Pervious Pavement Guidance Document

(Updated for April 13, 2011)

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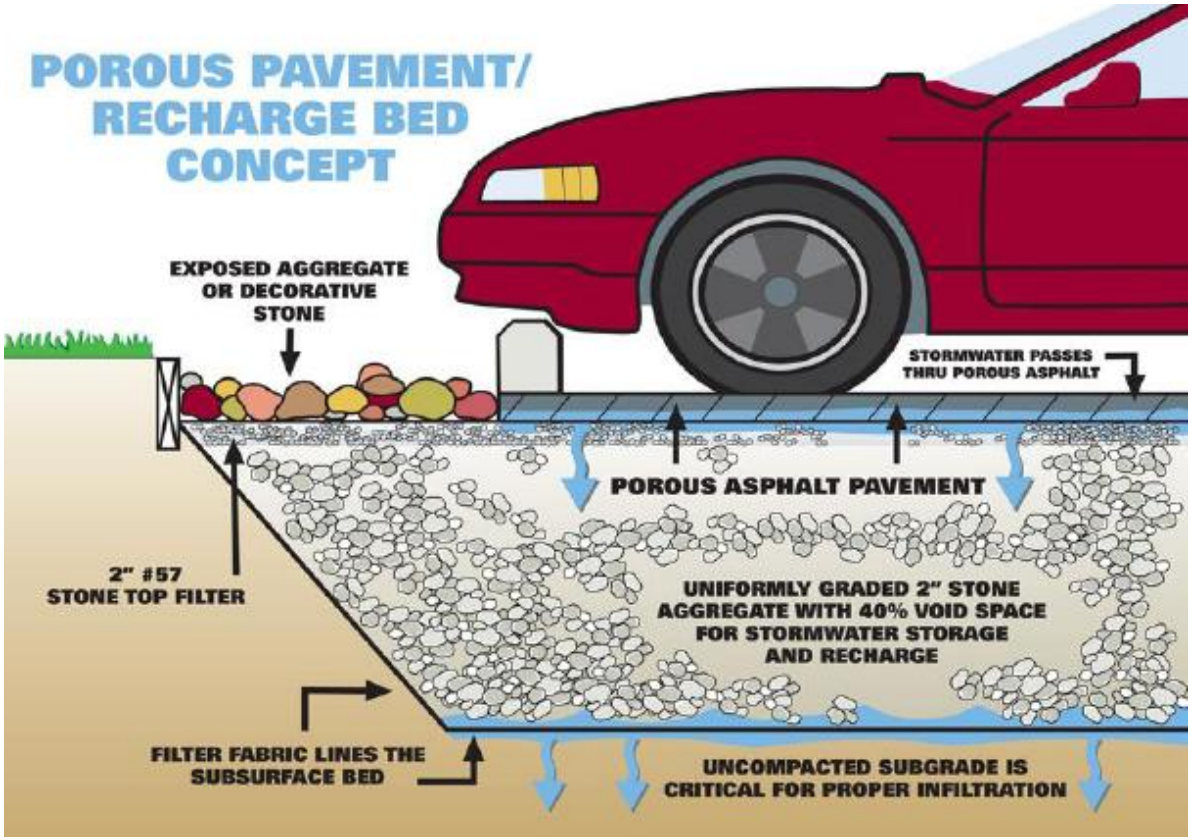
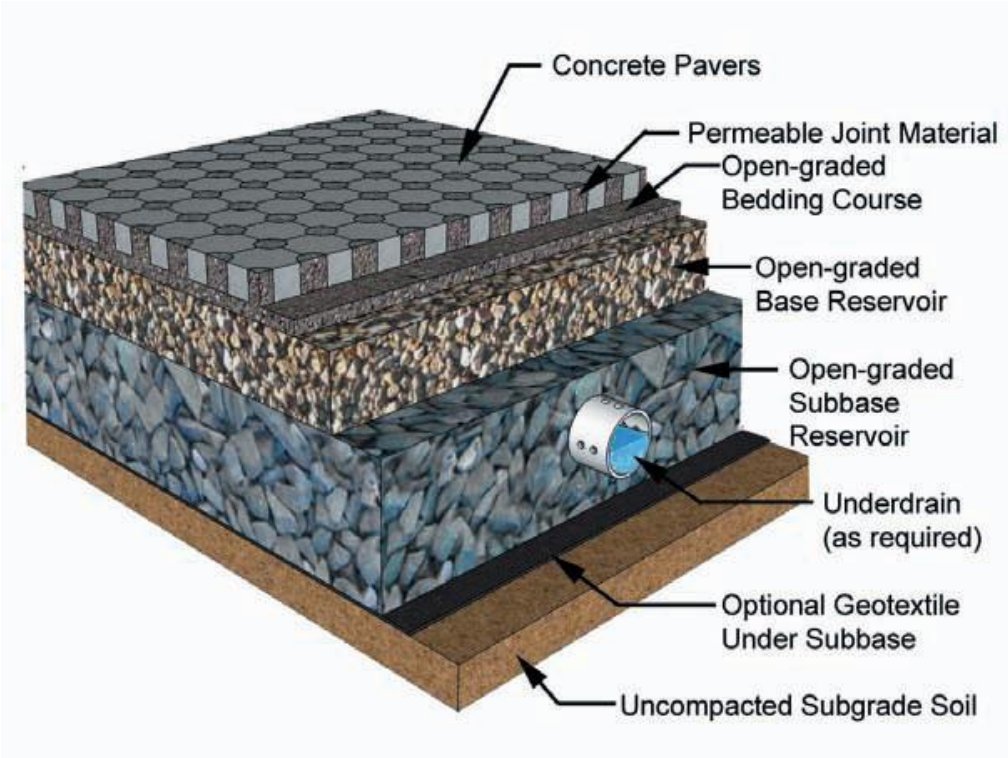
Pervious Pavement



