

Permeable Interlocking Concrete Pavement "PICP"



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Content:

Available information
and resources

System Components

- Pavers
- Aggregates
- Edge Restraints
- Geotextiles

Design Options

- PICP Sections

Installation

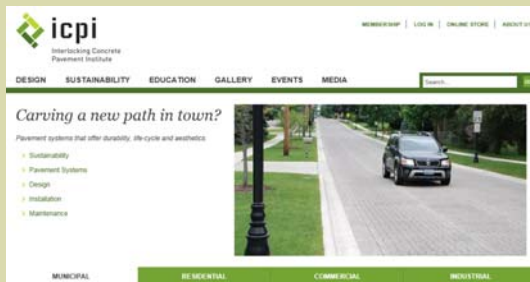
Maintenance

Cost

Case Studies, Project Photos



Technical Assistance



www.icpi.org



PICP 'Design Manual'
- Fourth edition

- Design
- Specifications
- Construction
- Maintenance

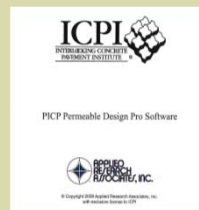




**PICP Permeable Design Pro
Design Software**

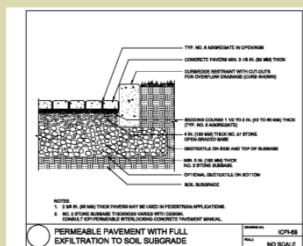
Balances system performance

- Structural support
- Hydraulic capacity





Design Details
Guide Specifications
Videos
Technical Research
Papers

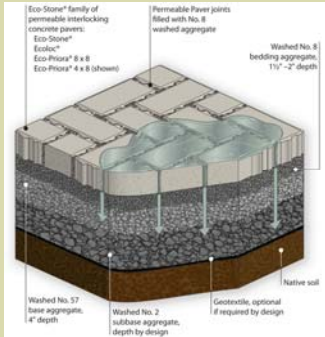


Additional resource for product information:



www.uni-groupusa.org

Permeable Interlocking Concrete Pavement (PICP)



PICP Product Standards

PICP pavers meet ASTM C 936:

"Standard Specification for Solid Concrete Interlocking Paving Units," (same as impermeable standard pavers):

- Minimum Compressive Strength = 8,000 psi
- Maximum Absorption = 5%
- Freeze-thaw durability per ASTM C 1645
- Aspect ratio (length:thickness) guidelines apply -
 - 4:1 pedestrian only
 - 3:1 to 4:1 for residential driveways
 - 3:1 or less for all vehicular areas

Typical Paver Shapes for PICP

Drainage joints



Drainage 'features' or shape

PICP Aggregates

Free-draining (open graded) aggregates comply with the requirements of ASTM D 448:

- Paver Joint fill
 - No. 8 aggregate, (#16 to 1/2" sieve)
- Bedding course
 - No. 8 aggregate, (#16 to 1/2" sieve)
- Base material
 - No. 57 aggregate, (#8 to 1-1/2" sieve)
- Subbase material
 - No. 2 stone, (3" to 3/4" sieve)

PICP Aggregates

In addition to gradation requirements:

- Crushed stone
 - 90% fractured faces
 - Do not use rounded river rock!
- Hard, durable material
 - LA Abrasion < 40 per ASTM C131, min. CBR of 80% per ASTM D1883
- No fines
 - Less than 2% passing the #200 sieve

PICP Aggregates

When project conditions require, or when recommended aggregates are not available:

Table 3-5. Filter criteria for PICP bedding, base and subbase aggregates

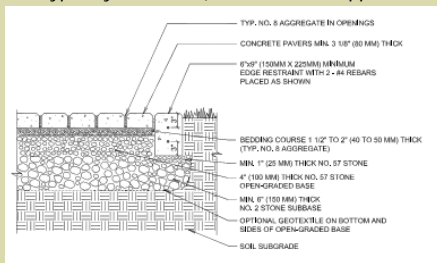
Permeability	$D_{15} \text{ Base}/D_{15} \text{ Bedding layer} >5$
Choke	$D_{50} \text{ Base}/D_{50} \text{ Bedding layer} <25$
	$D_{15} \text{ Base}/D_{85} \text{ Bedding layer} <5$

