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## WSU & Puget Sound Partnership Permeable Pavement Workshop **Inspection and Verification for Porous Pavements**

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April 2012

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# Topics of Discussion

- Pre construction
  - Installer Pre-qualifications
- Construction
  - Timing & Sequencing
  - TESC Measures
- Inspection
  - QA Testing
  - Specific inspection issues related to various materials
- Remedies for Failing Sites



# Installer Pre-qualifications

- TEST PANEL required.
  - May require multiple test panels for new installers.
  - If unable to install test panel, recommend they provide at least 3 examples of previous installations by crew done at locations nearby. Include mix design & test results.
- Installers and Supplier Certification required.
  - Pervious Concrete : Require installers to have National Ready Mixed Concrete Association’s Pervious Concrete “Installer” Certification (NRMCA). Local contact: Bruce Chattin with WACA. NRMCA is working on certification for suppliers or they could have NRMCA “Technician” Certification.
  - If crew has no certification, then require contractor to hire a construction consultant with NRMCA Craftsman certification (extensive porous pavement installation experience) to oversee installation.
  - Training by Manufacturer Rep. and/or require Manufacturer Rep. to be present for installation for proprietary products.
- Recommend at least 2-3 persons per crew have minimum certification.



# Timing & Sequencing – Planning Ahead

- Equipment access
- Different methods depending upon location on the site
- Sequencing of work
- Isolate area if possible



School in Medina, WA



# Timing and Sequencing – Equipment Access



La Center Parking Lot, Washington

[www.lcrep.org/fieldguide/examples/permeablepavers.htm](http://www.lcrep.org/fieldguide/examples/permeablepavers.htm)

# Timing & Sequencing



- Public Access
- Stabilize adjacent areas
- Temporary surface?
- Timing of when to excavate to native subgrade



# Install & Maintain TESC Measures during Construction



## Options:

- Timing and Sequencing / Install porous pavement at end of project?
- Cover and seal pavement surface (plastic and geotextile)
- Reroute flow around installed porous pavements until areas are stabilized
- Inform workers and other subcontractors of protection
- Fix: Redo work
- Other?

# Protect area from other construction activity



Patching due to footprint indentation.





# Inspectors

- PRE-precon with Inspectors to inform them of special issues related to porous pavement
- If possible, have Inspectors attend an installation training by manufacturer, industry (NRMCA), etc.
- Provide inspection checklists and discuss intent with staff
- Several agencies now have standard construction / plan reviewer checklists on their websites

# General Inspection Checklist – Sample items to include

- ✓ Installer certification
- ✓ Install Test Panel or review previous installations by crew
- ✓ TESC and Flow Diversion in place prior to excavation
- ✓ Material meets specifications and submittal?
  - ✓ Mix Design
  - ✓ Subbase
  - ✓ Geotextile (?)
- ✓ Subgrade free of sediment/fine deposits during construction (perform final 12” excavation until time for placement of full pavement section)
- ✓ Infiltration Testing of exposed subgrade prep
- ✓ Geotextile (if required) overlap and secure
- ✓ Subbase protected from sediment/fines from construction stormwater
- ✓ TESC and flow diversion measures are being maintained throughout construction until adjacent areas are stabilized

# General Post Installation QA Testing

- Field infiltration tests upon completion of paving section.
  - 18” cylinder & measure time it takes water to infiltrate
  - ASTM C1701-Standard Test Method for Infiltration Rate of In Place Pervious Concrete
  - Or Pressure Wash Test
- Depth of Section (check in field)
- Dry Unit Weight (cores for pervious concrete, ACI 522)



# Post Installation Observation review of Pervious Concrete and Porous Asphalt

- Uniform Finish vs. Excessive Sealing
- Some factors that affect/cause sealing:
  - Method of installation
  - Mix non-uniform (paste not thoroughly mixed)



Porous Uniform Finish



Porous Non-Uniform Finish

# Post Installation Observation review of Pervious Concrete and Porous Asphalt

- Uniform Finish vs. Excessive Raveling
- Factors that can affect/cause raveling:
  - Non-continuous protective cover during curing
  - Too Dry Mix (cement concrete)
  - Weather (Temp and Wind)
  - Loading pavement not as intended. (Using as construction entrance)



Pavement was placed early and used as a construction entrance for concrete deliveries.



Pavement being covered immediately as it's being placed to hold moisture in for curing.

# Pervious Concrete Pavement Joint Inspection



Sawcut joint (~1/5")

- Joints? or no Joints?
- Further spacing? Or follow conventional?
- No dowels or keyways
- Sawcut vs. Tooled joints
  - Pros & cons
- Keep width narrow otherwise can become a maintenance issue
- Pave up to castings vs. concrete pad
- Geotextile in lieu of premolded joint filler.



Too wide tooled joint



Longview, WA public road



Parking lot, Vancouver, WA

# Open Celled Paving Grids/Interlocking pavers

- Follow manufacturer testing and installation guidelines
- Plastic Geocells: Staking per manufacturer?
- Prefab interlocking pavers – Right side up?

