Porous Asphalt Pavement

Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment

Subcategory: Infiltration

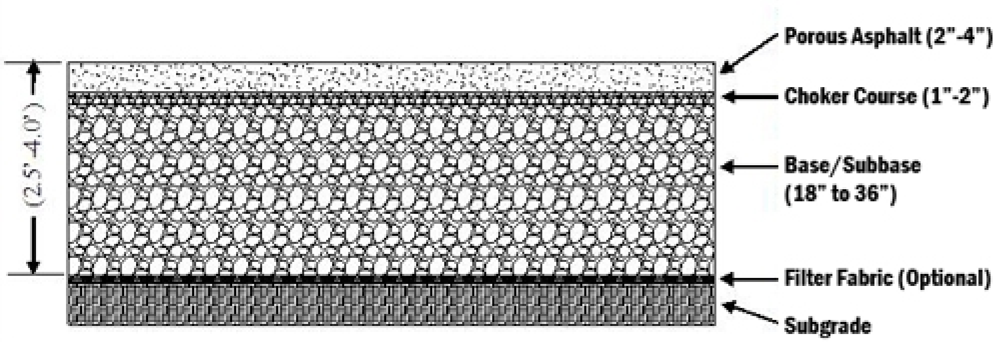

Figure 3. Typical Porous Asphalt Pavement Section *(diagram adapted from US EPA)*

Description

Porous asphalt is standard hot-mix asphalt with reduced sand or fines and allows water to drain through it. Porous asphalt over an aggregate storage bed will reduce stormwater runoff volume, rate, and pollutants. The reduced fines leave stable air pockets in the asphalt. The interconnected void space allows stormwater to flow through then enter a crushed stone aggregate bedding layer and base that supports the asphalt while providing storage and runoff treatment. When properly constructed, porous asphalt is a durable and cost competitive alternative to conventional asphalt.

Applicability

Porous asphalt allows for runoff volume and rate control, plus pollutant reductions. Projects use porous asphalt to meet post-construction stormwater quantity and quality requirements. The use of porous asphalt can potentially reduce additional expenditures and land consumption for conventional stormwater collection, conveyance, and detention infrastructure. Porous asphalt can replace traditional impervious pavement for most pedestrian and vehicular applications. It performs well in pedestrian walkways, sidewalks, driveways, parking lots, and low-volume roadways. The environmental benefits from porous asphalt allow it to be incorporated into low impact development programs. The appearance of porous asphalt and conventional asphalt is very similar. The surface texture of porous asphalt is slightly rougher, providing more traction to vehicles and pedestrians.

Design Criteria

Porous asphalt should be designed and sited to intercept, contain, filter, and infiltrate stormwater on site. Several design possibilities can achieve these objectives. For example, porous asphalt can be installed across an entire street width or an entire parking area. The pavement can also be installed in combination with impermeable pavements or roofs to infiltrate runoff. Several applications use porous asphalt in parking lot lanes or parking stalls to treat runoff from adjacent impermeable pavements and roofs. This design economizes porous asphalt installation costs while providing sufficient treatment area for the runoff generated from impervious surfaces. Inlets can be placed in the porous asphalt to accommodate overflows from extreme storms. The stormwater volume to be captured, stored, infiltrated, or harvested determinees the scale of permeable pavement required.

Porous asphalt (2 to 4 inches thick) comprises the surface layer of the permeable pavement structure, which also consists of:

- *Choke course* - This permeable layer is typically 1 - 2 inches thick and provides a level and stabilized bed surface for the porous asphalt. It consists of small-sized, open-graded aggregate.

