Pervious Concrete Pavements

The Answer for Storm Water Runoff Control

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What is Pervious Concrete?

- A No-Fines Concrete Mix
  - Coarse Aggregate
  - Portland Cement
  - Water
- Intended for use as an open-graded drainage material

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Why Pervious Concrete?

- The EPA Storm Water Phase II Final Rule
  - Requires operators of Municipal Separate Storm Sewer Systems (MS4's) with populations under 100,000 to obtain National Pollutant Discharge Elimination System permit coverage
  - Must submit a list of Best Management Practices (BMP's) showing how they will handle their storm water discharge issue
  - Pervious Concrete is recognized as a BMP
- PA Act 167

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Why Pervious Concrete?

- Storm Water Control
  - "First Flush"
    - 90% of surface pollutants washed off pavement
  - Detention/Retention Ponds
    - Unusable ground
    - $$$$$
- Pollution treatment
- Recharges the aquifer
- Sustainable Construction
  - LEED & "Cool Communities"

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Why Pervious Concrete?

- Safety

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Pervious Concrete Implications On the LEED Rating System

- Sustainable Sites
  - Credit 6.1 Storm Water Management (1 Pt)
  - Credit 7.1 Heat Island Effect: Non-Roof (1 Pt)
- Water Efficiency
  - Credit 1.1 Water Efficient Landscaping (1 Pt)
  - Credit 3.1/3.2 Water Use Reduction (1 Pt)

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Pervious Concrete Implications On the LEED Rating System

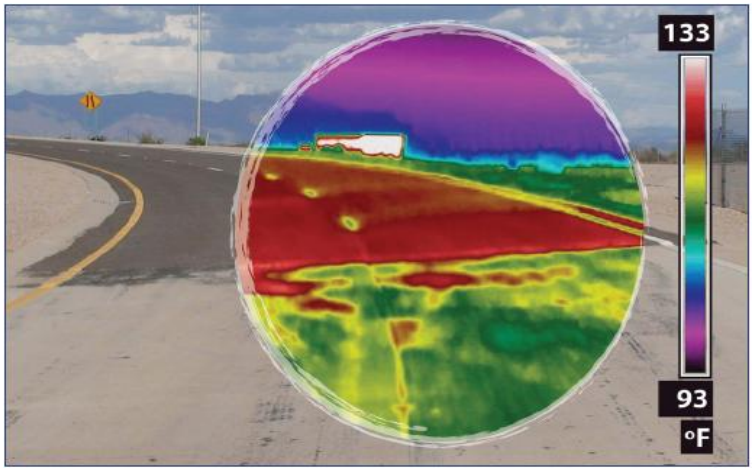
- Materials & Resources
  - Credit 4.1/4.2 Recycled Content (1 Pt)
  - Credit 5.1/5.2 Local/Regional Materials (1 Pt)
- Total Possible Points
  - Sustainable Sites (2 Pts)
  - Water Efficiency (2 Pts)
  - Materials & Resources (2 Pts)

Cool Communities

- Program of DOE
  - Use light colored roofing and cladding
  - Use light colored pavements
  - Landscape shading
- Reduce air temperatures by 5°
- Reduce air conditioning by 18%

Heat Island Effect

(Green Highways)



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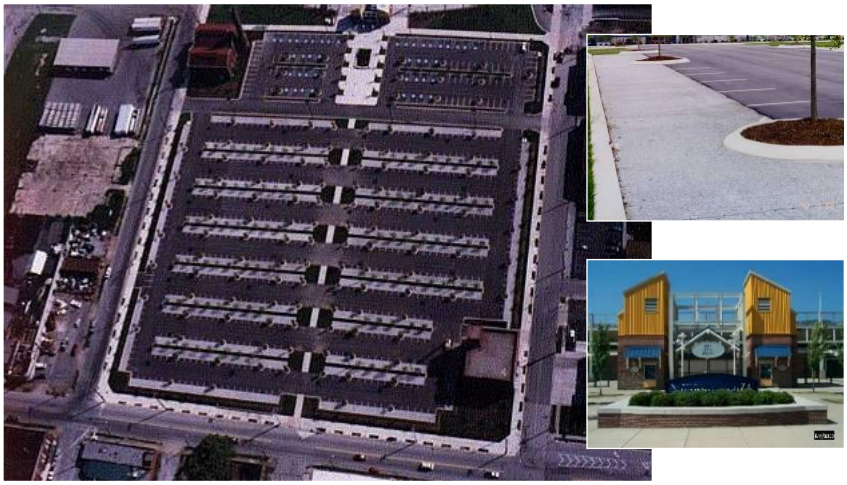
Parking Lots



