PERVIOUS CONCRETE

Resources and information:

Websites:

pervious pavement.org

concretenetwork.com

concreteparking.org

concretethinker.com

nrmca.org

specifyconcrete.org

cement.org/bookstore
publications:
EB302 Pervious Concrete Pavements
EB303 Hydrologic Design of
Pervious Concrete Pavements

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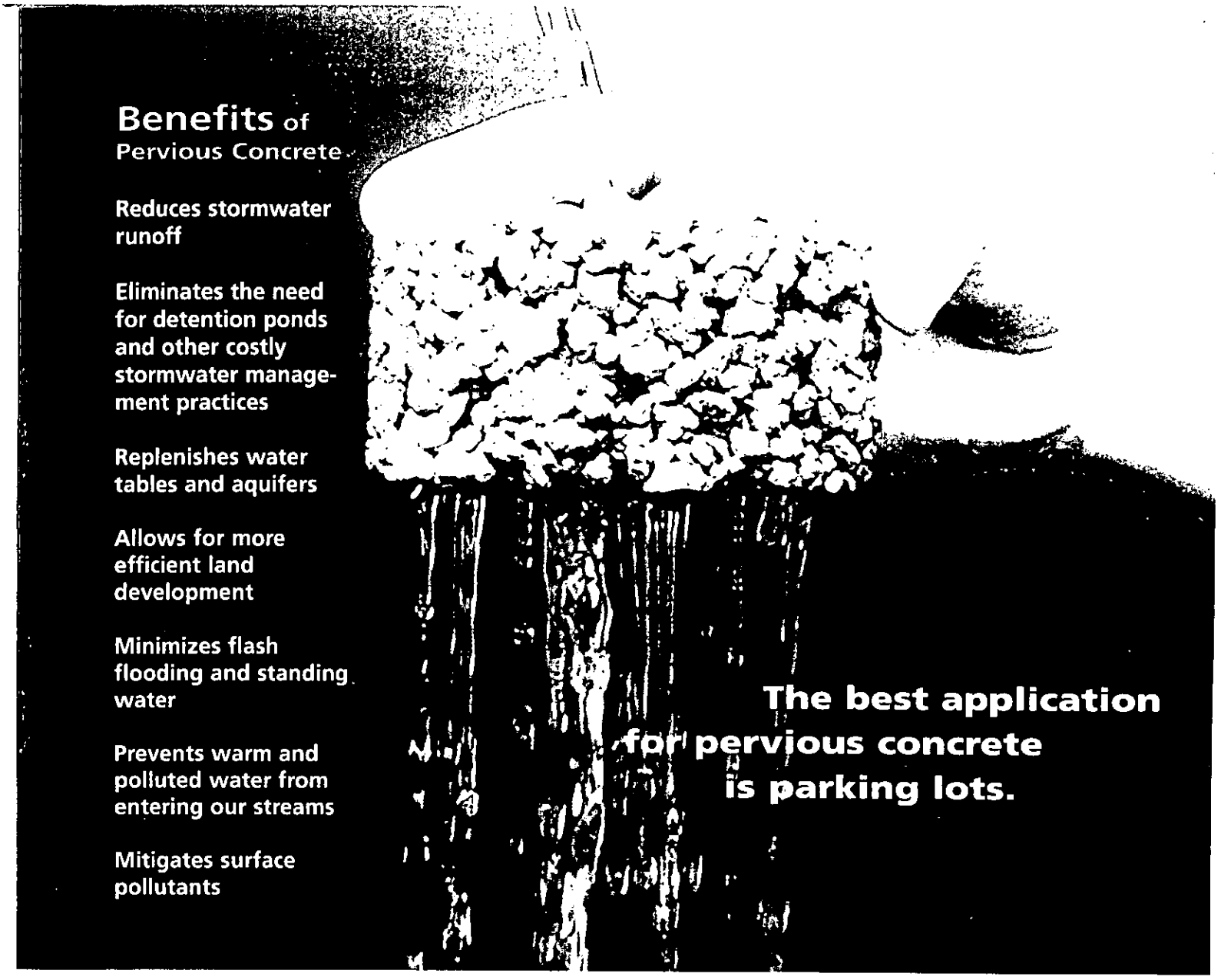
Benefits of Pervious Concrete

- Reduces stormwater runoff
- Eliminates the need for detention ponds and other costly stormwater management practices
- Replenishes water tables and aquifers
- Allows for more efficient land development
- Minimizes flash flooding and standing water
- Prevents warm and polluted water from entering our streams
- Mitigates surface pollutants



The best application for pervious concrete is parking lots.

When it Rains, it Drains.

