Porous Pavement & the Stormcrete® Modular Precast Porous Concrete System

North Country – October 20, 2016

Presented by: Kevin J. McKee, PE, CPSWQ

STORM CRETE®

When it Rains...it's Porous™

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Presentation Overview

- Porous/Pervious Pavements – Introduction/Applications
- Performance and Lessons Learned
- Stormcrete® - An alternative Porous Pavement System
- Simplified installation – a Case Study

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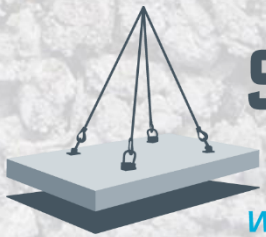
Benefits of Porous Pavement

- Lessens the impact on existing storm or combined sewers
- Greater base-flow in streams and rivers
- Provides natural filtration through soils of TSS, Nutrients, Heavy Metals and other pollutants.
- Higher coefficient of friction means safer stopping
- More closely mimicking the natural hydrologic responses to a rainfall events
- Reduces the Heat Island effect common to conventional pavement



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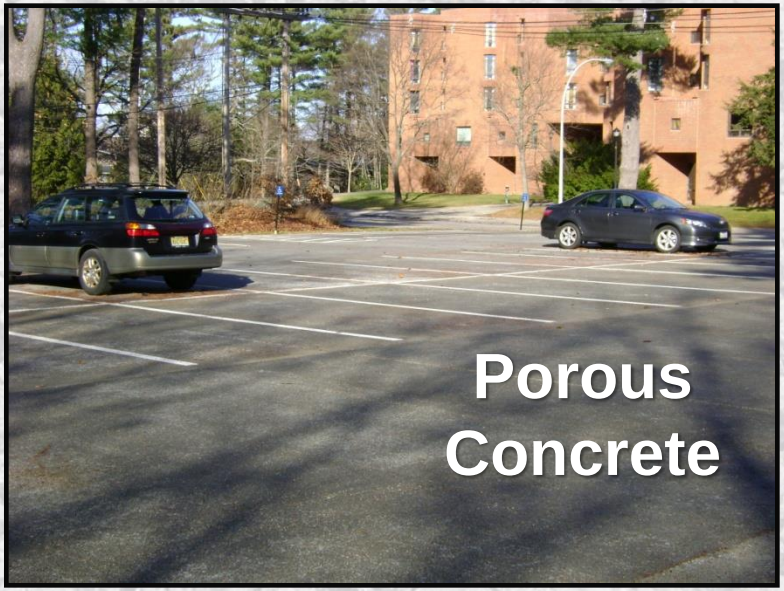
The Pre-Stormcrete® Porous Pavement Market



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Porous Pavement Types

Cast-in-place Pervious Concrete

Porous Pavement Types

Open Graded Friction Course

Figure 1.1: Difference in Spray from Conventional and PFC Pavements

Source: Stormwater Quality Benefits of a Porous Asphalt Overlay, Michael E. Barrett, Author

Porous Pavement Types

Field placed Porous Asphalt

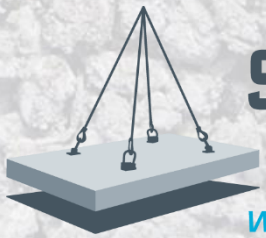
Porous Pavement Types

Grid Pavement Systems

Porous Pavement Types

Precast Porous Concrete Slabs

Lessons Learned



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Porous Asphalt Installation Considerations

5. Porous asphalt should not be installed on wet aggregate, treated bases, or when the ambient air temperature is below 13°C (55°F). The production temperature of the bituminous mix should be determined by the results of draindown testing (ASTM D6390) and recommendations of the asphalt supplier, but typically ranges between 135°C and 150°C (275°F and 302°F). Porous asphalt is typically placed in one lift for small projects or two lifts for thicker sections. The two-layer pavement/ATPB surface is installed directly over the aggregate base layers to the specified finish thickness (**Figure 2-20**). Two to three passes with an 8 to 10 ton static steel wheel roller is required for proper compaction (i.e., air voids of 18% to 22%). Additional rolling could reduce surface course porosity and/or cause aggregate breakdown. Additional rolling with a small roller to smooth seams and remove marks is normally required (**Figure 2-21**). Rollers should move slowly and uniformly to prevent displacement of the mix, and they should not be stopped or parked on the freshly placed mat.[1].

