Chapter 7.7 - Manmade Pervious Surfaces

Porous pavement consists of the use of a permeable surface, base, and subbase materials which allow penetration of runoff through the surface and into the underlying soils. Pavement alternatives vary in load bearing capacities but are generally appropriate for low traffic areas such as sidewalks, parking lots, overflow parking and residential roads. It is important to choose a material appropriate for the desired use (light, moderate or heavy use). Maintenance is essential for long term use and effectiveness. The efficiency of pavement alternative systems will depend on whether the pavement is designed to store and infiltrate most runoff, or only limited volumes of runoff (e.g., "first-flush") with the remainder discharged to a storm drainage system or overland flow. The effectiveness of pavement alternatives will also depend on the long term serviceability. This manual describes three different permeable pavement alternatives (porous asphalt or concrete, block pavers, and plastic grid pavers) Examples of these porous pavement alternatives are shown below. Refer to Chapter 9.0 for further information on the performance and design of level spreaders.

Types of Porous Pavement: A typical permeable pavement alternative consists of a top porous asphalt, block pavers or plastic grid paver course, a filter course, a reservoir course, a geotextile filter fabric and existing soil or subbase material. Some materials will be more resilient to intended use and site conditions; and the selection of a type of paver alternative must be carefully considered. A brief description of three types of porous pavements is provided below and a comparison provided in Table 7.7.1.

- *Porous Asphalt:* Porous asphalt is very similar to conventional asphalt except that it is mixed without particles smaller than coarse sand (less than 600 µm or No. 30 sieve). Without these smaller size particles, water is able to pass through the surface and into a crushed stone storage area which allows the water to slowly infiltrate into the ground. The lack of fine particles in the material limits the load capacity of the asphalt compared to conventional asphalt thus it should not be used for areas of high traffic.
- *Block Pavers:* Block pavers consist of a set of interlocking, normally concrete pavers that connect in a way to leave open or void spaces between them to allow water to infiltrate into the underlying gravel reservoir. Typical installation consists of a soil subgrade, a gravel subbase, a layer of sand, and the grid pavers. The infiltration capacity is based on the thickness of the gravel subbase and the material in the void space. Void spaces can be filled with gravel or soil and grass.
- *Plastic Grid Pavers:* Plastic grid pavers are often constructed from recycled material. They generally come in a honeycomb pattern and the voids are filled with either gravel or soil and grass depending on use. The grid pavers give added stability to and allow minimal compacting of soils in voids. They are flexible and can be used in areas with uneven terrain.
- *Artificial ball fields (turf athletic fields):* These are also considered pervious surfaces that require similar design considerations. The synthetic nature of the turf may be a concern for the infiltration of chemicals into the subsurface; however, no restriction will be applied until more data is available on this subject.

Siting Plans:

- *Soils:* Pavement alternatives are not suitable when on soils with field-verified permeability rates less than 0.50 inches per hour or with clay content that is greater than 30%. Soil borings must be taken two to four feet below the level of the base of the pavement system or the bottom filter course, whichever is deeper, to identify any restrictive layers. Frost-susceptible soils or on wet or unstable subgrade of fill soils prone to slope failure are not good candidates. Sites without suitable natural soils for infiltration may be used for pavement
- alternatives, but will require provision of subsurface drainage and a discharge outlet from the system for the treated percolate.

Table 7.7.2 - Comparison of Porous Pavement			
	Porous Asphalt	**Block Pavers**	**Plastic Grid Pavers**
Application and Use	Parking Areas	Parking Areas	Parking Areas
	Walkways/ Bike Paths	Walkways/ Bike Paths	Walkways/ Bike Paths
	Overflow & Event Parking	Overflow & Event Parking	Overflow & Event Parking
	Driveways/Patios/Fire Lanes/Emergency Access	Driveways/Patios/Fire Lanes/Emergency Access	Driveways/Patios/Fire Lanes/Emergency Access
	Light Traffic Roadways		Light Traffic Roadways
Design Strength	259,200-345,600 lbs/ft^2 - slightly less than porous concrete	Per manufacturer	Per manufacturer ~24,000-820,000 lbs/ft^2
Life Span	15-20 yrs	Per manufacturer	Per manufacturer
Subbase	Geotextile fabric topped with 18-36" of crushed stone and 1"chocker course	Geotextile topped with 6" or more of gravel (omitted in residential areas) and 1" sand bedding	Varies based on manufacturers - Some grids are filled with either gravel or grass.
Maintenance	Periodic vacuum-sweeping	Refill voids/replace damaged blocks	Refill voids/replace damaged sections
	Fill potholes with patching mix unless >10% of surface	Seed low grass	Seed and mow grassed sections
	Drill 0.5" holes to address spot clogging	Remove and replace	Remove and replace
	No winter salt/sanding	No winter salt/sanding	No winter salt/sanding
	Raise plow blade 1" above surface	Raise plow blade 1" above surface	Raise plow blade 1" above surface

