Porous Asphalt Pavement Design, Construction and Maintenance
What are Porous Pavements?

Porous Pavement/Recharge Bed Concept

- Exposed aggregate or decorative stone
- Stormwater passes thru porous asphalt
- Uniformly graded 2" stone aggregate with 40% void space for stormwater storage and recharge
- Uncompacted subgrade is critical for proper infiltration

2" #57 stone top filter

Filter fabric lines the subsurface bed

AMERICA RIDES ON US
Porous Asphalt
Why Porous Pavement?

- New stormwater regulations
  - Reduce total volume (not just peak flow)
  - Limiting impervious area
  - Improve runoff quality
  - Taxing runoff
- Sustainability
- Build lot flat,
- no puddles
Porous Asphalt Pavement Development

• Concepts developed by the Franklin Institute under US EPA grant – 1972
• Tested in pilot projects during 1970’s
• Franklin Institute Press – Porous Pavement by Thelen and Howe - 1978
• Development of geotextiles in 1979
• Current design since 1980
• Cahill Associates (now CH2MHiIl) has built over 150 projects since 1980
• Outstanding engineering project - 2000
Porous Asphalt Use – Light Duty Parking Facility
Porous Asphalt Use – Light Duty Parking Facility
POROUS PAVEMENT FOR STORMWATER CONTROL

• Design
• Construction
• Maintenance
POROUS PAVEMENT
Design, Construction, Maintenance

• Components of a porous pavement system
• Performance
• Design considerations
• Constructing a porous pavement system
• Ensuring long life through proper maintenance
POROUS PAVEMENT/RECHARGE BED CONCEPT

EXPOSED AGGREGATE OR DECORATIVE STONE

STORMWATER PASSES THRU POROUS ASPHALT

POROUS ASPHALT PAVEMENT

UNIFORMLY GRADED 2” STONE AGGREGATE WITH 40% VOID SPACE FOR STORMWATER STORAGE AND RECHARGE

FILTER FABRIC LINES THE SUBSURFACE BED

UNCOMPACTED SUBGRADE IS CRITICAL FOR PROPER INFILTRATION

2” #57 STONE TOP FILTER

OHIO RIDES ON US
Highly permeable asphalt surface
Highly permeable asphalt surface
Highly permeable asphalt surface

- **Air Voids:** 17%
- **Permeability:** 352 to 6000 ft/day (soil: 6 in/hr)
- **AASHTO no. 8 size aggregate** (1/2 inch max)
- 100% crushed stone for strength & stability
- **Polymer modified asphalt binder** (6% min)
- **Layer thickness:** 4 to 6 inches
- **Modeled after ODOT SS803** (open graded friction course)
Stone recharge bed / reservoir
Purpose: Stormwater storage and discharge

Depth/thickness of reservoir will depend on design storm event and soil permeability.

Air Voids: 40%

AASHTO no. 2 size aggregate (1 ½ - 2 ½ inch)

100% crushed stone ensures stability

Ensure void structure provides long-term permeability

Stone recharge bed / reservoir
<table>
<thead>
<tr>
<th>Aggregate Size</th>
<th>Voids (Average %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 2 Limestone</td>
<td>41</td>
</tr>
<tr>
<td>No. 4 Limestone</td>
<td>41</td>
</tr>
<tr>
<td>No. 57 Limestone</td>
<td>41</td>
</tr>
<tr>
<td>No. 8 Limestone</td>
<td>42</td>
</tr>
<tr>
<td>No. 7 Limestone</td>
<td>42</td>
</tr>
<tr>
<td>Limestone sand</td>
<td>36</td>
</tr>
</tbody>
</table>

Source: Ohio Aggregates and Industrial Minerals Association
Porous Asphalt Pavement

- Surface Course (1” Thick)
- Base Course (3” Thick)
- Stabilizing Layer
- Stone Recharge Bed / Reservoir
- Filter Fabric
- Uncompacted Subgrade

INCREASING VOID DIMENSION

OHIO RIDES ON US
Stabilizing layer
Purpose: Lock up surface of stone recharge bed / reservoir in preparation for paving

Thickness: approx. 2 inches

AASHTO no. 57 size aggregate (3/4 inch)

100% crushed stone ensures stability

Stabilizing layer
**Geotextile fabric**

**Purpose:** Prevent migration of fines from subgrade or excavation into the pavement structure.

**Material:** ODOT 712.09, Type B
Uncompacted subgrade
Uncompacted subgrade

Purpose: retain soil permeability

Avoid any activities that would result in compacted subgrade

Use excavation equipment that leaves a light footprint.