Permeable Pavements, Bethany Eisenberg, et. al, 2015 ASCE Publications

Durability Issues

Porous Asphalt Installation Specifications

Table 1.5.1 QA/QC Asphalt Testing Minimum Frequency for select variables

Test	**Minimum Frequency**
Mix temperature in trucks prior to leaving plant	Six (6) times per day
Mix temperature at installation in trucks	At arrival of each truckload and immediately prior to installation
Mix temperature while rolling	Every two hours
Gradation	Greater frequency of either (a) one (1) per five hundred (500) tons (b) two (2) per day

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Plugging Issues due to “run-on”

Pervious Concrete Installation Restrictions

Project Conditions

A. Weather Restrictions

1. The Contractor shall not place pervious concrete pavement when the ambient temperature is predicted by the National Weather Service Point Forecast for the jobsite to be 40°F (4.4ºC) or lower during the seven days following placement, unless otherwise permitted in writing by the Architect/Engineer.

2. The Contractor shall not place pervious concrete pavement later in the year than November 1 or earlier in the year than April 1 unless otherwise permitted in writing by the Architect/Engineer.

3. The Contractor shall not place pervious concrete pavement when the ambient temperature is predicted by the National Weather Service Point Forecast for the jobsite to rise above 90°F (32.2ºC) during the seven days following placement, unless otherwise permitted in writing by the Architect/Engineer.

4. The curing cover shall remain securely in place, uninterrupted, until the concrete has reached a maturity equivalent to 14 days of curing at 70°F (21°C) at 95% relative humidity. Maturity shall be determined by an independent testing laboratory. No vehicular traffic shall be permitted on the pavement until curing is complete without written permission from the Architect/Engineer.

Pervious Concrete Installation Sensitivity and Timing

Durability and Maintenance


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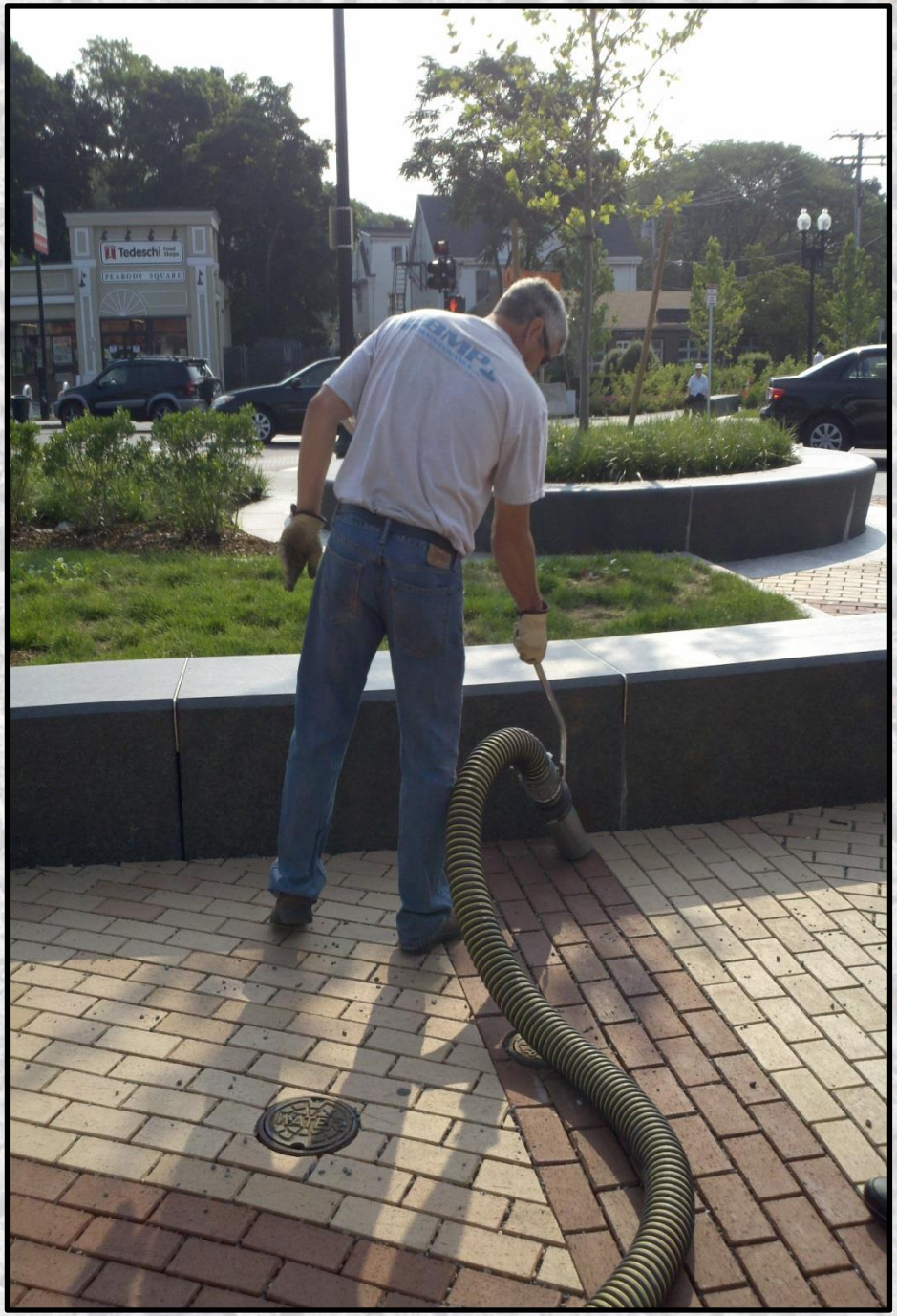
Tedeschi
PEABODY SQUARE
BMP