- *Traffic Volumes:* Pavement alternatives are limited to areas with light to moderate traffic. They are not recommended for most roadways, and cannot withstand heavy vehicles.
- *Off-site Runoff:* Any off-site runoff directed to the system has to be pretreated to prevent the clogging of the pavement structure and underlying soils.
- *Grading:* The site should slope with less than 5% and preferably closer to 1%.
- *Sediment loading:* Pavement should not be used in areas expected to receive high levels of sediments as they are highly susceptible to clogging.
- *Reservoir Course:* The reservoir course should consist of clean washed 1½ to 3-inch aggregate. The depth of the reservoir course should be based on the desired storage volume and frost penetration.
- *Porous Asphalt Course:* The top porous asphalt course should be 2-4 inches thick, depending on load and traffic application. A typical porous asphalt mix is provided in Table 7.7.2. The porous asphalt mix and thickness should be designed based on site specific conditions such as the use of the paved area, the required load bearing capacity, climate, etc.

Table 7.7.2 - Typical Porous Asphalt Gradation	
Sieve Size	**% Passing**
1/2"	**100**
3/8"	**95**
#4	**35**
#8	**15**
#16	**10**
#30	**2**

- *Asphalt Mix:* Porous asphalt is weaker than conventional asphalt pavement; however with the proper admixture design and installation, its durability has shown to be effective for both commercial and roadway applications. The following mixtures are available:
  - *Low/Moderate Durability:* PG 64-28 with 5 pounds of fibers per ton of asphalt mix. This mix is recommended for smaller projects with lower use or loading potential.

- o *Moderate Durability:* Prep-blended PG 64-28 SBS/SBR with 5 pounds of fibers per tons of asphalt mix. This mix is for large projects (>1 acre) where high durability pavement is required.
- o *High Durability:* Pre-Blended PG 76-22 modified with SBS/SBR and 5 pounds of fiber per ton of asphalt mix. This mix is recommended for large sites with high wheel load (H-20) and traffic counts.

- *Geotextile Fabric:* A geotextile fabric may prevent surrounding soils from migrating into the system and reducing its storage capacity. Choose a compatible fabric that is free of tears, punctures, and other damage. Overlap seams a minimum of 12 inches.
- *Filter Course:* A filter course should be provided between the top porous asphalt or paver course and the reservoir course. This provides a level surface to construct the top porous asphalt or paver course. The filter course should meet the following requirements:
- *Cold Climates:* Winter maintenance procedures may be problematic (e.g., scraping by plows, clogging by sand, clogging by or inability to treat de-icing chemicals). Snow removal and deicing activities should be done carefully to avoid disturbance to the pavement structure and stripping of any vegetation. The plow blade should be raised 1" above the surface or outfitted with a flexible rubber bottom piece.