If necessary, reestablish permeability by scarifying.
POROUS PAVEMENT
Design, Construction, Maintenance

• Components of a porous pavement system
• Performance
• Design considerations
• Constructing a porous pavement system
• Ensuring long life through proper maintenance
Stormwater Quantity Control

- Predevelopment
- Post Development
- Post Development w/ Detention
- Post Development w/ Recharge

Discharge (cfs)

Time Interval (hrs)
Pollutant Removal

- Median Pollutant Removal Efficiency

Infiltration Wetlands Wet Ponds Filtering Swales Dry Ponds
TSS Removal Efficiencies

Source: University of New Hampshire Storm Water Center

- Stone-lined Swale
- Vegetated Swale
- Berm Swale
- Retention Pond
- HDS Systems
- ADS Infiltration
- StormTech Infiltration
- AquafILTER Filtration
- Bioretention
- Tree Filter
- Gravel Wetland

Porous Asphalt

[Graph showing TSS removal efficiencies for various stormwater management practices, with Porous Asphalt highlighted.]
Pavement Longevity

These parking areas are paved with porous pavement.

Since 1977, it has raised the local water table while reducing erosion, pollution, and the need for storm drains or road salt. A brochure is available. A demonstration project by Mass. D.E.P. & Mass. Dem.
Porous Pavement – No maintenance treatments

Dense-graded Pavement – Two maintenance treatments
POROUS PAVEMENT
Design, Construction, Maintenance

- Components of a porous pavement system
- Performance
- **Design considerations**
- Constructing a porous pavement system
- Ensuring long life through proper maintenance
Design Considerations

• Porous pavements can be designed as infiltration OR detention systems
• UNHSC research indicates some infiltration will occur even in low-permeability, clay-like soils.
  – TANK project confirms infiltration occurs in poor draining soil
  – Build in failsafe (e.g. underdrains, catchbasins, etc)
Failsafe
Failsafe
Design Considerations

• Soil bed must be designed to be flat to maximize infiltration area. Step pavement to assure flat surface.
Design Considerations

• Provide a pavement structure that will carry paving equipment without distorting.
  – Avoid thick courses (> 3 inches) of single size aggregate such as no. 57
POROUS PAVEMENT
Design, Construction, Maintenance

• Components of a porous pavement system
• Performance
• Design considerations
• Constructing a porous pavement system
• Ensuring long life through proper maintenance
Constructing a Porous Pavement System

• Build porous pavement last
  – Protect from construction debris
  – Protect from debris laden runoff

• Protect site from heavy equipment
  – Avoid compaction of subgrade by construction equipment

• Excavate to subgrade using soft footprint
Constructing a Porous Pavement System

- Place filter fabric, ensuring fabric extends above excavation to protect pavement until vegetation is established
Constructing a Porous Pavement System

• Compaction of asphalt mixes is crucial to performance
• Asphalt binder content is 6.0 min.

Source: University of New Hampshire Storm Water Center
POROUS PAVEMENT
Design, Construction, Maintenance

• Components of a porous pavement system
• Performance
• Design considerations
• Constructing a porous pavement system
• Ensuring long life through proper maintenance
**LET IT FLOW!**

DO NOT USE SAND OR OTHER ABRASIVES FOR SNOW AND ICE CONTROL

DO NOT PLACE SOIL, MULCH OR OTHER MATERIAL THAT CAN CLOG

REGULARLY SWEEP, VACUUM OR BLOW PAVEMENT TO REMOVE LEAVES, NEEDLES OR OTHER DEBRIS THAT CAN CLOG
Regularly sweep, vacuum or blow pavement to remove leaves, needles or other debris that can clog.
Regularly sweep, vacuum or blow pavement to remove leaves, needles or other debris that can clog.
Snow & Ice

Source: University of New Hampshire Storm Water Center
Resources

Porous Asphalt Pavements

NHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds

Rev. October 2009
Resources

http://www.flexiblepavements.org
Porous Asphalt Use – Light Duty Parking Facility
Porous Asphalt Use – Light Duty Parking Facility

Anna Dean Medical Complex – VASCO Asphalt Co.
Quality Award for Asphalt Paving

Porous Asphalt Parking Facility at Munroe Falls Metro Park
Contractor: Perrin Asphalt
Porous Asphalt Use – Light Duty Parking Facility

Munroe Falls Metro Park – Perrin Asphalt
Questions ?