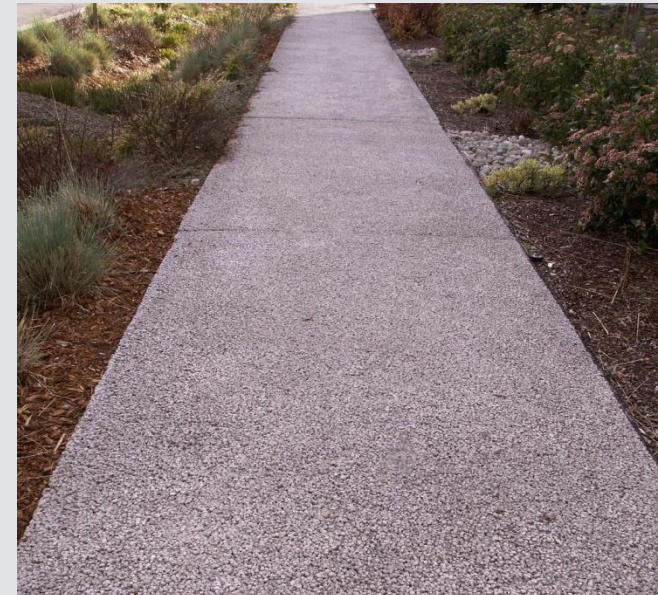


# Prevention for failing installations

- Determine reason for failure
  - Design?
  - Materials?
  - Installation?
  - Maintenance?
  - Unknown condition?
- Preventive measures
  - Preplanning & Precon
  - Test Panel Practice
  - Timing & Sequencing
  - TESC and Flow Diversion
  - Request CA services for construction
  - Research issues/Lesson learned
  - OTHER?
- Remedies?
  - What are the impacts?
  - Leave as is or repair required?
  - Learn from experience and implement measures to avoid repeating history
  - Inform other designers, manufacturer reps of issues learned



Above Photo: Used not as intended. Maintenance vehicles drove over walkway in park.





# Resources (1 of 2)

- American Concrete Institute's Specification for Pervious Concrete Pavement 522.1-08  
<http://www.concrete.org/general/home.asp>
- National Ready Mixed Concrete Association Pervious Concrete Publications  
[www.nrmca.org](http://www.nrmca.org)
- "Freeze Thaw Resistance of Pervious Concrete," National Ready Mixed Concrete Association, May 2004. [www.nrmca.org](http://www.nrmca.org)
- "Pervious Concrete Contractor Certification," National Ready Mixed Concrete Association, August 2005. [www.nrmca.org](http://www.nrmca.org)
- City of Seattle Department of Planning and Development Client Assistance Memo #515. <http://www.ci.seattle.wa.us/dclu/Publications/cam/CAM515.pdf>
- LID Technical Guidance Manual for Puget Sound,  
[http://www.psat.wa.gov/Publications/LID\\_tech\\_manual05/lid\\_index.htm](http://www.psat.wa.gov/Publications/LID_tech_manual05/lid_index.htm)
- Lower Columbia River Field Guide to Water Quality Friendly Development  
<http://www.lcrep.org/fieldguide/examples/permeablepavers.htm>
- City of Olympia  
[www.olympiawa.gov/cityutilities/stormwater/scienceandinnovations/porouspavement.htm](http://www.olympiawa.gov/cityutilities/stormwater/scienceandinnovations/porouspavement.htm)
- Delatte, Norbert, Dan Miller of Cleveland State University "Portland Cement Pervious Concrete Pavement: Field performance Investigation on Parking Lot and Roadway pavements, Final Report" to RMC Research & Education, December 1, 2007.
- Dierkes, Carsten, Lothar Kuhlmann, Jaya Kandasamy, George Angelis. Abstract: "Pollution Retention Capability and Maintenance of Permeable Pavements". Presented at Global Solutions for Urban Drainage: 9th International Conference on Urban Drainage. Portland, OR. September 2002.

## Resources (2 of 2)

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- “Porous Pavements,” by Bruce K. Ferguson, Taylor & Francis Group, 2005.
- “Pervious Concrete Pavement” by Paul D. Tennis, Michael L. Leming and David J. Akers and Portland Cement Association and National Ready Mixed Concrete Association, 2004.
- “NC State University Permeable Pavement Research: Water Quality, Water Quantity, and Clogging,” Eban Z. Bean, EL, PhD Candidate and William F. Hunt, PhD, PE, NWQEP Notes, North Carolina State University, Number 119, November 2005.
- “Long-Term Stormwater Quantity and Quality Performance of Permeable Pavement Systems,” by Benjamin O. Brattebo and Derek B. Booth, July 1, 2003, Center for Water and Watershed Studies, Department of Civil and Environmental Engineering, University of Washington at <http://depts.washington.edu/cwws/Research/Reports/permeableparking.pdf>
- La Center Parking Lot, <http://www.uni-groupusa.org/PDF/La%20Center.pdf>
- Pervious pavement in cold climates: <http://www.perviouspavement.org/asphalt%20vs.concrete.htm>
- SvR Design Company [www.svrdesign.com](http://www.svrdesign.com)



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Question & Answers

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