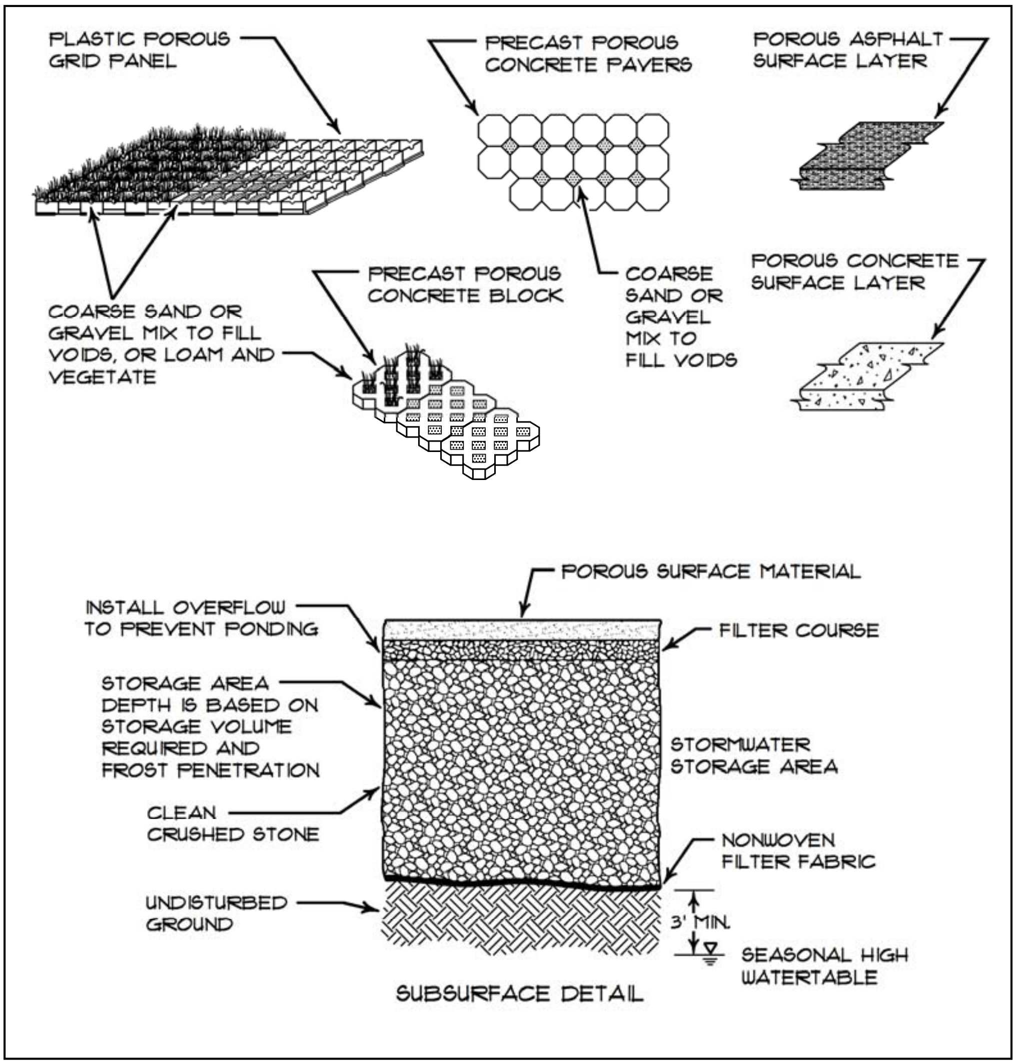

Figure 7.7.1 – Types of Pervious Pavement

Design for Infiltration: All specifications from Chapter 6, Infiltration apply:

- At a minimum, one foot separation is needed below the road subbase and above the groundwater table. The depth of the water table elevation needs to be considered in designing the road for sufficient frost protection depth.
- A filter layer providing pretreatment before infiltration to groundwater can be part of the subbase and base. It should be 8 inches minimum, mostly granular; but with 4 to 7% fines (passing #200 sieve), and should extend across the bottom of the entire filter area. This material should be uniform, free of stones, stumps, roots, or other objects larger than two inches. The preferred material should meet the specifications of a MEDOT aggregate (MEDOT # 703.01) as shown on Table 7.7.3. However, more fines would be preferable (between 8% and 10% fines passing the #200 sieve).
- A reservoir course within the filter layer or subbase and base is needed to allow the direct entry of one inch or more of water.
- The road design may provide the storage capacity for the direct entry of rain precipitation from a 24-hour, 25-year storm (5+ inches) event.
- Infiltration rate should be confirmed with a double ring infiltrometer test to determine the soil's permeability. The test needs to be on native subgrade even if there is fill above it, and not on the fill itself. Recommended infiltration should be less than 2.41 inches per hour but great enough that one inch of stored precipitation infiltrates in 24 hours (i.e. >0.04 inches per hour).
- The stored volume needs to fully infiltrate within 24-48 hours.
- Provide appropriate drainage and discharge of flows from larger storms where is needed.

Table 7.7.3 - Maine DOT Specifications for Aggregate (MEDOT #703.01)

Sieve Size	% by Weight
3/8”	100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#60	10-30
#100	2-10
#200	0-5 (8-10% is preferred)

Table 7.7.4 - Maine DOT Specifications for Underdrains (MEDOT #703.22)

Sieve Size	% by Weight
UNDERDRAIN - TYPE B	
1”	90-100
½”	75-100
#4	50-100
#20	15-80
#50	0-15
#200	0-5
UNDERDRAIN - TYPE C	
1”	100
¾”	90-100
3/8”	0-75
#4	0-25
#10	0-5

Design for Storage and Filtration: All specifications from Chapter 7, Filtration apply; and a minimum storage capacity for one inch of precipitation within the filter layer or subbase and base is needed.