Permeability	$D_{15} \text{ Subbase}/D_{15} \text{ Base} >5$
Choke	$D_{50} \text{ Subbase}/D_{50} \text{ Base} <25$
	$D_{15} \text{ Subbase}/D_{85} \text{ Base} <5$

Source: David R. Smith, *Permeable Interlocking Concrete Pavements*, 4th edition, pg. 41

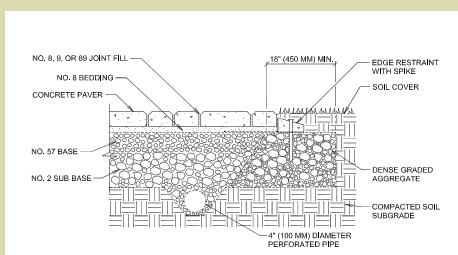
PICP Edge Restraints

- Suitable for loading conditions
 - Typically concrete (all commercial applications)



PICP Edge Restraints

Plastic & metal “staked” edging is suitable for residential applications. Use dense graded base under edging only:



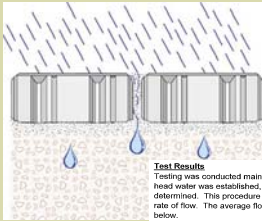
Geotextiles

- Option of the design engineer
- Non-woven recommended (high water flow)
- AASHTO M-288 provides minimum requirements
- AOS selection criteria in P1C1P manual
- Or use manufacturer's recommendations
- Place on sides & bottom
- Minimum overlap 12 in. (0.3 m)
- Poor soils overlap 24 in. (0.6 m)
- AASHTO M-288
 - Tables 1 & 2: Strength & Subsurface Drainage Geotextile Requirements

-
-
-
-
-
-



Surface Infiltration Rates



Uni Eco-Priora® pavers
 8 x 8 (200X200mm)
 3/8" (10mm) Joint
 Infiltration Rate > 15 in/hr
 after 10 years

Test Results

Testing was conducted maintaining three levels of head water above the pavers. The level of head water was established, maintained for a minimum of 30 seconds, and the rate of flow was determined. This procedure was performed multiple times at each level to verify a consistent rate of flow. The average flow rate at each level was determined and is reported in the table below.

Head Water (Inches)	Rate of Flow (Inches per hour)
0.5	105
1.0	140
2.0	181



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 Senior Geotechnical Engineer

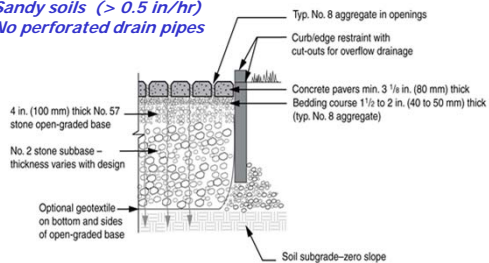
PICP Design Basics: Exfiltration Options