Source: Flexible Pavements of Ohio (2008)

Pervious Pavement



Source: ICPI

Why a Document?

- Promote the Use of Pervious Pavement
- Goals
  - Runoff Reduction
  - Enhance BMP Toolbox
  - Consistency/Reviewability
  - Minimize Failures

Document Outline

- Condition Where Practice Applies and Does Not Apply
- Planning Considerations
- Pavement Options
- Design Criteria – Stormwater
  - WQv
  - Peak Discharge
- Design Criteria – Structural
- Construction
- Maintenance

Document Draft Available for Public Comment

ftp://ftp.dnr.state.oh.us/Soil_&_Water_Conservation/Stormwater/DraftPractices/PervPaveDraft4-2011.pdf

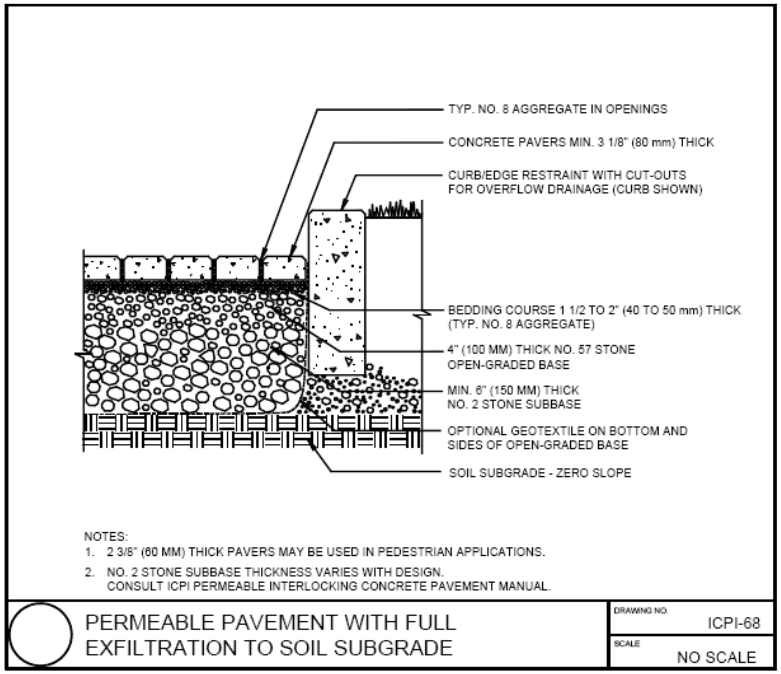
Condition Where Practice Applies

- Most settings where traditional pavements are used
- Especially suited to parking lots, parking lanes, sidewalks, playgrounds, plazas
- Sites where space is limited for use of traditional detention basins

Condition Where Practice Typically Does Not Apply

- Heavy Traffic Areas
- Potential Groundwater Contamination
  - Industrial & Chemical Storage Areas
  - Fueling Stations
- Sites with Sediment Source Areas (e.g., vehicle wash areas, bare soils, spoil piles, sand storage, certain landscaped areas, …)
- Unstable Slope Areas
- Pavement Slopes Greater than 5%

Structural Considerations



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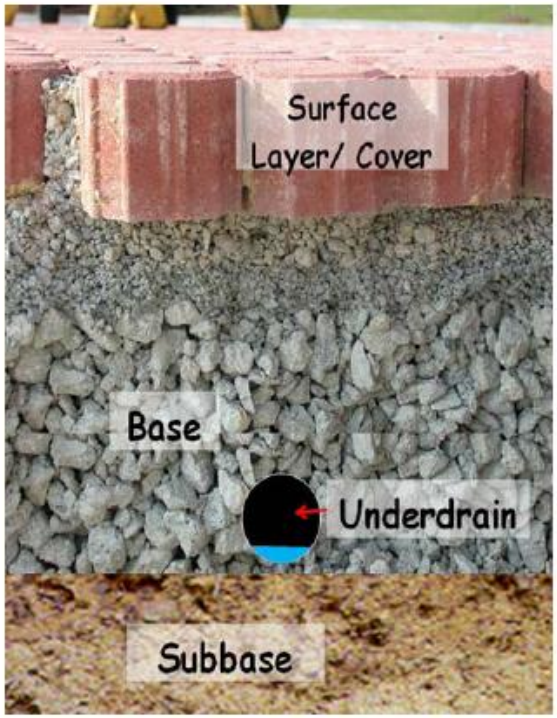

Figure 1. Cross-section of permeable pavement, including the surface layer (cover), a gravel base, the soil sub-base, and the underdrain.

Source: NC State Extension (2008)

Structural Considerations

- Must be Evaluated by Design Engineer on Case-by-Case Basis
- Structural Recommendations Based on Industry Research and Guidance

Structural Considerations

SPECIFIER'S GUIDE
FOR
PERVIOUS CONCRETE
PAVEMENT WITH DETENTION

(OHIO READY MIXED CONCRETE ASSOCIATION – PCP- 2795)
October 23, 2009

Disclaimer

The information contained herein is provided for use by professional personnel who are competent to evaluate the significance and limitations of the information provided and who will accept total responsibility for the application of this information. The project Engineer of Record shall be responsible for the review and acceptance of the design recommendations. The recommendations reflect the judgment of the Ohio Concrete Engineering Services Center and Ohio Ready Mixed Concrete Association (ORMCA) and ORMCA makes no representations or warranties concerning the fitness of this information for any particular application or installation and DISCLAIMS any and all RESPONSIBILITY and LIABILITY for the accuracy of and the application of the information provided to the full extent of the law.