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Tree Wells

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Driveways

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Sidewalks

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Nature Paths

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Other Uses

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"Typical" Pervious Concrete Mix

- Cement
  - Type I
  - 450-650 lbs./yard
  - Some mixes have incorporated fly ash or slag
- Coarse Aggregate
  - 3/8" stone (may use larger, more open surface, ADA compliant)
  - 2000 – 2600 lbs./yard
- Admixtures
  - VMA's, Hydration Stabilizer

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Properties of Pervious Concrete

- Very low slump (1" or less)
- 15% to 35% air void content
- 110 to 130 lbs/ft^3 unit weight
- 500 to 3000 psi strength*
- Drainage rate = 2 to 18 gal/min/ft^2

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Appropriate Consistency

- Wet metallic sheen
- Smooth paste
- Three evaluation methods:
  - Hand squeeze
  - Slump
  - Inverted slump

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Hand Squeeze Method

- Grab sample in hand
- Squeeze and release
- Aggregates adhere to vertical surface, paste is sticky enough
- Aggregates fall off, paste is too dry
- Paste sticks but aggregates fall off, paste is too wet

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Inverted Slump Cone

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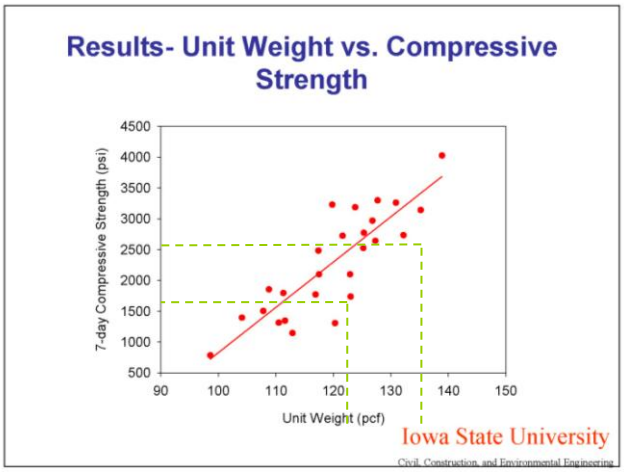
Compressive Strength vs. Unit Weight



Effect of Compaction on Pervious Concrete Properties, *Suleiman*, et al.

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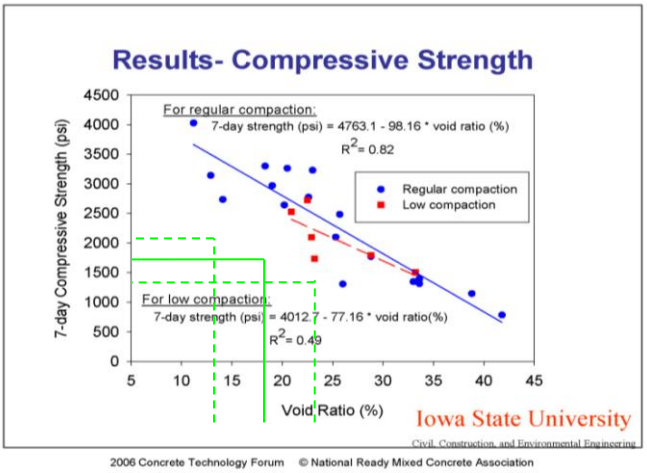
Compressive Strength vs. Void Ratio



Effect of Compaction on Pervious Concrete Properties, *Suleiman*, et al.

