering the porous paved surface area, which prevents clogging. A subsurface drain may be incorporated into the design of the stone reservoir to collect water and route it to a detention or infiltration basin.

NOTE: Porous paving materials are not effective at removing dissolved nutrients from water; therefore, they should be located at least 100 feet from drinking water sources. Pre-treatment of runoff is necessary where oil, grease or other groundwater contaminants are expected.

Benefits and Uses

- Reduces total amount of impervious cover
- Reduces peak velocity and volume of stormwater runoff delivered to storm sewer system
- Alleviates flooding and erosion downstream
- Applicable to all types of sites (residential/commercial/industrial)
- Recharges groundwater supply
- Filters contaminants from runoff prior to its discharge to the storm sewer system
- Allows for land use in areas that otherwise would not meet stormwater retention guidelines
- Requires less need for curbing and storm sewers

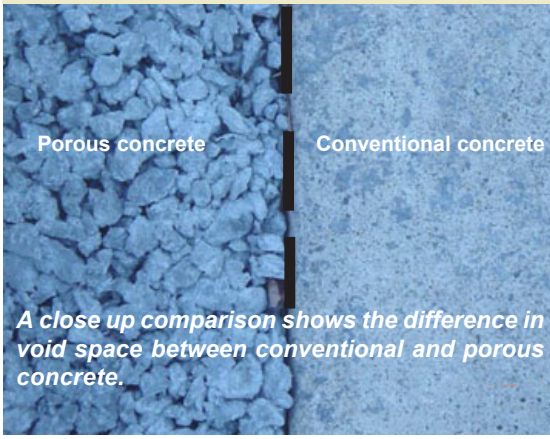
Additional Resources

PA Department of Environmental Protection
- www.dep.state.pa.us
- Pennsylvania Stormwater Best Management Practices Manual

US Environmental Protection Agency
www.epa.gov

Cahill Associates
www.thcahill.com - click on "Technologies" for project examples and general information

Villanova Urban Stormwater Partnership
www3.villanova.edu/VUSP/bmp.html



A close up comparison shows the difference in void space between conventional and porous concrete.

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Proceed with Caution

Though permeable paving materials have been in existence since the 1970's, their implementation has been slow, due predominantly to unfamiliarity with correct procedure, leading to faulty installation, and a subsequently high rate of failure. However, with proper installation and maintenance, these systems can be very effective and long-lasting. Key design factors to ensure optimum pollutant removal and longevity include:

- Placement in areas with highly permeable soils; if underlying soil is damp, microbiological decomposition of pollutants may be impeded
- Existence of organic material in soil
- Vacuum sweeping on a quarterly schedule
- Use in low-density parking areas
- Restrictions on use by heavy vehicles
- Limited use of de-icing chemicals
- Inspection and enforcement of specifications during construction
- Pretreatment of runoff to paved area
- Implementation of a sediment control plan
- Extending the depth of reservoir level to below the frost line to prevent subgrade from frost heave

1. *(above)* Site is excavated.

3. *(above)* Concrete is poured and spread.

5. *(above)* Work edges and surface to a clean finish.
6. *(right)* Cover area for curing process.

Porous Concrete Installation

2. *(above)* Stone base layer is poured, spread and graded.

4. *(above)* Concrete is leveled with a screed.

General Design Considerations

- Test soil at least four feet below base of stone reservoir for permeabilityof at least 0.5 inch per hour
- Porous surface permeability should be at least eight inches per hour
- Suitable for drainage area of less than 15 acres
- Existing soil base must be level to prevent ponding under the system
- Avoid compaction of soil base; if new fill is required, the addition of stone is recommended over adding compacted soil
- Install at least four feet above seasonal high groundwater table to prevent contamination
- Design should include overflow drainage to remove excess stormwater
- Perforated pipe placed in the stone bed will distribute runoff evently throughout bed and may provide additional storage volume, depending on size of pipe
- Stone bedding layer should drain within 72 hours of a rain event
- Slope of pavement surface should be no greater than 5%, 2% grade is recommended
- Aggregate for reservoir bed should be approximately 1 to 3 inches in diameter
- Reservoir aggregate must be clean-washed and contain at least 40% void space
- Reservoir layer should be at least twelve inches deep
- Air temperature during concrete pour must be at least 50°F
- Porous concrete sets up quickly
- Take care not to overwork porous concrete surface
- Design of system should consider expected type and frequency of usage
- Control of sediment is critical - remove surface sediment with a vacuum or by sweeping; avoid power-washing, as it will clog the system
- Design must provide for a backup method for water to enter stone reservoir (e.g. stone-edged drain near wheel stop if curbing is not in place)
- Concrete should be covered with polyethylene film for at least one week to aid with curing
- Not suitable for "stormwater hot spots", such as truck stops, gas stations, etc. due to high level of contaminants present
- Use snow plows with caution during snow removal
- Prohibit use of sand, ash, salt or de-icers
- Installation in areas of high traffic or heavy vehicles not recommended
- Not recommended in areas where wind erosion supplies significant amounts of windblown sediment
- Post signs to prevent vehicles with muddy tires from entering area
- Potholes and cracks may be patched with traditional patching mix, unless more than 10% of porous surface area needs to be repaired