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& Rentals
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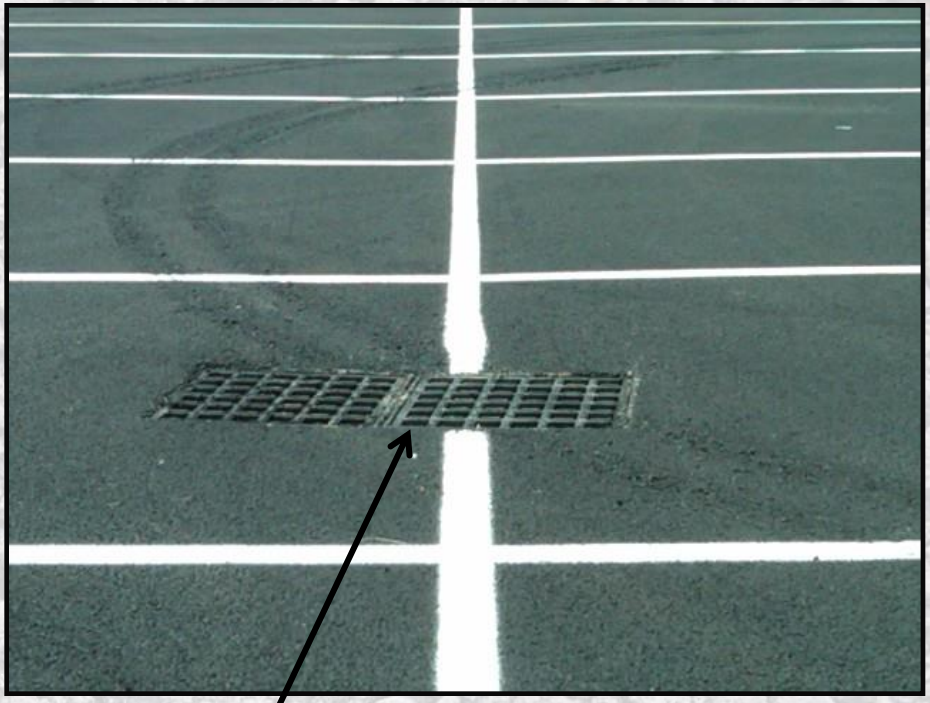