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- *Open-graded base reservoir* - This aggregate layer is immediately beneath the choke layer. The base is typically 3 - 4 inches thick and consists of crushed stones typically 3/4 to 3/16 inch. Besides storing water, this high infiltration rate layer provides a transition between the bedding and subbase layers.
- *Open-graded subbase reservoir* - The stone sizes are larger than the base, typically ¾ to 2 ½ inch stone. Like the base layer, water is stored in the spaces among the stones. The subbase layer thickness depends on water storage requirements and traffic loads. A subbase layer may not be required in pedestrian or residential driveway applications. In such instances, the base layer is increased to provide water storage and support.
- *Underdrain (optional)* - In instances where porous asphalt is installed over low-infiltration rate soils, an underdrain facilitates water removal from the base and subbase. The underdrain is perforated pipe that ties into an outlet structure. Supplemental storage can be achieved by using a system of pipes in the aggregate layers. The pipes are typically perforated and provide additional storage volume beyond the stone base.
- *Geotextile (optional)* - This can be used to separate the subbase from the subgrade and prevent the migration of soil into the aggregate subbase or base.
- *Subgrade* - The layer of soil immediately beneath the aggregate base or subbase. The infiltration capacity of the subgrade determines how much water can exfiltrate from the aggregate into the surrounding soils. The subgrade soil is generally not compacted.

Maintenance

The most prevalent maintenance concern is potential clogging of the porous asphalt pores. Fine particles that can clog the pores are deposited on the surface from vehicles, the atmosphere, and runoff from adjacent land surfaces. Clogging will increase with age and use. While more particles become entrained in the pavement surface, it does not become impermeable. Studies of the long-term surface permeability of porous asphalt and other permeable pavements have found high infiltration rates initially, followed by a decrease, and then leveling off with time. With initial infiltration rates of hundreds of inches per hour, the long-term infiltration capacity remains high even with clogging. When clogged, surface infiltration rates usually well exceed 1 inch per hour, which is sufficient in most circumstances for the surface to effectively manage intense stormwater events. Permeability can be increased with vacuum sweeping. In areas where extreme clogging has occurred, half inch holes can be drilled through the pavement surface every few feet or so to allow stormwater to drain to the aggregate base. A stone apron around the pavement connected hydraulically to the aggregate base and subbase can be used as a backup to surface clogging or pavement sealing.

Due to the well draining stone bed and deep structural support of porous asphalt pavements, they tend to develop fewer cracks and potholes than conventional asphalt pavement. When cracking and potholes do occur, a conventional patching mix can be used. Freeze/thaw cycling is a major cause of pavement breakdown, especially for parking lots in northern climates. The lifespan of a northern parking lot is typically 15 years for conventional pavements; however porous asphalt parking lots can have a lifespan of more than 30 years because of the reduced freeze/thaw stress. In cold climates, sand should not be applied for snow or ice conditions. However, snow plowing can proceed as with other pavements and salt can be used in moderation. Porous asphalt has been found to work well in cold climates as the rapid drainage of the surface reduces the occurrence of freezing puddles and black ice. Melting snow and ice infiltrates directly into the pavement facilitating faster melting. Cold weather and frost penetration do not negatively impact surface infiltration rates. Porous asphalt freezes as a porous medium rather than a solid block because permeable pavement systems are designed to be well-drained; infiltration capacity is preserved because of the open void spaces. However, plowed snow piles should not be left to melt over the porous asphalt as they can receive high sediment concentrations that can clog them more quickly.

Effectiveness

Permeable pavement reduces pollutant concentrations through several processes. The aggregate filters the stormwater and slows it sufficiently to allow sedimentation to occur. Also, studies have found that in addition to beneficial treatment from bacteria in the soils, beneficial bacteria growth has been found on established aggregate bases. In addition, permeable pavement can process oil drippings from vehicles.

Permeable pavement water quantity and pollutant reduction characteristics such as 80 percent total suspended solids reductions can qualify it to earn credits under green or sustainable building evaluation systems such as Leadership in Energy and Environmental Design (LEED®) and Green Globes. Credits also can be earned for water conservation and conservation of materials by utilizing some recycled materials and regional manufacturing and resource use.

Reference: USEPA, Post-Construction Stormwater Management in New Development and Redevelopment, http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=5