Pervious Pavers: Where is the Perviousness?

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USEPA Stormwater Phase II
Post-Construction Runoff Control
Minimum Control Measure

BMPS Include:

- Non-structural
  - Planning / zoning around sensitive areas
  - Site-based minimization of disturbance

- Structural
  - Retention / detention
  - Infiltration
  - Vegetative
Pervious Pavement Types

- Porous concrete
- Grass pavers
- Gravel pavers
- Permeable interlocking concrete pavers
- Bricks
- Concrete grid pavers
- Recycled chipped tire surface...
Causes of Decreased Infiltration Rates in Pervious Paver Systems

Clogging by:

- Silt and clay
- Organic matter
- Oil and grease
- Wear of paver

Proximity to erodible surfaces
Proximity to landscaping
High traffic counts
Improper material
Previous Research

✦ Infiltration rates of permeable paver systems may be significantly improved by performing maintenance. (Bean et al., 2007)

✦ In some cases, maintenance can return paver system to original infiltration rate. (Balades et al., 1995;)

✦ Removal of top 15-25 mm and backfill with clean sand to original grade. (Gerrits and James, 2002)

Maintenance of Pervious Paver Block Systems

Maintenance Methods

- Vacuum
- Vacuum Sweep
- Sweep
- Powerwash
- Powerwash with Suction
Objectives

- Evaluate changes in runoff and infiltration rates from two paver block systems receiving runon from an erodible surface under repeated rainfall events.

- Determine the importance of infiltration in paver blocks themselves vs infiltration in the spaces between them.
Example Pervious Paver Schematic

Adapted from: Interlocking Concrete Pavement Institute
Residential Driveway
http://icpi.org
Schematic of Experimental Apparatus

Silt loam
$\theta_v = 18\%$
BD 1.2 g/cm$^3$
Paver Boxes

Small Block (18.0 x 10.0 x 4.0 cm)

Large Block (22.5 x 15.0 x 5.5 cm)
Rainfall Simulation

- 11 rainfall events
- 30 mm/hr for 60 min
- 5-yr return period
- 24-72 hrs between events

Timed Samples
- Surface Run-on
- Surface Runoff
- Deep Infiltration (20cm)
- Rainfall Rate
Run-on Water Rate (mm/hr)

Run-on Sediment Rate (g/min)

Time (min)
Sedimentation of Paver Surface

Before Rain

After Rain
Steady State Deep Infiltration Rates

$y = -\ln x + b$

$R^2 = 0.99$

$R^2 = 0.91$
Steady State Runoff Rates

\[ Y = \ln(x) + b \]

- Impermeable Block
- Impermeable Block 95% Confidence
- Permeable Block
- Permeable Block 95% Confidence

R^2 = 0.98
R^2 = 0.93
Paver Infiltration Tests

Mariotte Bottle

Constant Head 7.6 cm

Plumber’s Putty 8 mm

Single Paver

Collection Bottle
## Paver Infiltration Tests

<table>
<thead>
<tr>
<th>Paver Type</th>
<th>Average Steady State Infiltration Rate (cm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permeable Block</td>
<td></td>
</tr>
<tr>
<td>“Before Rain”</td>
<td>145.5</td>
</tr>
<tr>
<td>Permeable Block</td>
<td></td>
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<tr>
<td>“After Rain and Sweeping”</td>
<td>1.4</td>
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<tr>
<td>Impermeable Block</td>
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<tr>
<td>“Before Rain”</td>
<td>&lt;0.01</td>
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</tbody>
</table>
Conclusions

- Measured deep infiltration rates of pervious paver block systems were shown to decrease from 87% to 3% of total water input when receiving precipitation and run-on from an erodible surface.

- Maintenance may not be effective in restoring infiltration rates of individual paver blocks.
  - Infiltration is most important in the open spaces between paver blocks.
  - The benefit of using a permeable paver block over using a more durable impermeable paver block is questionable.

- There may be implications to applicability of porous concrete?
Thank You

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