Stormwater Management with Pervious Concrete Pavement

CA Dept. Water Resources
January 2010
What is Pervious Concrete?

- 15-25% Void Space
- Also Called No-fines Concrete
Pervious Concrete

Pavement Passes:

• 3 - 10 gallons per minute per sq. ft.

= 6,000 to 20,000 inches per day!!!
Basic Ingredients

- Cement
- Coarse Aggregate
- Water
- No Sand
- Admixtures
Texture Comparison
Pervious Concrete is Not New!

In use as pavement in the US for over 30 years!

- Initial US applications were in Florida
- FL/GA/WA/OR initial applications were for flood control
- 1987 Clean Water Act and NPDES brought pervious concrete into use for control of urban runoff
- Several large applications in California that are over 6 years old and performing well
- Large number of parking areas in Florida which are 20-30 years old
Why use Pervious Concrete?
stormwater plume
Run-off Issues

Jay Manning, Dir. Washington, Dept. of Ecology

“Based on actual sampling in the Puget Sound basin, we have estimated that the volume of oil that is carried into Puget Sound by stormwater run off is equal to the oil spill in Prince William Sound that the Exxon Valdez spilled.

Every two years, the stormwater in Puget Sound carries that volume of oil into Puget Sound.”
EPA Stormwater Regulations

- EPA Stormwater Phase II Regulations
- Cities greater than 50,000 must manage stormwater
- Limit amount of stormwater that can leave a building site
- Pervious pavement is a Best Management Practice (BMP)
Signed into Federal Law 12-19-07

SEC. 438. STORM WATER RUNOFF REQUIREMENTS FOR FEDERAL DEVELOPMENT PROJECTS:

“The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.”
Stormwater may be Polluted

- Oils and Grease
- Metals
- Sediments
- Fertilizers
Pollution Treatment

- About 90% of the surface pollutants are carried off by the first ½-inch to 1-inch of rainfall (first flush)
- First flush passes through pavement into soil
- Soil filters and treats rainfall
- Rainfall is spread over entire parking area (instead of detention pond)

**Hydrocarbons are treated by filtration and microbial conversion**
Detention Pond is under the pavement
Solution to Stormwater Management

Diagram showing the layers of a stormwater management system:
- Stormwater In
- Pervious Concrete Pavement
- Aggregate Base
- Stormwater Out
- Subgrade
Capture the water...

- To save energy
- Keep it where it falls (rain or snow)
- Allow Infill development (SB 375)
- Financial benefits:
  - Incentives and rebates by water agencies
  - SB 790 incentives
Why?.....Sustainability

- Low-Impact Development
- Pollution Treatment
- Recharging Groundwater
- Tree Protection
- LEED Requirements
- Cool Communities
Low Impact Development

Pre-Development

Post-Development

Low-Impact Development
Protects Trees

Can pave within the drip line
Water and air filters to roots
Tree protection
Meets LEED Requirements

- Reduce stormwater runoff
- Use Recycled Materials
- Use Regional Materials
- Reduce urban heat islands
Design Considerations
Pavement Thickness

Suggested Minimums
- 6” Parking lots
- 6” Residential Driveways
- 8” Streets
- 8” Commercial Driveways

Heavy truck traffic
- 10”in lifts

High volume traffic
- consider conventional concrete or a hybrid
# Pavement Thickness is Volume Based

<table>
<thead>
<tr>
<th>Material</th>
<th>Pathways &amp; Sidewalks</th>
<th>0-20 ADTT</th>
<th>20-100 ADTT</th>
<th>100+ ADTT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sandy</strong></td>
<td>4” on native</td>
<td>6” on native</td>
<td>8” on native</td>
<td>10” on native</td>
</tr>
<tr>
<td><strong>Silty w/ low clay</strong></td>
<td>4” on 3-6” drain rock with filter fabric</td>
<td>6” on 3-6” drain rock with filter fabric</td>
<td>8” on 3-6” drain rock with filter fabric</td>
<td>10” on 3-6” drain rock with filter fabric</td>
</tr>
<tr>
<td><strong>Moderate clay</strong></td>
<td>4” on 6-12” drain rock with filter fabric</td>
<td>6” on 6-12” drain rock with filter fabric</td>
<td>0” on 6-12” drain rock with filter fabric</td>
<td>10” on 6-12” drain rock with filter fabric</td>
</tr>
<tr>
<td><strong>Heavy clay</strong></td>
<td>4” on 12” drain rock with filter fabric</td>
<td>6” on 12” drain rock with filter fabric and (optional) Darcy Columns</td>
<td>8” on 12” drain rock with filter fabric and (optional) Darcy Columns</td>
<td>10” on 12” drain rock with filter fabric and (optional) Darcy Columns</td>
</tr>
</tbody>
</table>
When Pervious Concrete Abuts Existing Pavement