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US-permeable pavers.doc (updated 1-09)

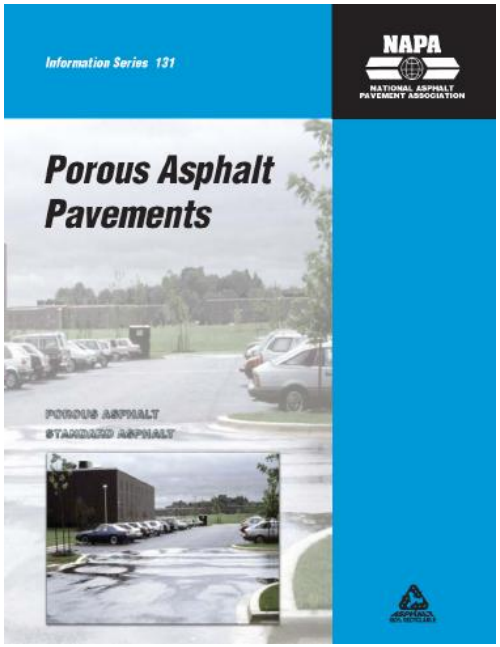
SECTION 32 14 13.19
PERMEABLE INTERLOCKING CONCRETE PAVEMENT
(1995 MasterFormat Section 02795)

Note: This guide specification for U.S. applications describes construction of permeable interlocking concrete pavers on a permeable, open-graded crushed stone bedding layer (typically ASTM No. 8 stone). This 2 in. (50 mm) layer is placed over an open-graded base (typically No. 57 stone no greater than 4 in. or 100 mm thick) and a sub-base (typically No. 2 stone or similar sized material). The pavers and bedding layer are placed over an open-graded crushed stone base with exfiltration to the soil subgrade. In low infiltration soils or installations with impermeable liners, some or all drainage is directed to an outlet via perforated drain pipes in the subbase. While this guide specification does not cover excavation, liners and drain pipes, notes are provided on these aspects.

The text must be edited to suit specific project requirements. It should be reviewed by a qualified civil or geotechnical engineer, or landscape architect familiar with the site conditions. Edit this specification term as necessary to identify the design professional in the General Conditions of the Contract.

PART 1 GENERAL

1.01 SUMMARY
A. Section Includes
1. Permeable interlocking concrete pavers.
2. Crushed stone bedding material.
3. Open-graded subbase aggregate.
4. Open-graded base aggregate.
5. Bedding and joint/opening filler materials.
6. Edge restraints.
7. [Geotextiles].
B. Related Sections
1. Section [_____]: Curbs.
2. Section [_____]: [Stabilized] aggregate base.
3. Section [_____]: [PVC] Drainage pipes
4. Section [_____]: Impermeable liner.
5. Section [_____]: Edge restraints.
6. Section [_____]: Drainage pipes and appurtenances.
7. Section [_____]: Earthworks/excavation/soil compaction.



Design Criteria - Stormwater

- WQv
- Peak Discharge

Water Quality Volume (WQv)