- **Full Exfiltration**
- **Partial Exfiltration**
- **No Exfiltration**

PICP Design Basics: Exfiltration Options

Full Exfiltration

Sandy soils (> 0.5 in/hr)
No perforated drain pipes

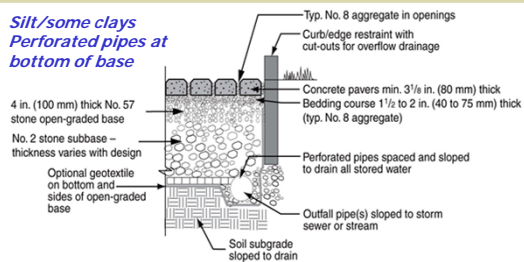




PICP Design Basics: Exfiltration Options

Partial Exfiltration - detention & exfiltration

Silt/some clays
Perforated pipes at bottom of base

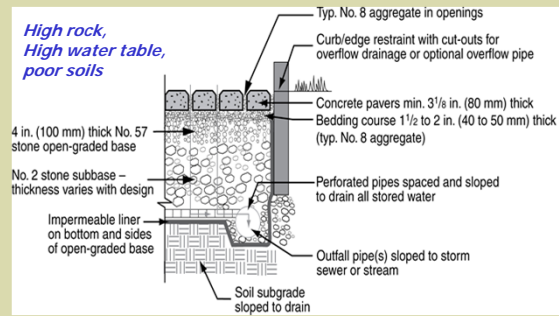




PICP Design Basics: Exfiltration Options

No Exfiltration - detention only

*High rock,
High water table,
poor soils*







Impermeable EPDM (or equivalent) liner

Use 'No Exfiltration' design when....

- Near water supply wells (100 ft)
- High water table (3 ft)
- High depth of bedrock
- Some fills & expansive soils
- Contain potential contaminants from entering soils & groundwater
- Rainwater harvesting

PICP Installation

- During excavation, do not compact native soil
- Compacted soil is 30 to 90% *less* permeable than un-compacted soil



Keep delivery trucks off of native soil, if at all possible

Spreading Base Material – “back-dumping”

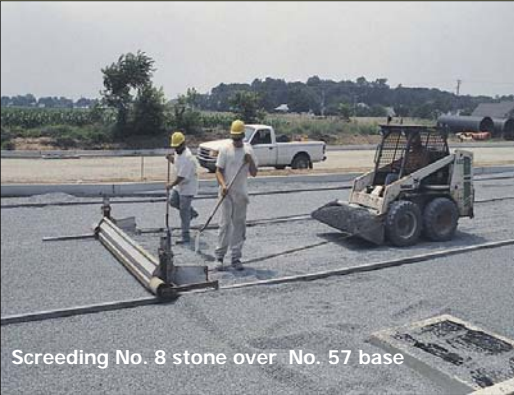




Final grading of base material



Compacting base material



Screeding No. 8 stone over No. 57 base



Mechanical Installation

Mechanical installation of PICP can decrease construction time 20-80% over manual installation

Manual paver installation:

approx 1,000 sq. ft. per man per day

Mechanical paver installation:

3,000 – 10,000 sq. ft. per machine per day

Edge pavers cut and placed, then compacted



Compact before sweeping in aggregate



Filling the openings with No. 8 stone, final compaction

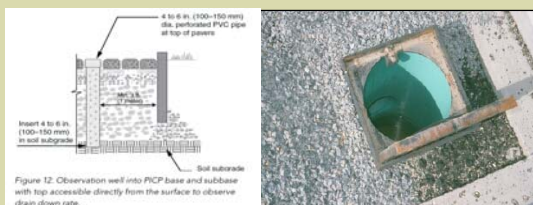






Observation well:

- Install at lowest point of pavement
- Min. 6 in. dia. perf. pipe w/cap
- Monitor drainage rate, sediment, water quality, temperature



Maintenance

Annually: overall system performance inspection,
check observation well , inspect after major
storm, vacuum surface (once, twice, or more)
to ensure optimum design life performance

Maintenance checklist (specific to each project)

Model maintenance agreement

Monitor adjacent uses



PICP Inspection Checklist

Vacuum surface	<i>1 to 2 times annually, adjust for sediment loading</i>
Replenish aggregate in joints	<i>As needed</i>
Inspect vegetation around PICP perimeter for cover & stability	<i>Annually, repair/replant as needed</i>
Check drain outfalls for free flow of water and outflow from observation well	<i>Annually and/or after a major storm event</i>

PICP Maintenance



Sweeper Effectiveness

Best: Vacuum sweeper
(no water)

OK: Regenerative air
(broom) sweeper
(no water)

