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Short Memo: Aspects & Impacts of Porous Pavements

The purpose of this short memo is to discuss aspects of use, applicability, and environmental impacts of porous pavements as gleaned from practical findings and pertinent examples. A porous pavement is one with high enough porosity and permeability to allow rain and snowmelt to pass through it, thereby reducing the runoff from a site and surrounding areas. In intensely built up areas, pavements account for more than half of all the land, and for about two-thirds of total built cover (Ferguson, 2005, 2-3). Parking lots, in particular, account for the majority of paved areas. Pervious paving materials have the capability of providing a dual purpose in parking and other areas with low to moderate traffic; they serve both as a parking/traffic area and to manage stormwater.

Components & Function

There are several types of porous pavements, namely porous asphalt, porous concrete, and numerous modular paver systems. Both a construction material and a design technique, systems may be used individually or enhanced through a combination of types. Porous asphalt consists of an open-graded coarse aggregate bonded together by asphalt cement. The mixture contains fewer fines than traditional asphalt and sufficient void space between aggregate particles allows water to drain through quickly. Porous concrete also consists of an open-graded coarse aggregate, formulated with Portland cement and water. Modular porous pavers are structural units, such as concrete blocks or reinforced plastic mats, with void areas that are filled with pervious materials, to achieve a load-bearing permeable surface. The pervious fill materials include sand, grass turf, and gravel.

Each of these surfaces is typically placed over a highly permeable layer of base course comprised of open-graded gravel and crushed stone (EPA, Sept. 1999). This base serves as a reservoir for stormwater runoff where water is allowed to infiltrate to underlying permeable soils or is redirected through an overflow drain system. Filter fabric is placed beneath the aggregate subgrade to prevent fine particles from moving into the soil bed.

Essentially, “porous pavement infiltrates and treats rainwater where it falls” (Ferguson, 2005, 10). The pore space and aggregate base act as rainwater retention, reducing runoff during storm events. Further, particles and pollutants are removed from the water flow through the filtration process, with the underlying soils acting as a second filter treatment area and as a water recharge basin.

Use & Applicability

Porous pavements are particularly functional as low-volume traffic surfaces and parking areas and have been used for over thirty years. Early installations continue to function as both parking lots and stormwater management systems. Cahill Associates (CA) designed one of the first large-scale porous parking lots for an office park in a Philadelphia suburb. The design consists of porous asphalt parking bays terraced down a hillside and connected by conventional traffic lanes. The site is over 20 years old, has not needed repaving, and has staved off sinkholes in an area prone to them. CA attributes this to even distribution of stormwater through infiltration and particularly to the aggregate reservoir below the surface. Through other projects, CA has found that “porous asphalt has held up as well as, or better than, the conventional asphalt” largely because of the aggregate sub-base (Adams, May/June 2003).

While porous pavement systems have proved highly successful in many cases (especially as design and construction techniques have evolved), there is an attributable failure rate. Failure of these systems relates to poor design, inadequate construction techniques, soils with low permeability, and poor maintenance. Installation of porous paving is site-specific and may or may not be appropriate in place of standard, pervious paving. On sites where slopes are too steep, traffic loading is too great, sediments are directed onto the porous surface, or drainage is inadequate, permeable paving may not function as well as standard paving (Ferguson, 2005, 58). Furthermore, certain sites do not benefit from permeability and should remain impervious. These include brownfields or other land uses that could potentially contaminate the groundwater supply, as well as areas where rainwater is being directly harvested and does not need to be infiltrated (Ferguson, 2005, 6).

Implications

When appropriately designed and implemented, porous pavement systems have the capacity to fulfill land use needs while treating urban stormwater, with high rates of removing TSS, metals, oils, and grease. In addition to pollutant removal, porous paving requires less need for curbing, storm sewers, and detention systems. This relates to cost mitigation of installing and maintaining a porous system. While some porous pavers are more expensive than the traditional impervious, the overall expense is reduced in that additional storm systems are not needed. Potential reduction of land acquisition expenses for the otherwise-necessary water management areas may also cut municipal costs.

Specific site criteria, design, and construction are key considerations in the successful use of either porous or non-porous paving. Apart from these physical necessities, social and political decisions play a role in the implementation of either surface. Perceived costs, uncertainties regarding specifications, training installers, and annual maintenance may be current limitations on widespread use of porous systems. However, these systems are being used in different regions, with varying climates, and for different purposes. Residential streets and interstate shoulders have been constructed of porous systems, and more extensive weight-bearing roads are functioning in Europe.

More research and site study of porous paving techniques and specifications are needed to continue to increase knowledge and implementation of these systems, and to further their capacity for use.

Works Cited

Adams, Michele (May/June 2003). "Porous Asphalt Pavement With Recharge Beds," *Stormwater Magazine*. www.forester.net/sw_0305_porous.html

Ferguson, Bruce (2005). *Porous Pavements*. FL: CRC Press.

Georgia Stormwater Management Manual (2001). "Porous Concrete." Vol. 2, 3.3-33 - 3.3-40.

Georgia Stormwater Management Manual (2001). "Modular Porous Paver Systems." Vol. 2, 3.3-41 – 3.3-46.

U.S. EPA (September 1999). *Stormwater Technology Factsheet: Porous Pavement*. Washington, DC: EPA 832-F-99-023.