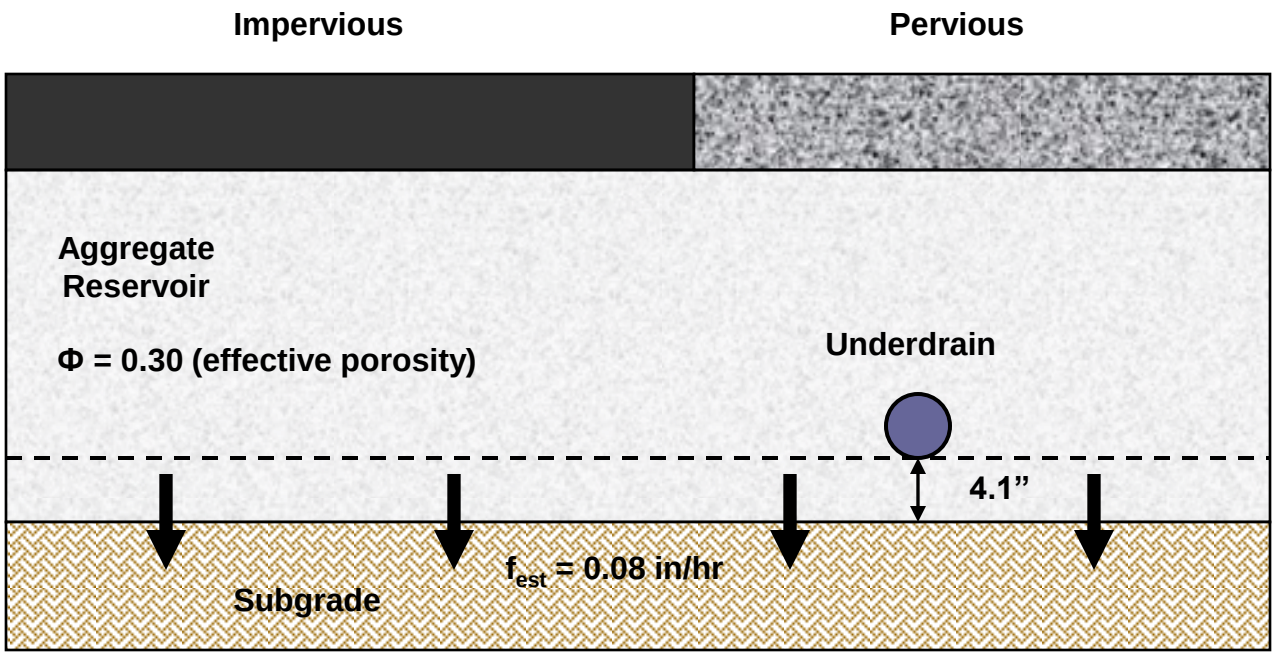
- Full Infiltration of WQv – no pre-approval from Ohio EPA
- No Infiltration of WQv (lined system or compacted subgrade) – case-by-case, prior approval required
- Partial Infiltration of WQv – case-by-case, prior approval required
- Redevelopment Projects

Infiltration Estimates

Subgrade Soil Texture	Clay Content (%)	Clay + Silt Content (%)	Compaction Factor = 1.00		Compaction Factor = 1.05		Compaction Factor = 1.10	
			Density (g/cc)	Ksat (in/hr)	Density (g/cc)	Ksat (in/hr)	Density (g/cc)	Ksat (in/hr)
Sand	<8	<15	1.51	4.3	1.58	3.5	1.66	2.8
Loamy Sand	<15	<30	1.53	3.3	1.61	2.6	1.69	2.1
Sandy Loam	<20	<60	1.56	1.7	1.64	1.2	1.72	0.90
Loam*	7 - 27	48 - 80	1.54	0.51	1.62	0.33	1.70	0.20
Silt Loam*	<27	48 - 100	1.50	0.26	1.57	0.15	1.64	0.08
Silt*	<12	80 - 92	1.55	0.33	1.63	0.19	1.71	0.09
Sandy Clay Loam	20 - 35	<55	1.57	0.26	1.65	0.15	1.72	0.08
Clay Loam	27 - 40	54 - 80	1.47	0.12	1.54	0.06	1.61	0.02
Silty Clay Loam	27 - 40	>80	1.39	0.12	1.45	0.06	1.52	0.03
Silty Clay	40 - 60	>80	1.28	0.09	1.35	0.05	1.41	0.02
Sandy Clay	35 - 55	<55	1.51	0.03	1.58	0.01	1.66	<0.005
Clay	> 40	>55	1.37	0.02	1.44	0.01	1.51	<0.005

Note: For silt, silt loam and loam subgrade textures, check for the presence of a fragipan which can severely limit permeability.