Vote of no confidence shown by the engineer

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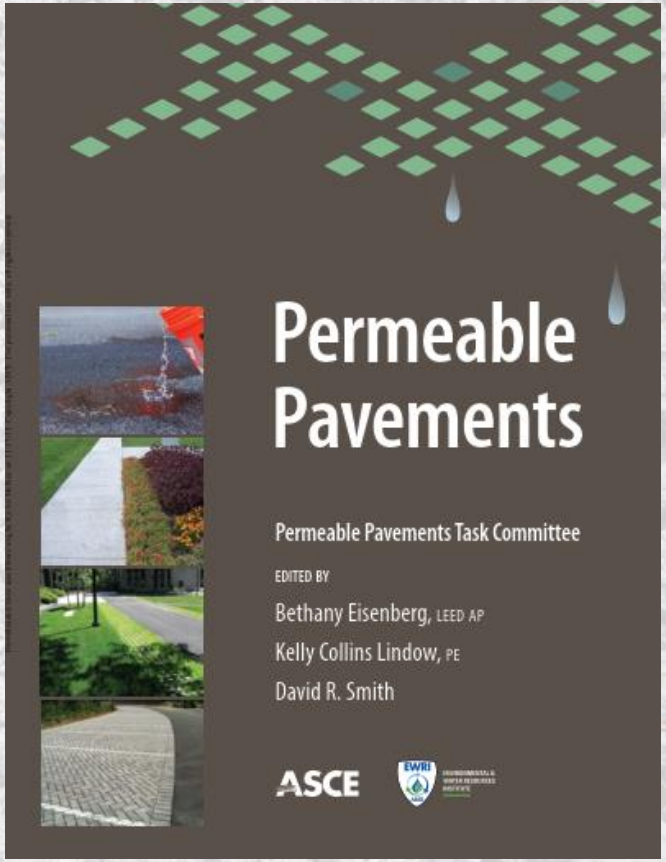
Make use of Resources



Negative Perceptions of Porous pavement in the Marketplace

Durability

Installation is labor intensive

Inconsistency in mix from batch to batch

Difficult to produce

Weather dependent (can't install when to cold/hot)

Difficult to maintain and Repair

No access to subgrade (utilities)

HIGH RISK!!!