Stormwater runoff occurs when rain falls. This runoff causes increased pollution in rivers and streams, flash floods, and loss of rainwater that could otherwise replenish water tables and aquifers. Pervious concrete has a 15-25% void structure and allows 3–8 gallons of water per minute to pass through each square foot—accounting for far more than is generated during most rain events. Pervious concrete puts rainwater back in the ground where it belongs.

Pervious Concrete: The Natural Choice

It's tough to balance the demand for development with the need to preserve our natural resources. However, this balance becomes easy to achieve when you construct parking lots using pervious concrete.

Pervious concrete is a mix of coarse aggregate, cement, water, and little to no sand. Also known as "no-fines" or porous concrete, this mixture creates an open-cell structure, allowing rainwater to filter through to underlying soil. By modeling natural ground cover, pervious concrete is an excellent choice for stormwater management.

Pervious Concrete: The Environmentally Sound Choice

According to the United States Environmental Protection Agency (EPA), stormwater runoff can send as much as 90% of the pollutants—such as oil and other hydrocarbon liquids found on the surface of traditional parking lots—directly into our rivers and streams. The EPA now requires state and local governments to implement measures to reduce and improve the overall quality of stormwater runoff in an effort to address this important pollution problem. Pervious concrete has been recognized by the EPA as a best management practice (BMP) to address this most vital environmental concern. The open-cell structure of pervious concrete provides a medium for aerobic bacteria that break down many of the pollutants that seep from parked cars.

Pervious concrete also contributes to enhanced air quality by lowering atmospheric heating through lighter color and lower density, decreasing the impact of heat island effects. The heat island effect occurs when tree-covered areas are replaced with dark pavement surfaces, and is characterized by up to a 12-degree average temperature increase between an urban area and its surrounding countryside. This heat island effect increases ground level ozone production by as much as 30%.

Concrete surfaces, both pervious and conventional, have a much higher albedo—a measure of reflectance—than competitive paving materials. Specifications requiring a minimum surface albedo are becoming increasingly popular. The inherently light color of concrete naturally reflects heat and light. *Studies have shown as much as a 30% savings in lighting costs over other pavement types due to concrete pavement's reflectivity.*

Pervious Concrete: The Smart Business Choice

Using pervious concrete pavement in your parking lot can reduce the need for large detention ponds because the pavement acts as a detention area. Parking lot owners will spend fewer dollars on labor, construction and maintenance of detention ponds, skimmers, pumps, drainage pipes, and other stormwater management systems. Expensive irrigation systems can also be downsized or eliminated.

A pervious concrete parking lot will help reduce demands upon sewer systems. Today, many government agencies are now implementing stormwater impact fees for all impervious areas. Pervious concrete can reduce these fees for the property owner.

Developers are using pervious concrete for parking lots to increase utilization of commercial properties. The land ordinarily devoted to costly stormwater management practices or compliance with maximum impervious area ordinances can now be developed or preserved, enhancing the bottom line.

Pervious concrete is a durable material—parking areas properly designed and constructed will last 20-40 years with little or no maintenance. Thus concrete, conventional or pervious, is widely recognized as the lowest life cycle cost option available for paving.

Pervious Concrete
Frequently Asked Questions

Q: What about drainage issues in soils with high clay content?

A: Typically if a soil type has sufficient percolation to support a septic tank system it will be allowable for pervious concrete. If a soil is truly impervious, the pervious concrete system will still be useful for detention pond requirements. Soil percolation rates are most important if you must meet stormwater quality requirements. A typical parking lot design may have 5"–8" of pervious pavement on top of a 6"–12" sub-base of #57 stone (40% voids) on a geotextile fabric. In sandy areas pervious is placed directly above the sand.

Q: What about freeze-thaw issues?

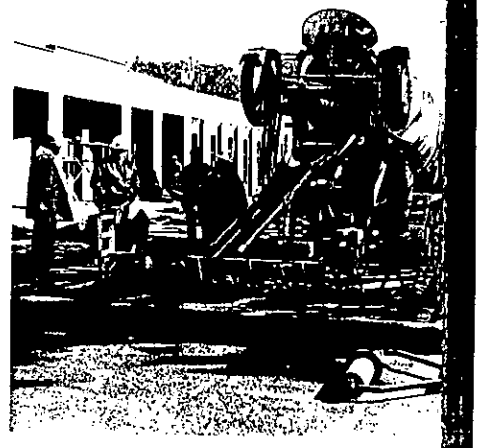
A: Pervious concrete has been placed in freeze-thaw climates for over 15 years. Successful applications of pervious concrete in freeze-thaw environments have two common design features—the cement paste is air-entrained, and the pervious concrete is placed on 6–12 inches of drainable aggregate base (3/4" or larger clean gravel). For more information on pervious pavement in freeze-thaw applications go to www.concreteparking.org and view documents on pervious concrete, including "Freeze-Thaw Resistance of Pervious Concrete" and "Concrete in Practice #38–Pervious Concrete."