- To meet the Chapter 500 Flooding Standards requirements, the road design needs to provide a minimum storage capacity for the direct entry of the rain precipitation from a 24-hour, 25-year storm (5 + inches).
- The filter bed may be part of the road base and subbase horizon. The filter must be a mineral soil with between 4 to 7% fines (passing # 200 sieve) and must be a minimum of 4 inches thick.
- The underdrained layer, 12-inch thick of underdrain gravel meeting the MDOT Specification 703.22, Type C as shown on Table 7.7.4, should provide sufficient coverage for the underdrain piping.
- An underdrain pipe network is needed to drain adequately the underdrain layer. Pipes should be placed perpendicular to the slope and should be spaced no further than 20 feet apart. An orifice may be needed to control the outflow.
- Stored volume needs to fully drain within 24-48 hours.
- Provide appropriate drainage and discharge of flows from larger storms where is needed.

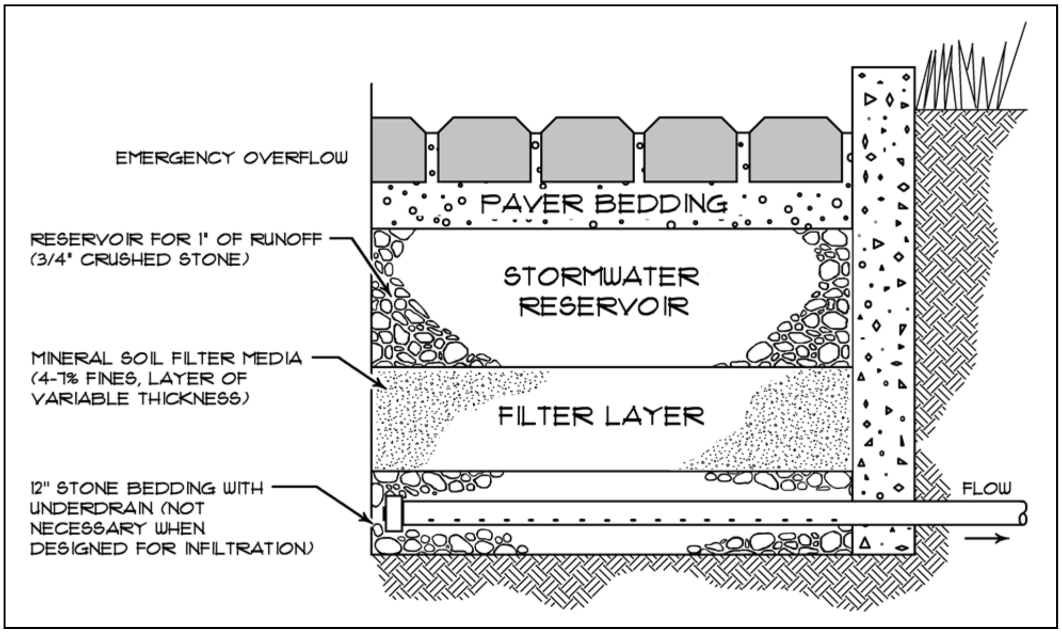

Figure 7.7.2 – Pervious Pavement Cross-Section

7.7.1 - Run-on Modular Pervious Pavement

In addition to the design guidelines from above, an area of modular pervious pavement structure may be used to provide the treatment of impervious pavement where the area of pervious pavement is no less than 20% of the impervious area that drains to it. However, the thickness of the filter sand layer must be equivalently increased, and must meet the following design criteria:

- The thickness of the sand filter layer should be increased exponentially from 4 inches for a full (100%) pervious pavement section with no run-on from other areas to 18 inches for a pervious section and treatment system that is no less than 20% of the impervious area draining into it.
- The flow path over the impervious area should not exceed 50 feet before reaching the pervious pavement section for treatment.
- Subsurface storage and a drainage structure must be provided to control the channel protection volume for a 24-48 hour discharge unless the system is designed for infiltration. Long-term inspection and maintenance by a DEP approved stormwater maintenance inspector will be regularly provided under a five-year binding inspection and maintenance contract that is renewed before contract expiration.
- The replacement of the modular pervious system will be provided when more than 40% of the pervious system shows signs of clogging.