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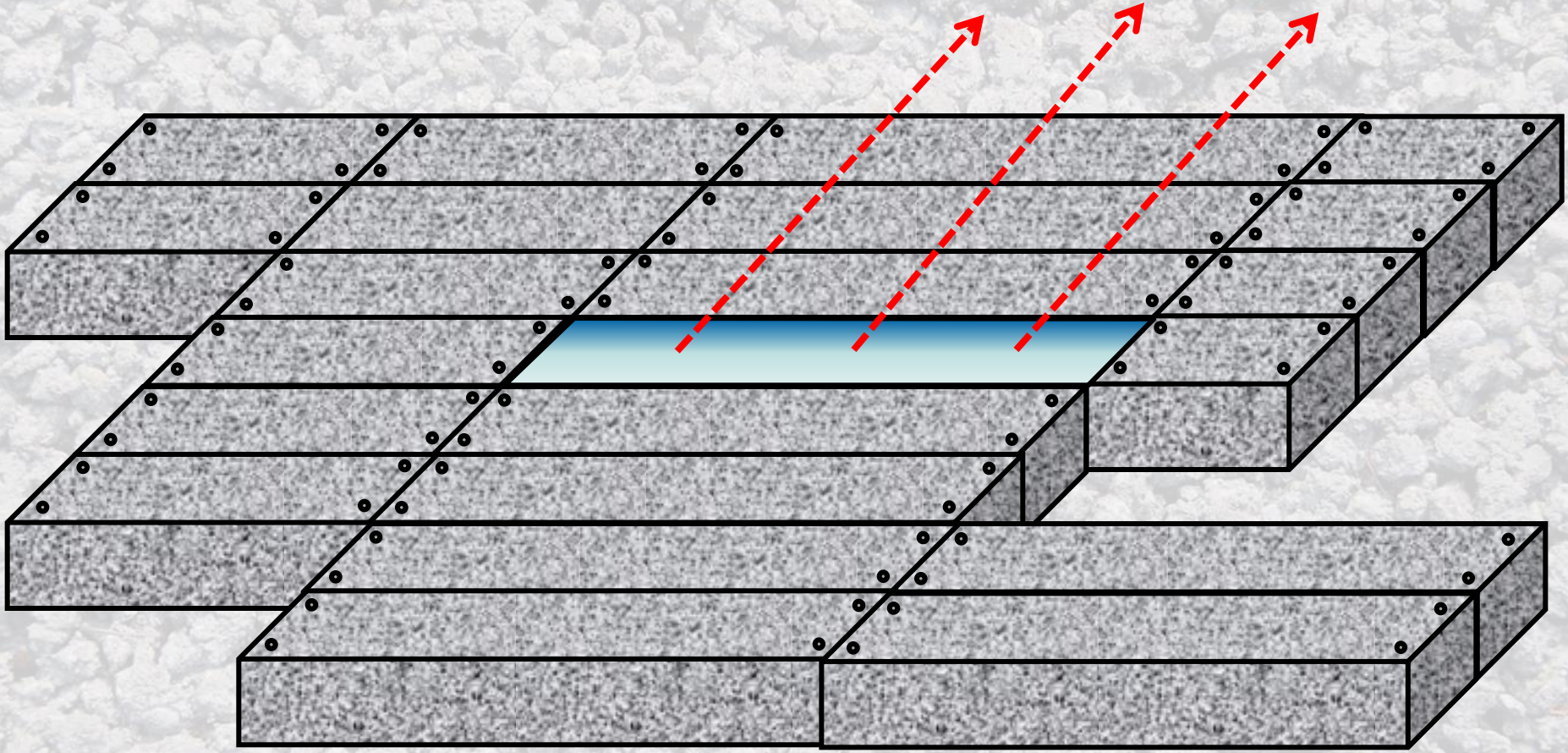
When it Rains...it's Porous™

Introducing Stormcrete®

Modular Precast
Porous Concrete Stormwater System

POROUS
TECHNOLOGIES, LLC
When it Rains...it's Porous™

Each precast porous segment is REMOVABLE and REUSABLE



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When it Rains...it's Porous™

Modular Precast Porous Concrete Stormwater System

Stormcrete® - Modular Precast Porous Concrete StormWater System

Green Infrastructure Technique:

Controls StormWater Quality and Quantity

Slabs manufactured, CURED and stored in an controlled environment

Porous section is removable / maintainable / Reusable

Provides access to sub-base – utilities, spills, etc.

Reduced life cycle costs

Can be installed year round in almost any type of weather conditions

Ready to use immediately – pre-cured

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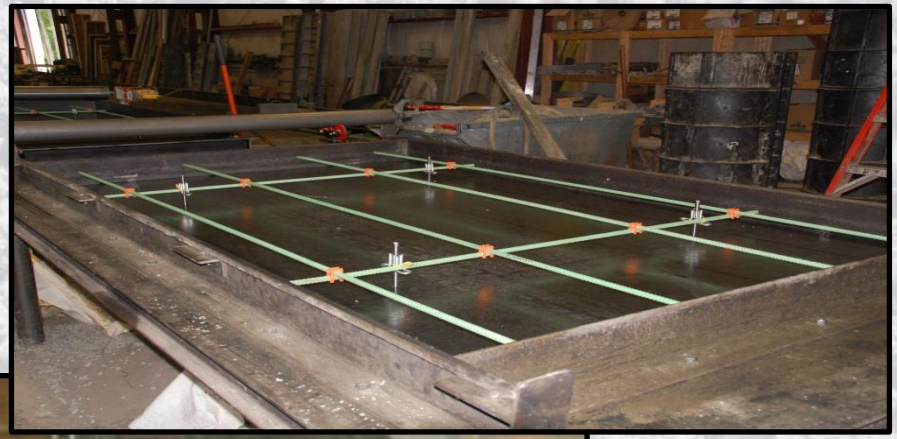
When it Rains...it's Porous™

LOW RISK!!!