Full Infiltration of WQv



A_{inf} = 4.5 Ac

$d_{agg} = WQv/A_{inf}/\Phi$

= 5.48 Ac-in/4.5 Ac/0.30

= 4.1 in

Subsurface Extended Detention of WQv

- WQv Determination
- Determine Volumetric Runoff Coefficient, C
- Follow Wet Pond Standards – Drain P=0.75” in 24 hr (<1/2 WQv in 1/3 Td)
- Determine Thickness of Aggregate Layer and Outlet to Meet WQv
- Install Orifice Invert at Bottom of ED Storage Layer

Critical Storm "Credit"

- At discretion of MS4
- ODNR recommendation - Reduced CN based abstraction potential of BMP

	Fully Infiltrating WQv		Partially or Non-Infiltrating
HSG	Measured Infiltration Rate (in/hr)	CN	CN
A	>1.0	68	77
B	>0.2	79	86
C	>0.05	86	91
D	>0.02	89	94

Peak Discharge

- Model as Typical Detention Basin w/Effective Porosity (use 0.30)
- Exfiltration (if applicable)
- WQ Outlet (if applicable)
- Secondary Outlet May Be Required
- Keep 10-yr Within Aggregate Layer (minimum standard)
- Check Routing of 100-yr Event

Construction & Oversight

- All Infiltrative BMPs Require Higher Level of Oversight During Construction
- Critical to Have a Stabilized Tributary Area to Pavement System Before Installation of Aggregate Layer and Pavement Surface

Maintenance

- Good Housekeeping
- Routine Inspections Recommended
- In Areas With Organic Debris (leaves, etc.) Bi-annual Cleaning Recommended

Winter Maintenance

Winter Maintenance Guidelines for Porous Pavements

Maintenance Guidelines	• Road surfaces, porous and non-porous, are commonly not treated and plowed until 2 or more inches of snow accumulation. • Plow after every storm. If possible plow with a slightly raised blade, while not necessary, this will help prevent pavement scarring. • Up to ~75% salt reduction for porous asphalt can be achieved. Salt reduction amounts are site specific and are affected by degree of shading. *USE SALT REDUCTION NUMBERS WITH CAUTION!!!* • Pervious concrete salt reduction will vary and is heavily dependent upon shading. For shaded areas, pervious concrete may not achieve salt reduction. • Apply anti-icing treatments prior to storms. Anti-icing has the potential to provide the benefit of increased traffic safety at the lowest cost and with less environmental impact. • Deicing is NOT required for black ice development. Meltwater readily drains through porous surfaces thereby preventing black ice. • Apply deicing treatments during, and after storms as necessary to control compact snow and ice not removed by plowing. • Sand application should be limited since its use will increase the need for vacuuming • Vacuum porous areas a minimum of 2-4 times per year, especially after winter and fall seasons when debris accumulation and deposition is greatest. • If ponding water is observed during precipitation clearing is recommended.
Winter Maintenance Challenges	• Mixed precipitation and compact snow or ice is problematic for all paved surfaces, but is particularly problematic for porous surfaces. This is corrected by application of excess deicing chemicals. • De-icing chemicals work by lowering the freezing point of water. Generally, the longer a de-icing chemical has to react, the greater the amount of melting. Meltwater readily drains through porous surfaces thereby reducing chemical contact time. This is corrected by excess salt application. • Excess salt application in these instances is offset by the overall reduced salt during routine winter maintenance and salt reduction.
Additional Resources	• The UNH Stormwater Center: http://www.unh.edu/erg/cstev/ • Pennsylvania Asphalt Pavement Association (PAPA) Porous Asphalt Pavements Guide: http://www.pahotmix.org/PDF/porous1.pdf • National Asphalt Pavement Association (NAPA) Porous Asphalt Pavements for Stormwater Management Revised 11/2008, Information Series 131

SC UNIVERSITY OF NEW HAMPSHIRE STORMWATER CENTER

Source: UNH Stormwater Center

OHIO DEPARTMENT OF NATURAL RESOURCES

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