Pervious Concrete:
Hydrologic Design and Performance

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Pervious Palooza
Westminster, MD
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Keys for success

• The right application
• The right location
• The right design
• The right timing
• The right mix
• The right contractor
• The right owner / operator
## Practitioner stream

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
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</thead>
<tbody>
<tr>
<td>Designer/LA</td>
<td>Subgrade infiltration, Site Design &amp; Layout for Particulate Loading</td>
</tr>
<tr>
<td>Engineer/Geotech</td>
<td>Hydrologic Design &amp; Structural Design, Constructability, Maintenance</td>
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<tr>
<td>General Contractor</td>
<td>Subgrade Compaction, Staging &amp; Clogging</td>
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<td>Demo &amp; Grading</td>
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<tr>
<td>Supplier</td>
<td>Mix-Delivery Time, strength-permeability tradeoff, workability, aggregate</td>
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<tr>
<td>Installer</td>
<td>Off-load time to curing, moisture control, consolidation and hydration</td>
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<td>Inspector</td>
<td>Material testing &amp; water content, critical timing,</td>
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<tr>
<td>Facility Manager</td>
<td>Routine inspection &amp; maintenance, Clogging, Winter Maintenance</td>
</tr>
</tbody>
</table>
Specifications

Beyond Hydrologic and Structural design

- ACI 522.1-13 – spec (ACI 522R-15)

- Materials – Mix Proportions
- Performance (e.g. 400 in/hr)
- Constructability Analysis
- Testing: ASTM 1688 ASTM 1701
- NRMCA Contractor Certification
- Test Panels – acceptance and reference
- Maximum Mix (60* min) and Install (20 min) Timing
- Weather Extremes: Misting, Moisture & Insulating Blankets
- Inspection and Maintenance
- Winter Maintenance
- ASTM tests - in progress
Site Design

Butt joint to flexible pavement

Jointing

Run-on

Infiltration testing at subgrade
Hydrologic Design:
Freeze Thaw &
Drawdown

Overdrain to Minimize Pavement Saturation

Underdrain to Provide Positive Drainage & Drawdown

Table 5.5 Effective RCNs for Permeable Pavements

<table>
<thead>
<tr>
<th>Subbase</th>
<th>Hydrologic Soil Group</th>
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<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>6”</td>
<td>76(^1)</td>
</tr>
<tr>
<td>9”</td>
<td>62(^2)</td>
</tr>
<tr>
<td>12”</td>
<td>40</td>
</tr>
</tbody>
</table>

\(^1\) Design shall include 1 - 2” min. overdrain (inv. 2” below pavement base) per 750 s.f. of pavement area.
\(^2\) Design shall include 1 - 2” min. overdrain (inv. 2” below pavement base) per 600 s.f. of pavement area.
\(^3\) Design shall include 1 - 3” min. overdrain (inv. 3” below pavement base) and a ½” underdrain at subbase invert.
Hydrologic Design at Work

1. MTA Park and Ride – 550 parking spaces 1.77 acres pervious concrete

Section

Pervious Concrete: 8"

#57 Stone: 4 inches to drain invert, 12 inch total.
#2 Stone: ≥ 12 inches
Sand: 6 inches

Storage below invert: 6.6"

Storage (porosity)

1.6” (20%)  
1.2” (30%) + 2.4” (30%) above invert
3.6” (30%)  
1.8” (30%)

24hr-25 year storm: 6.28”
24hr-100 year storm: 8.65”

With subgrade infiltration of 0.5 in/hr section captures and infiltrates the 100 year storm – zero discharge!

Peak wse 1.57 feet
Hydrologic Design at Work

2. PA Pervious Concrete Sidewalk Design
Proposed design:
- 520 s.f. pavement
- 5,700 s.f. contributing drainage (run-on)
- 24 inch subbase
- Total DA = 6,220 s.f.
- 0.5 in/hr exfiltration

Fails Freeze-Thaw: 1.2 inch storm saturates pavement

Contrast with No Run-on:
DA = IA 1.5’ subbase fully infiltrates 8.5 inch storm!

3. Pervious Alley
Proposed design:
- 1,000 s.f. pavers
- 10,000 s.f. contributing drainage (CN=95)
- 48 inch subbase
- 8-inch underdrain
- minimal exfiltration

DA:IA = 10:1

Exfiltration 0.1 in/hr: ECN 93
Exfiltration 0.52 in/hr ECN 86
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• Weather Extremes: Misting, Moisture & Insulating Blankets
• Inspection and Maintenance
• ASTM tests - in progress
Fresh Density
ASTM 1688 ±5 lbs

Standard Test Method for Density and Void Content of *Hardened* Pervious Concrete:
ASTM 1754

Surface Infiltration
ASTM 1701
Specifications

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• **Inspection and Maintenance**
• ASTM tests - in progress
Inspection and maintenance

Inspection – condition assessment

After pressure washing
Condition-based Maintenance

- Clogging & Maintenance Effectiveness
White Oak Community Center Pervious Concrete Parking Lot

Monitoring Well
Laid out Delatte Infiltrometers and water jugs
Tests were GPS Referenced
Tests were given a “Leakage” classification from 1-3, depending on the size of the wetted footprint after the test. Leakage can indicate sealing/poor performance.

Class 1 – very little/no leakage. Wetted footprint is no larger than the device used.

Class 2 – some leakage. Wetted footprint is slightly larger than the device used.

Class 3 – severe leakage. Wetted footprint is significantly larger than the device used.
Baseline Infiltration Map – White Oak Community Center

215 GPS referenced drawdown tests

Fast
8-15 sec.

>100 sec
Slow
Long drawdown time with significant leakage = clogged pavement
sweeper and vacuum truck

Pressure Washing + Vacuum
Short drawdown time with no significant leakage = Restored pavement
Winter Maintenance

Polyurethane Plow Blades

De-icing Chemicals Ineffective
Subprime BMPs

- Site Layout
- Hydrologic Design
- Infiltration testing
- Construction without stormwater design!
- Craftsmanship
- Inspection and Maintenance Plan
- Winter maintenance

Align knowledge and practice across project team

Rich Opportunities - High Stakes!
Conclusion

Proven Reliable Green Infrastructure Technologies

Avoid Sub-Prime BMPs!!!!!!

End-to-End Integration of Knowledge & Expertise across the communities of practice

Raise our Game – to reliably get the outcomes we want
Thanks!

Questions?