7.7.2. - Run-on Asphalt Pervious Pavement

An area of asphalt pervious pavement may be used to provide the treatment of regular asphalt pavement that is impervious may be used with the following criteria:

- The area of pervious pavement is equal in length of the impervious area that drains to it, but the flow path over the impervious area should not exceed 50 feet before reaching the pervious pavement section for treatment.
- The minimum thickness of the filter sand layer is 12 inches.

- Subsurface storage and a drainage structure must be provided to control the channel protection volume for a 24-48 hour discharge unless the system is designed for infiltration. And, the system is sized to meet the requirements for flooding control if required.
- Long-term inspection and maintenance by a DEP approved stormwater maintenance inspector will be regularly provided under a five-year binding inspection and maintenance contract that is renewed before contract expiration.
- The pervious pavement will be replaced when more than 40% of the pervious system shows signs of clogging.

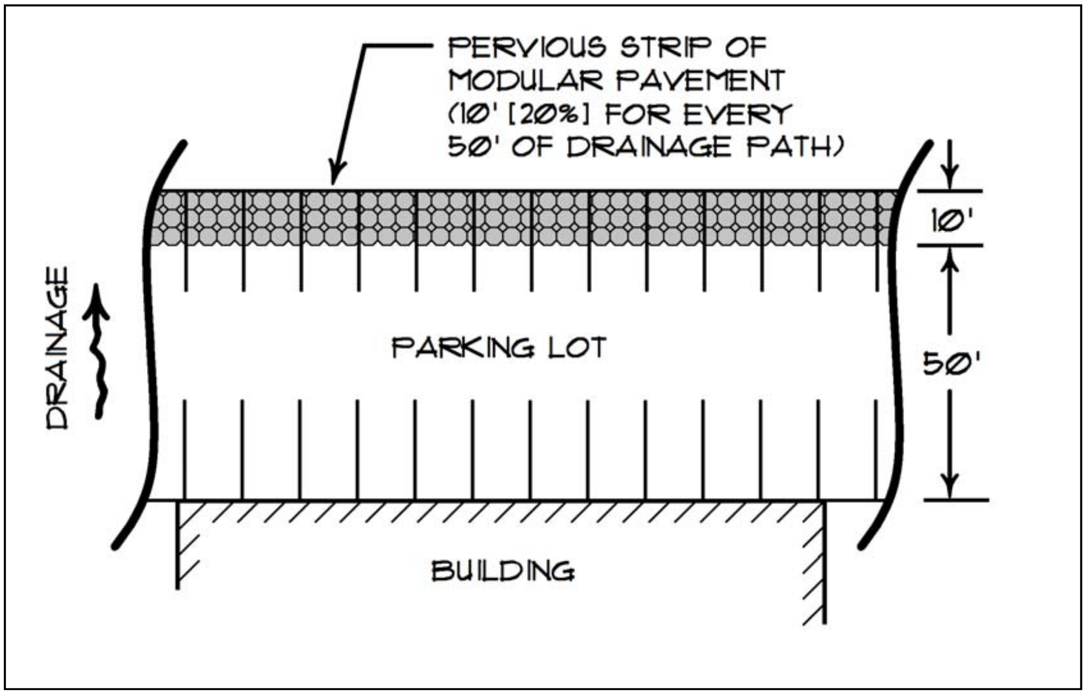

Figure 7.7.3 – Run-On Pervious Pavement

Maintenance: Pervious surfaces and pavement, whether asphalt, concrete or paving stones, have the potential to become impervious if not properly maintained. The following need to be planned for and be met:

- Frequent inspections are performed during the first few months following construction. Then, the system is inspected routinely on an annual basis. Inspections should be made after significant storm events to check for surface ponding that could indicate failure due to clogging. Non-routine maintenance may require reconstruction of the surface treatment, and possibly the filter and reservoir layers, to relieve major clogging.
- Prevent sedimentation due to the erosion of areas upgradient the pervious pavement structures.
- Prevent vehicles with muddy wheels from accessing onto areas intended for pervious pavement.
- Sweep, vacuum and/or pressure wash pavement twice annually at a minimum.
- Limit salt use for deicing, and do not use sand.
- Remove leaves and organic debris in the fall.
- Measures should be taken to ensure that an area designed to be porous does not receive a future overlay of conventional non-porous paving.