Q: What about clogging?

A: Clogging problems are mainly an issue of design. If a natural area with grass or exposed soil is allowed to drain stormwater across a pervious concrete pavement, fine material can be introduced into the system causing localized clogging. Vegetative matter can collect on the surface of the pervious concrete causing some clogging, but routine sweeping or vacuuming will restore porosity. Studies have been conducted that indicate pressure washing will restore most of the porosity of clogged pervious concrete to nearly new conditions.

Q: What other uses are there for pervious concrete?

A: Pervious concrete has been successfully used for low volume streets, driveways, sidewalks, golf cart paths, retaining walls, slope protection, and French drains. Pervious concrete can be utilized in a variety of paving applications to provide hardscape without altering hydrology of the land.



Concrete Delivers

Engineered concrete solutions for sustainability, durability and value.

For more information and contacts on pervious concrete, visit:

900 Spring Street, Silver Spring, MD 20910
888.84.NRMCA, www.nrmca.org

Count on Concrete

Field Performance Investigation of Pervious Paving

The RMC Research & Education Foundation has released its latest research report on pervious concrete, "Portland Cement Pervious Concrete Pavement: Field Performance Investigation on Parking Lot and Roadway Pavements." The study includes a long-term field performance investigation on the use of pervious concrete, particularly in areas susceptible to freezing and thawing. Although use of pervious concrete has significantly increased in southern areas of the U.S. over the last decade, in northern locations it hasn't been widely embraced because of questions about its performance under cycles of freezing and thawing.

This new study shows that pervious concrete has stood up to freezing and thawing with little maintenance. Many of the installations are still relatively new; therefore, they should be examined again in 5 and 10 years. This report will then serve as a benchmark of the pavement condition.

EVALUATION AND TESTING

For the study to represent the different weather, subgrade, materials, and design conditions, the research team identified projects of various ages and in areas of differing soils, environmental conditions, and geographical locations. They chose 24 sites in Ohio, Kentucky, Indiana, Colorado, and Pennsylvania for field evaluation and nondestructive testing.

Visual observation yielded information on the overall performance of the pervious concrete. To maintain consistency, a questionnaire was filled out for each site, including the total area of pervious concrete, general description of the topography, separation distance of expansion joints, and traffic volume of heavy vehicles. Based on initial results, areas were chosen for further nondestructive testing. Other testing included drain time/infiltration rate, maintenance/infiltration rate (a test to determine if the surface is in need of maintenance), ultrasonic pulse velocity (UPV), void ratio, hydraulic conductivity, compressive strength, and splitting tensile strength. Extensive testing was carried out at sites in Indiana, Kentucky, and Ohio. Only visual observation and surface infiltration tests were performed at the Pennsylvania site and four Colorado sites.

Although some pavements exhibited clogging, raveling, and cracking, overall, the sites are performing well. Most of the problems with clogging were caused by debris, overcompaction during construction, or a wet mixture at the time of placement. Dry mixtures or under-compaction led to raveling. Cracking seemed to be mostly due to a lack of expansion joints or heavy vehicle traffic.

SUMMARY OF SITE VISITS

Charter school, Gary, IN—This parking lot and driveway, built in July 2006, are subject to traffic from school buses, construction vehicles, and fire trucks. The areas damaged by heavy traffic have been repaired, but the rest of the lot is performing well, with little clogging, raveling, and cracking.

Keystone Concrete, Churubusco, IN—Built in August 2004, this small storage pad was constructed as three test strips of different materials. At the time of inspection, it was clogged with leaves and other debris, but no cracking or raveling was observed.

Kuert Concrete Corporate Office, South Bend, IN—Two strips of pervious concrete act as the drains for the conventional concrete parking lot. One of the two strips, installed in July 2005, was clogged by shingle debris, as the building's downspout empties directly onto it. It's been power-washed, but infiltration hasn't been restored. The other pervious concrete section is performing well, with no raveling, little clogging, and two full-width cracks.

Rieth Village (Merry Lea Environmental Learning Center of Goshen College), Albion, IN—The surface of this sidewalk, built in April 2006, was sealed off during construction, either because the mixture was too wet or was overcompacted.

Patterson Dental Supply, South Bend, IN—Installed in June 2004, this small patio drains well and doesn't appear to be clogged. There's minor raveling and cracking.

Boone County Farmer's Market, Burlington, KY—The

parking stalls were placed in January 2006. Much of the surface is clogged with silt, and some portions were over-compacted during installation. Despite this, the pavement drains well.