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Pervious Concrete "News"

- ASTM 1701 Standard Test Method for the Infiltration Rate of In-Place Pervious Concrete
- ASTM 1688 Standard Test Method for Density and Void Content of Freshly Mixed Pervious Concrete
- Pervious Concrete Mix Design Software (NRMCA)
- PerviousPave - new ACPA Product

Design Considerations

- Hydraulic
  - Expected rainfall
  - Permeability of the sub-grade
    - Percolation rate ½" per hour
    - 100% "drain down" not to exceed 5 days
  - Storage capacity of base material
    - Porosity
    - Depth
  - Grade as flat as possible (0%-1% slope)
  - Software is available

Design Considerations

- Structural
  - ACI 330R-01 (Guide for Concrete Parking Lots)
  - Typical 6” , if occasional truck traffic 8”

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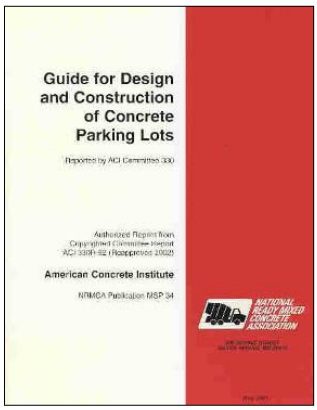
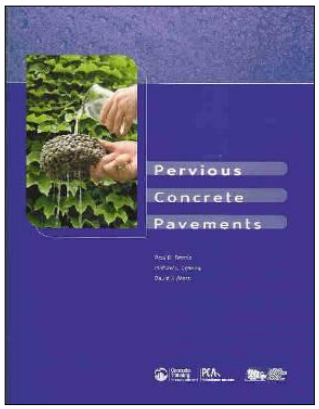
Design Aids





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Pervious Concrete Placement

- For fixed-form placement
  - Place and level forms to desired grade
  - Place and screed pervious concrete level to top of form (desired final grade)
  - Compaction of top 3/4” - 1” depending on compactive force

Pervious Concrete Placement

Demonstration

Parker Hill Pervious.MOV

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Pervious Concrete Placement

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Demonstration

PACA Pervious1.MOV

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Pervious Concrete Placement

- Temple University/Sachin Pandey Group Method



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Pervious Concrete Placement




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Jointing Pervious Concrete

- Contraction, construction, and isolation
- Typically tooled into pavement
  - May be sawn, caution issued regarding dust and fines created by sawing process

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Curing Pervious Concrete

- Cover with 6 mil. poly immediately after placement, consolidation, and jointing
- Curing to remain in place for 7 days
- Do not use dirt or other loose materials as an anchor for the poly
- ACI hot/cold weather techniques apply

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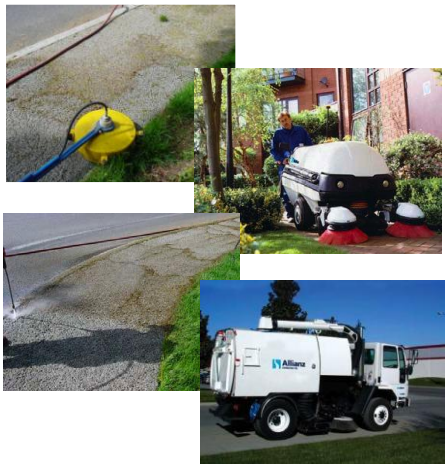
Maintenance

- Pervious may require periodic cleaning to keeps “pores” open
  - Cleaning may be facilitated with a power washer or vacuum assisted sweeper
  - Use of chemical cleaners not recommended



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Maintenance

- Snow/Ice removal
  - Deicing chemicals not recommended
  - Mechanical removal should employ small snow blowers or light plows
    - Plow should be fitted with rubber/plastic shield

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General Issues

- Durability
  - Iowa State University Studies
  - Penn State Welcome Center
    - Sidewalk - 9 years old
- Cost
  - 5% - 40% greater than traditional concrete

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Pervious Concrete Examples

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Liberty Properties

Lewisberry, PA

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Lebanon County Conservation District Office

Lebanon, PA

www.pacaweb.org

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Lower Saucon Twp. Park

Bethlehem, PA

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Parker Hill Church

Clarks Summit, PA

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PACA Office

Harrisburg, PA

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Pervious Concrete Certification

- PACA/PCPC is NRMCA LSG
- Certification training in state
- Who?
  - Contractors
  - Producers
  - Architects/Engineers
  - Agencies (DCNR, DEP, Conservation Districts)

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Does it Work?

Other Concrete Stuff!

- PCA/NRMCA Partnership with MIT
- RMC Research Foundation Report
- Sustainability, Sustainability, Sustainability

Websites of Interest

- www.specifyconcrete.org

- www.perviouspavement.org
- www.cptechcenter.org
- www.concreteparking.org

Websites of Interest

- www.concreteanswers.org
- www.concretethinker.com
- www.usgbc.org

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