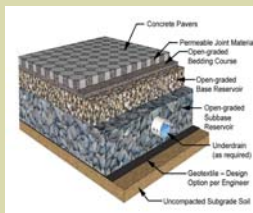


Vacuum essential as brush
bristles clean ~ 1/4 in. into surface



Maintenance





Cost

Furnished and Installed:
\$5.80 to \$14.25 *per sq ft*

Includes:

- Pavers placed, cut, compacted, & swept-
- 2" of ASTM #8 Bedding Aggregate-
- 4" of ASTM #57 Base Aggregate

Case Studies & Project Profiles

JORDAN COVE URBAN WATERSHED STUDY



Port of New York and New Jersey





Tacoma Community College



















Lynwood Residence





Medina Development in Spanaway



Medina Development in Spanaway



The Bridge Tacoma, WA



Lowes / Safeway in Lacey, WA



City of La Center, WA

City of La Center, WA



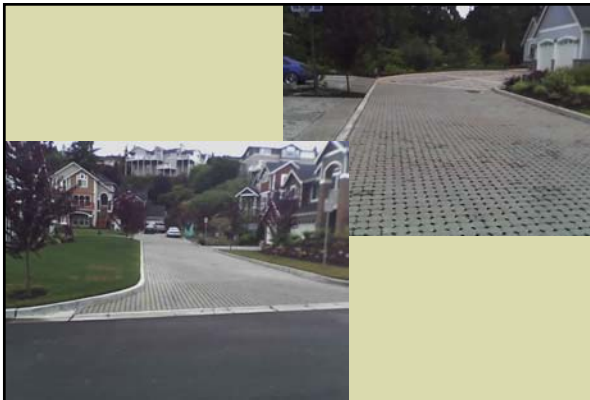
Marysville, WA Park & Ride







Railway Museum Restoration, Snoqualmie, WA



Holbrook Ave Everett, WA



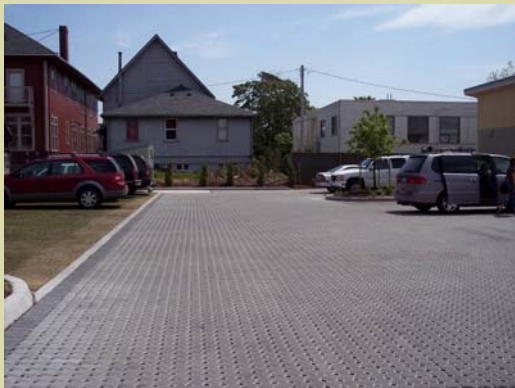
Westlake Union



Tacoma Landfill Pervious Pave Demo



Mutual Materials Branch, Vancouver, WA



Pediatric Dental Clinic, Bellingham, WA



Railroad Avenue, Bellingham, WA



Vineyard Lanes, Bainbridge Island



River Front Trail Puyallup, WA



Highpoint Development W. Seattle



South Lake Union Street Car Facility



West Seattle Mix Use Building



Columbia City Live Above, Seattle, WA



Union Station, Marysville, WA



Twin County Credit Union, Lacey, WA



Wastewater Treatment Plant, Winlock, WA



Prairie Line Trail, Yelm, WA



Wedge Park Fife, WA

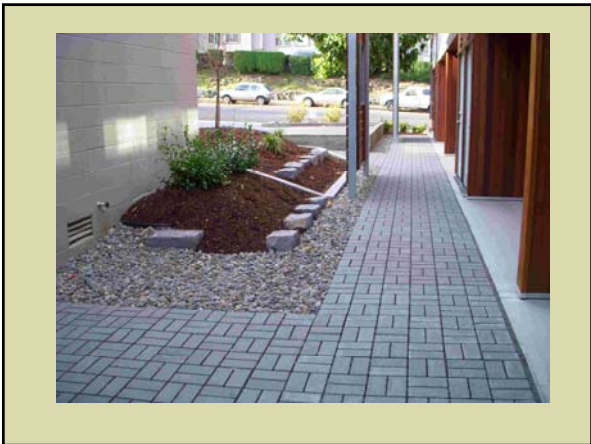






















Thank you!

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