Northern Kentucky Sewer District Sanitation District #1, Fort Wright, KY—Completed in January 2004, sections of the parking stalls were sealed by overcompaction during construction. The surface has been vacuumed twice to remove loose surface aggregate and maintain infiltration capability.

Ball Brothers Contracting, Monroe, OH—The storage lot, installed in January 2004, was clogged with debris. At some spots, the surface was overcompacted and sealed off during construction. The surface drains reasonably well, though the report recommends that power-washing or vacuuming should be attempted to restore infiltration capability.

Bettman Natural Resource Center, Cincinnati, OH—The parking lot was overcompacted during installation in October 2006. The outside edges are clogged by runoff from adjacent landscaping beds. Some of the surface has been damaged by aggressive power-washing.

Cleveland State University Lot D, Cleveland, OH—Completed as a demonstration project in August 2005, the parking lot is a closed system, with an impermeable plastic membrane to carry water to a perforated plastic pipe leading to a drop inlet. Due to debris from construction projects and the deteriorating adjacent lot, drainage is fair to poor. The lot has been aggressively salted and plowed without causing any damage.

Collinwood Concrete Saranac Plant, Cleveland, OH—This installation is subject to heavy vehicle loading. It's clogged with debris from vehicles and drainage from an adjacent conventional concrete area.

Fred Fuller Park, Kent, OH—The parking stalls, placed in December 2003, comprise the oldest pervious concrete installation in Northeast Ohio. It's been through four winters with no visible damage from freezing and thawing.

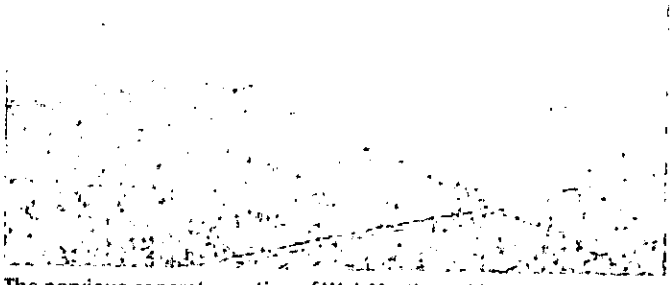
Harrison Concrete Plant Office, Harrison, OH—A strip of pervious concrete was placed adjacent to a conventional concrete parking lot in September 2006. There is no cracking, little raveling, but some clogging from soil.

Indian Run Falls Park, Dublin, OH—Some areas of the handicapped parking stalls, installed in May 2006, seem to have been sealed by overcompaction. There is considerable debris and severe raveling, especially at joints.

John Ernst patio, Tipp City, OH—A pervious concrete patio was installed at a persistent wet spot in the yard of a private residence. There's very little raveling or clogging.

Kettering bus stop, Kettering, OH—In September 2004, pervious concrete was placed at a bus stop. Though there's no visual evidence of clogging, the infiltration rate is slow. There's no cracking and very little raveling.

Lakewood bike path, Lakewood, OH—Pervious concrete was placed in November 2005 to allow water to flow to the roots of the trees surrounding the path. There's no cracking, light-to-moderate clogging, some raveling, and some evidence of surface sealing from overcompaction.



The pervious concrete section of Wal-Mart's parking lot, Denver, CO

Phillips Companies, Beavercreek, OH—A pervious concrete parking lot was installed in January 2006. There's no cracking, limited raveling at the joints, and some light-to-moderate clogging. Part of the surface appears to be sealed from overcompaction.

Cleveland State University Administration Building, Cleveland, OH—Following the success of Parking Lot D, the Cleveland State University Architect's Office decided to construct a second pervious concrete parking lot in July 2007. A significant amount of loose soil has washed onto the pavement, causing local but severe clogging.

Safeway, Denver, CO—The entire parking lot is pervious concrete. There's no raveling but some cracking. One small section was clogged by an oil stain.

Wal-Mart, Denver, CO—This parking lot used multiple paving materials, with the pervious concrete section farther away from the store. There's no visual evidence of cracking or clogging.

Bestway Concrete, Denver, CO—Two strips of pervious concrete were placed, one next to the office, the other consisting of eight parking spaces. The parking spaces had slow drain times, indicating the surface had probably been sealed during construction.

Ready Mixed Concrete, Denver, CO—This large parking lot showed some surface raveling at the joints. Overall, the site had good drainage.

Pennsylvania State University Visitors Center, State College, PA—This sidewalk, constructed in 1999, was the oldest installation researchers visited. There is no evidence of cracking, raveling, or damage from freezing and thawing; however, the surface is sealed.

To download the full report, visit **www.rmc-foundation.org**. A hard copy of the report can be obtained by contacting Jennifer LeFevre at (240) 485-1151 or jlefevre@rmc-foundation.org.

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Hydrologic Design of Pervious Concrete

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