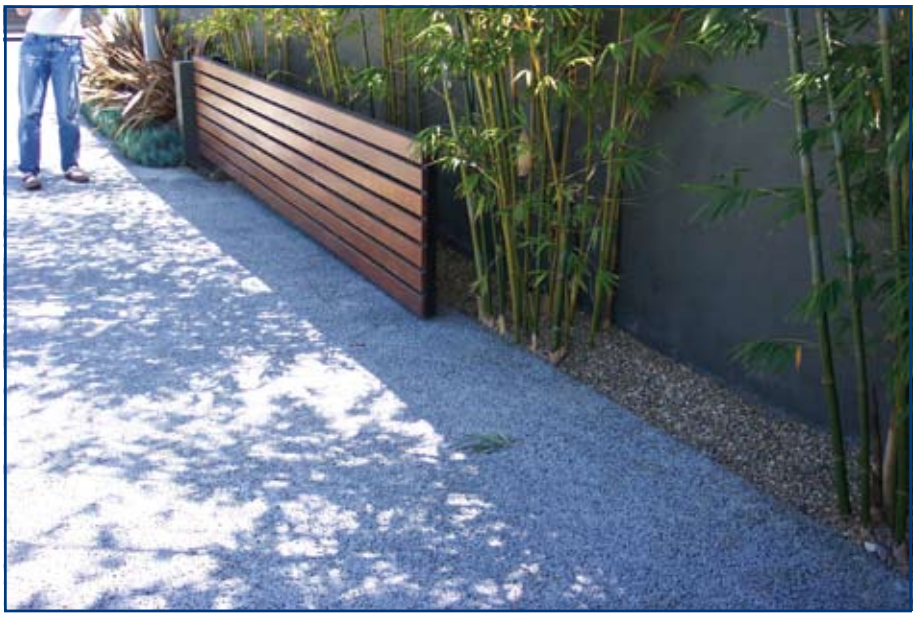
Permeable Paving



David Hertz Studio, an architectural firm in Santa Monica, has installed a permeable pavement parking lot, demonstrating its commitment to green building.

Benefits

- Reduces stormwater runoff
- Increases groundwater recharge
- Improves water quality
- Improves water flow and air circulation to tree roots
- Reduces splash and spray
- Reduces pollutants flowing to ocean
- Reduces detention pond requirement in some areas
- Alleviates downstream flooding
- Reduces impervious surface area
- Reduces need for curbs and storm sewers

Permeable Paving Reduces Flooding

Urban and suburban neighborhoods are generally paved with vast areas of impervious surfaces. These are surfaces such as streets, sidewalks, driveways, and garden paths constructed with traditional materials such as asphalt and concrete. These surfaces don't allow water to penetrate or percolate down into the soil. Instead, stormwater runoff flows into storm drains, carrying pollutants to the ocean at a high volume. Permeable paving can be one of several different materials that allows runoff to pass through the pavement and underlying stone bed, then into the soil below, filtering pollutants and recharging the groundwater supply. Studies indicate that porous paving can remove between 65and 85 percent of undissolved pollutants and up to 95 percent of sediment from runoff. Also, trees and large shrubs can be planted much closer to permeable paving that traditional paving, as the porosity allows for oxygen, carbon dioxide, water, and nutrients to pass freely to the plants' root zones.

Background

Permeable or porous paving became a method for addressing stormwater issues in the early 20th century. It has been installed in Europe for over fifty years. Concrete turfblock for grass paving began in the mid-1940s and plastic versions were invented in the late '70s and early '80s. The permeable pavement movement in the United States began in the 1970s when John Paine, a civil engineer in Florida, along with several of his associates, created a formula called *Portland Cement Pervious Pavement*. Since then, Florida has been a leader in the pervious concrete and porous asphalt movement due to critical water management concerns.

Pervious concrete can be installed in a wide range of colors to create exciting designs.

Components of Permeable Paving

Porous pavements by their very nature are designed to move water through their cross section - vertically and horizontally, without loss of structural integrity. Almost all pavements are made up of layers called courses: the first is the surface layer, which must be durable enough to withstand traffic, making it relatively expensive compared to the rest of the pavement structure. Second is the base course, which extends the thickness of the pavement and acts as a kind of underlying reservoir for water until it permeates into the subgrade. This course is made up of less expensive material. The third course is the subgrade, which is the soil below the base course.

Proper installation and regular maintenance are key in successful applications of permeable paving - especially with pervious concrete and porous asphalt.

Close up of porous asphalt being installed over open-graded aggregate.