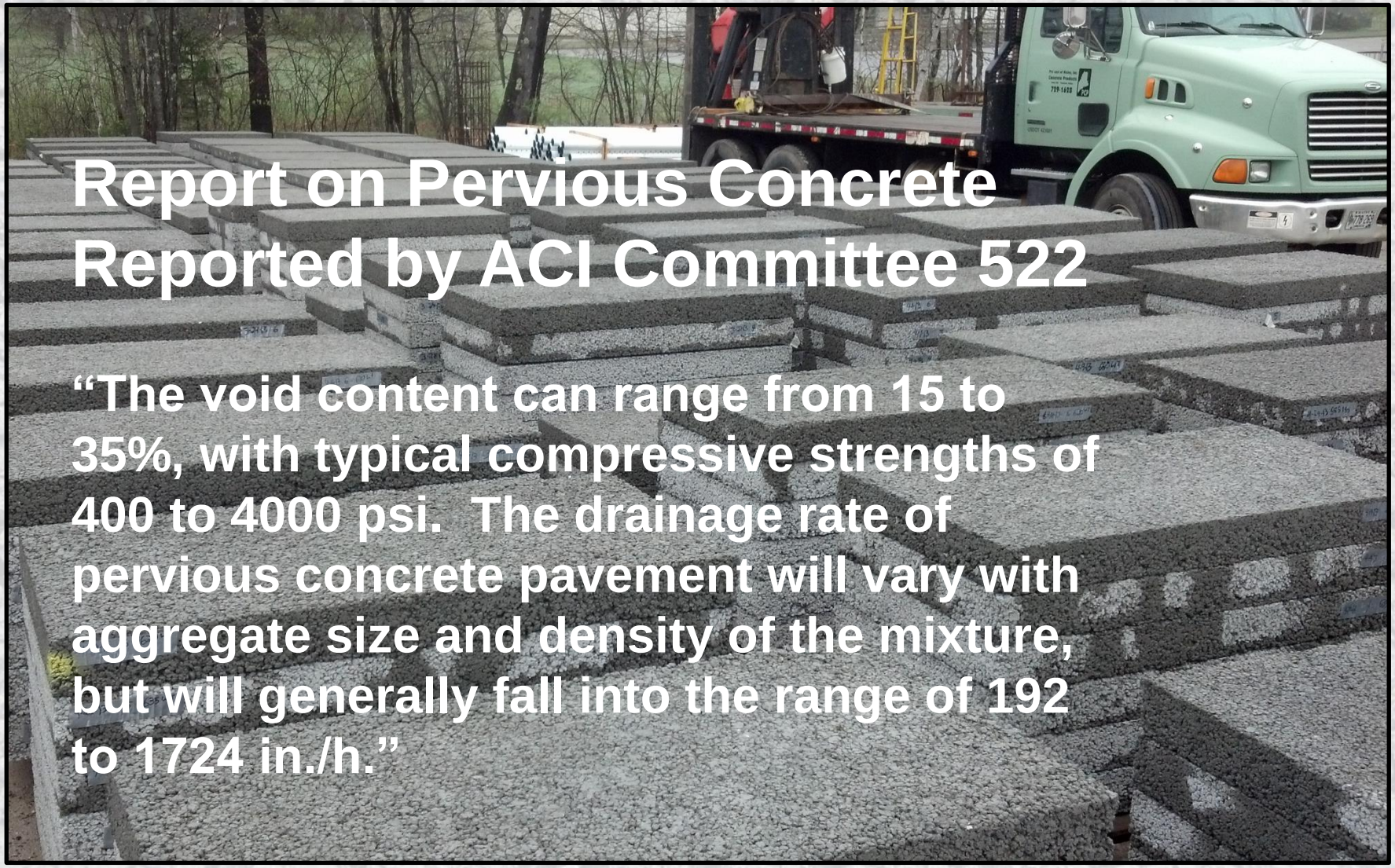
Standard Slab Sizes

5’ x 8’ **5’ x 4’** **5’ x 2.5’**

Controlled Environment Manufacturing



Quality Control

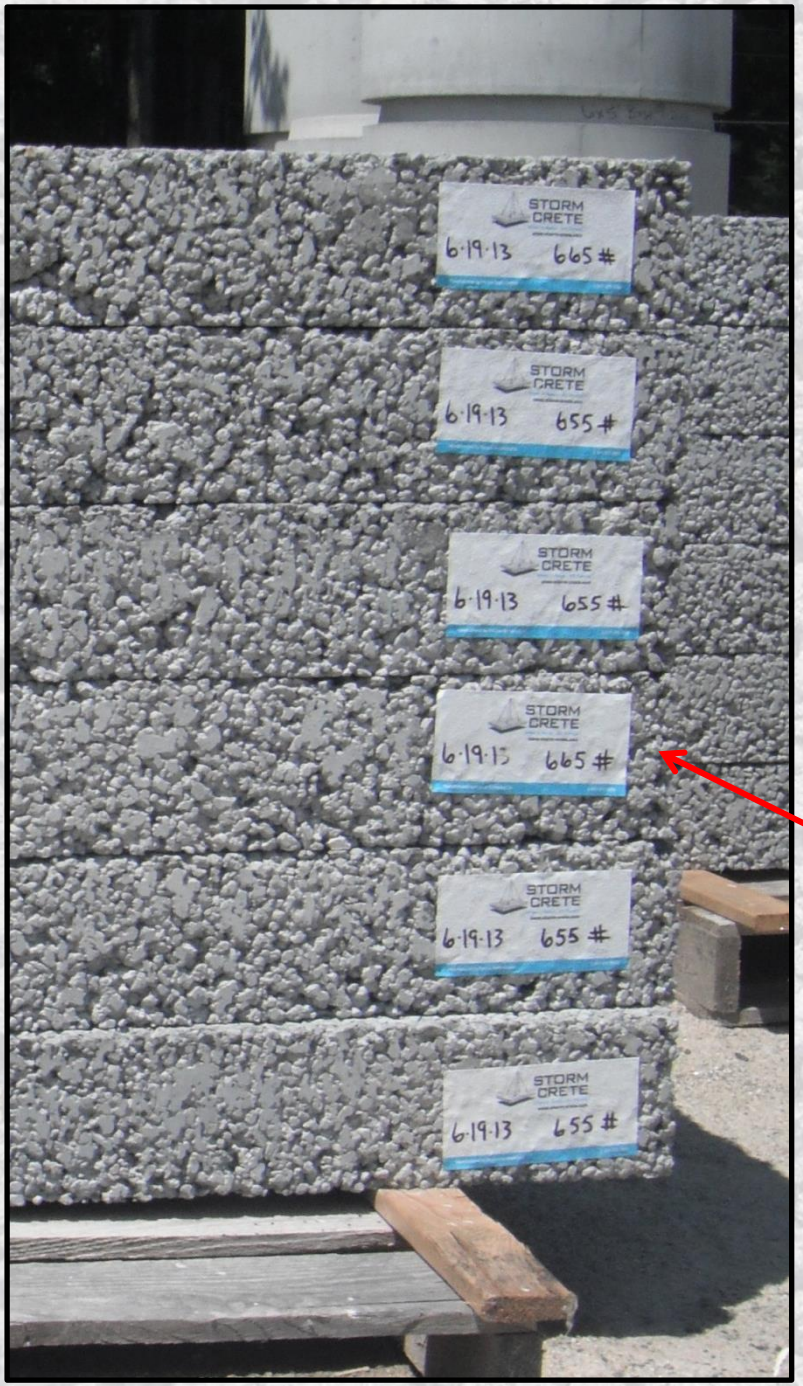


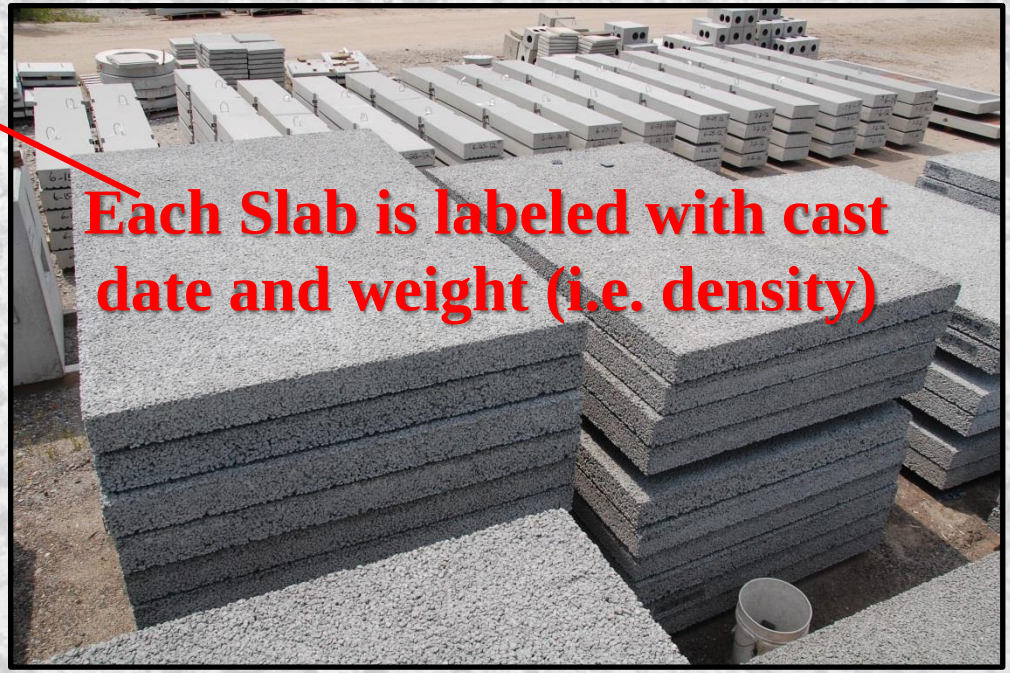
Report on Pervious Concrete Reported by ACI Committee 522