- **Existing Asphalt or Concrete**
- **3/4” or 1” drain rock at 6” thick**
- **Subgrade**
- **Pervious Concrete at 6” thick**
- **Water barrier of 24” wide thick visqueen run down the 12” deep excavation and 12” under the drain rock**
Freeze Thaw

Pervious concrete has been used in freeze thaw environments in the US for over 15 years

- Air entrain the cement paste
- Ideally use larger aggregate (1/2” x 3/8” minimum)
- Place on 6-12 inches of drain rock (3/4” or larger clean crushed rock)
- Surface compaction critical to obtain snow-plow durability
- Nearly 100 installations in the Lake Tahoe basin
- Safeway parking area in Denver
- Approved by TRPA (Tahoe Regional Planning Agency) as an infiltration BMP
Limit Potential for Total Saturation of Slab

Freeze-Thaw Durability
What A Difference!
The Next Morning After a Twelve Inch Snowstorm

Pervious concrete in Denver at the Safeway Shopping Center

The conventional asphalt parking lot across the street
Conventional Asphalt Pavement
(Across The Street – **NOT** Part of the Project)

Elev. 6500 Ft.
ARD Building
Northern Arizona Univ.
Flagstaff, Ariz.
11-30-06
Pervious Concrete Pavement
(Contributing as part of the Project Certification)

Elev. 6500 Ft.
ARD Building
Northern Arizona Univ.
Flagstaff, Ariz.
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Platinum
Chicago’s Green Alleys

This LID uses high albedo concrete which is safer and not slippery.
Getting it right..
Understand Total Site Layout

- Where is the pervious proposed?
- Capture impervious surfaces?
- Landscaping or building runoff?
- Drainage Release?
Specifications

• Utilize locally available guide specs
  – PSCA
  – NRMCA
  – ACI 522

• Insist on the following...
Qualified Contractor

- NRMCA Certification required
- Previous successful installations
- Test panels on job site
- Mix design submittals
Text reference for

Pervious Concrete Contractor Certification

NRMCA Publication #2PPCRT
Where to use Pervious Concrete
SIDEWALKS AND PATHWAYS

Seattle, WA

Olympia, WA

Sacramento, CA

San Francisco

Fair Oaks, CA

Monterey Country Club
Stevens Creek Trail
Coloring Pervious Concrete

...because protecting the environment should be beautiful.
Colored pervious concrete
Large Pedestrian Area

Figure 3. A porous concrete infiltration facility was constructed over one of Villanova University’s high-pedestrian-traffic areas.
Along Mississippi River – Minneapolis Metro
PARKING LOTS

Kings Beach Placer County, CA

Cerritos, CA

Menlo Park, CA

Petaluma, CA
Conventional vs Pervious
Fresno – stamped pervious concrete mixed with stamped decorative conventional concrete.
Ocean Honda, Soquel
Park & Ride Parking Lot (4 acres)

Prime Outlets – Williamsburg, VA
Re-Const. & Expansion
Major Factory Outlet Mall - 120 stores
(Completed Apr, 2008)

- 7.6 acres - Pervious Concrete
- 3.5 acres - Conventional Concrete
Prime Outlets – Williamsburg, VA

**Water Harvesting**
Infiltration system design included underground stormwater chambers for nearby irrigation
Pervious Concrete Parking Stalls
Conventional Concrete Drive Lanes
20 year old retention pond behind the mall
Former Detention Pond

Filled with Porous Load-Bearing Crates
Former Detention Pond

Granular Base Over Load-Bearing Crates
How many cars/trucks can you park on YOUR Detention Pond?

On This Project - 419
STREETS

Oakland, CA

Sacramento, CA

Portland, OR

Sultan, WA
City of Shoreview, MN
2009 Street Reconstruction Project
Woodbridge Neighborhood

Purposes

1. Low Volume Traffic
2. “Replacement” of Traditional Storm Sewer System
3. Control stormwater runoff & recharge groundwater
4. Stormwater Filtration (first flush pollutants)
City of Shoreview, MN
2009 Street Reconstruction Project
Woodbridge Neighborhood

Pavement approx. 1 mile long / 79,000 SF
CMI Homes in Sultan, WA

Extra lots and savings in stormwater management provided savings of $250,000 to CMI
Wildrose Ave. and Laurel Dr.
Marine Mammal Center, Marin Headlands
Pervious Concrete

Filters Water in Excess of 270 Inches per Hr.
Why Pervious Concrete?

• Saves Money for Agencies:
  – Eliminate upgrading of overburdened storm sewer systems
  – Reduce stormwater runoff monitoring requirements
  – Recharge groundwater to extend the lifetime of aquifer water sources
The Goal
Pervious Concrete:

- The right choice for today and tomorrow!

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