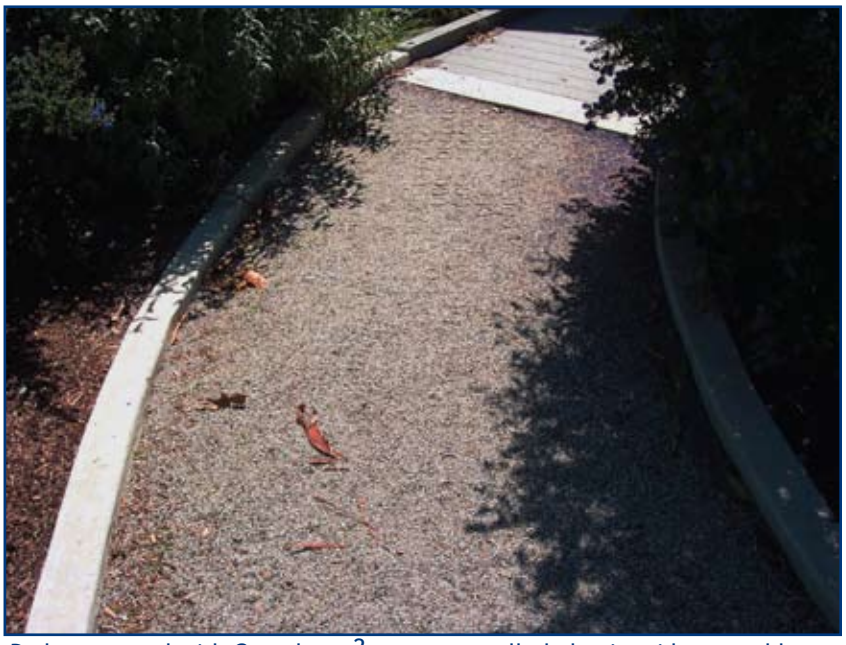
Types of Permeable Paving

Permeable paving can be constructed from several different processes and materials. One such material is pervious concrete. This paving can be used by homeowners for driveways, walkways, patios, paths, and overflow or RV parking areas. Pervious concrete is created by mixing water and cement-like materials into a paste that forms a thick coating around the open-graded or single-size aggregate particles. This mixture contains little or no sand and forms a system of "highly permeable, interconnected voids that drain quickly." 15% to 25% voids are achieved in the hardened concrete, and flow rates average around 480 in/hr. Pervious concrete is advocated as a best management practice (BMP) by the EPA. It has been used in many cities on residential streets. The Portland Cement Association maintains a list of certified contractors. Due to its lighter color, pervious concrete also has the added benefit of absorbing much less heat that asphalt, and therefore aids in greatly reducing urban heat islands. One drawback with pervious concrete is that a certain amount of time is needed for the pavement to cure before it can be used.

In porous asphalt installations, the pavement consists of an open-graded coarse aggregate bonded together by asphalt cement with sufficient interconnected voids to make it highly permeable to water. Polymers are added to the asphalt binder to prevent migration, and polymer-reinforcing fibers further hold it together. In addition, large enough particles are used so if a little migration occurs, openings remain that are large enough to allow infiltration. Practical applications include driveways, parking areas and roadways on larger properties. Porous asphalt can be more cost-effective, and in the colder mountain climates, greatly reduces the need for de-icing pavement. Paving with porous asphalt is no different from paving dense-graded asphalt – it requires no special training and can be supplied by conventional asphalt batch plants. Water passes through the asphalt and into the stone recharge bed where it is stored until the uncompacted subgrade can absorb it. The stone recharge beds make outstanding structural bases and perform equally well whether dry, wet or saturated.

Open-celled paving grids are another permeable paving option. They contain open spaces held together

with either strong plastic or concrete ribbing. The cells are filled with gravel, sand, or a growing compound that can be planted with a grass mixture. A potential disadvantage is that initially, the grass-filled grids or cells can be difficult to walk on. Turf needs time to grow over the grids and open spaces, before they can work well. Open-celled paving grids can be used in low-traffic areas, such as patios, loading areas, emergency-access lanes, overflow parking, walkways, and wheelchair access ways.



Pathway paved with Gravelpave^2 – an open-celled plastic grid permeable paving system.

Open-jointed paving blocks are segmental pavers that bear enormous traffic. They can be interlocking or unconnected with vegetation in between. These pavements can handle high weights and perform in a variety of climates. Thus the pavers are ideal for heavily used driveways and RV parking areas. The range of colors, shapes, and textures also makes pavers suitable to patio or seating areas. The interlocking pavers also have sufficient gaps between them to allow water to seep into the crushed stone layer below. With open-jointed pavers, there is no curing time – the pavement is ready to use upon installation. Also, more site flexibility is possible with segmental pavers – they can be used on sloped surfaces with proper design.

Open-graded aggregate without a grid support is "the most permeable material and the lowest cost material you can get anywhere, including conventional dense asphalt." Aggregate used to have the disadvantage of creating dust. Today it is made out of single-sized angular particles and washed before application. It is available in all geographic areas of the country. About 30% to 40% of that material is void space, and its permeability is measured in thousands of inches per hour. Other paving materials that can be utilized in special-use areas include wood mulch, crushed shell, and other organic materials. These are used for areas of pedestrian traffic such as wood- mulching gardens and playgrounds.

Porous turf can be used by itself as well as with modern reinforcements. It is well suited for infrequent or serial uses that allow the grass time to regenerate

Grasspave^2 open-celled grid systems provide a stable surface for wheel chairs.

Close up of pervious concrete shows void spaces between the open-graded aggregate where water filters down.

between events. Examples include parking areas or emergency or alternate access on larger properties. The cost of bringing in a sand rooting zone needs to be considered when selecting this technology. Sand does not get compacted like clay - it maintains its permeability and penetrability by the grass roots and the aeration to grass roots. Turf-based systems actively evapotranspire and cool off the immediate area by several degrees. The cooling is so prominent you can feel it when you move from an asphalt street into a grass parking area.

References and Resources

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Water poured onto pervious concrete filters through to recharge groundwater.

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