"The void content can range from 15 to 35%, with typical compressive strengths of 400 to 4000 psi. The drainage rate of pervious concrete pavement will vary with aggregate size and density of the mixture, but will generally fall into the range of 192 to 1724 in./h."

Target Mix: 125 lbs/ft^3 (2,083 lbs.)

This slab is < 1% from theoretical weight – Poured in place specs allow +/- 5% variation

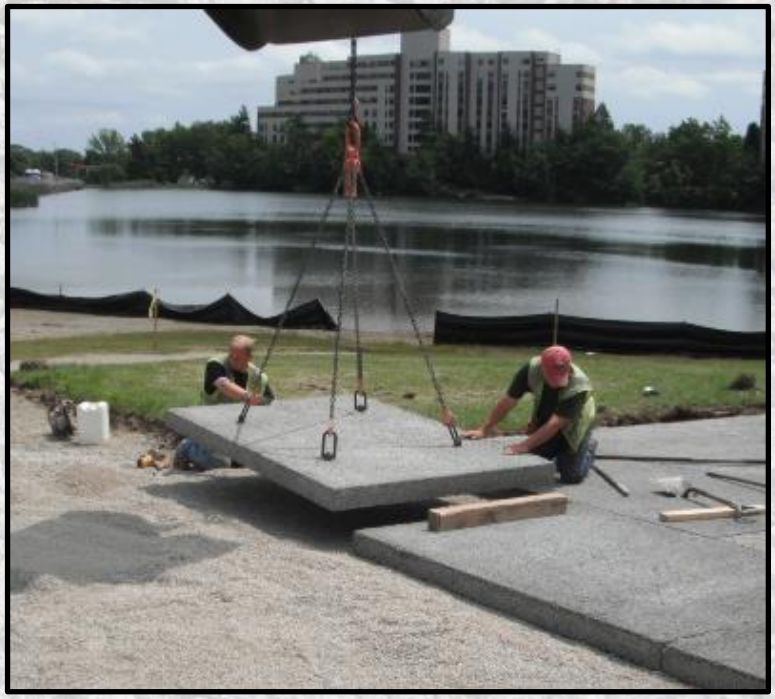




Each Slab is labeled with cast date and weight (i.e. density)


Cured Covered
Indoors


Outdoor Curing




Stormcrete®
Typically 3 man crew

REMOVABLE

REUSABLE

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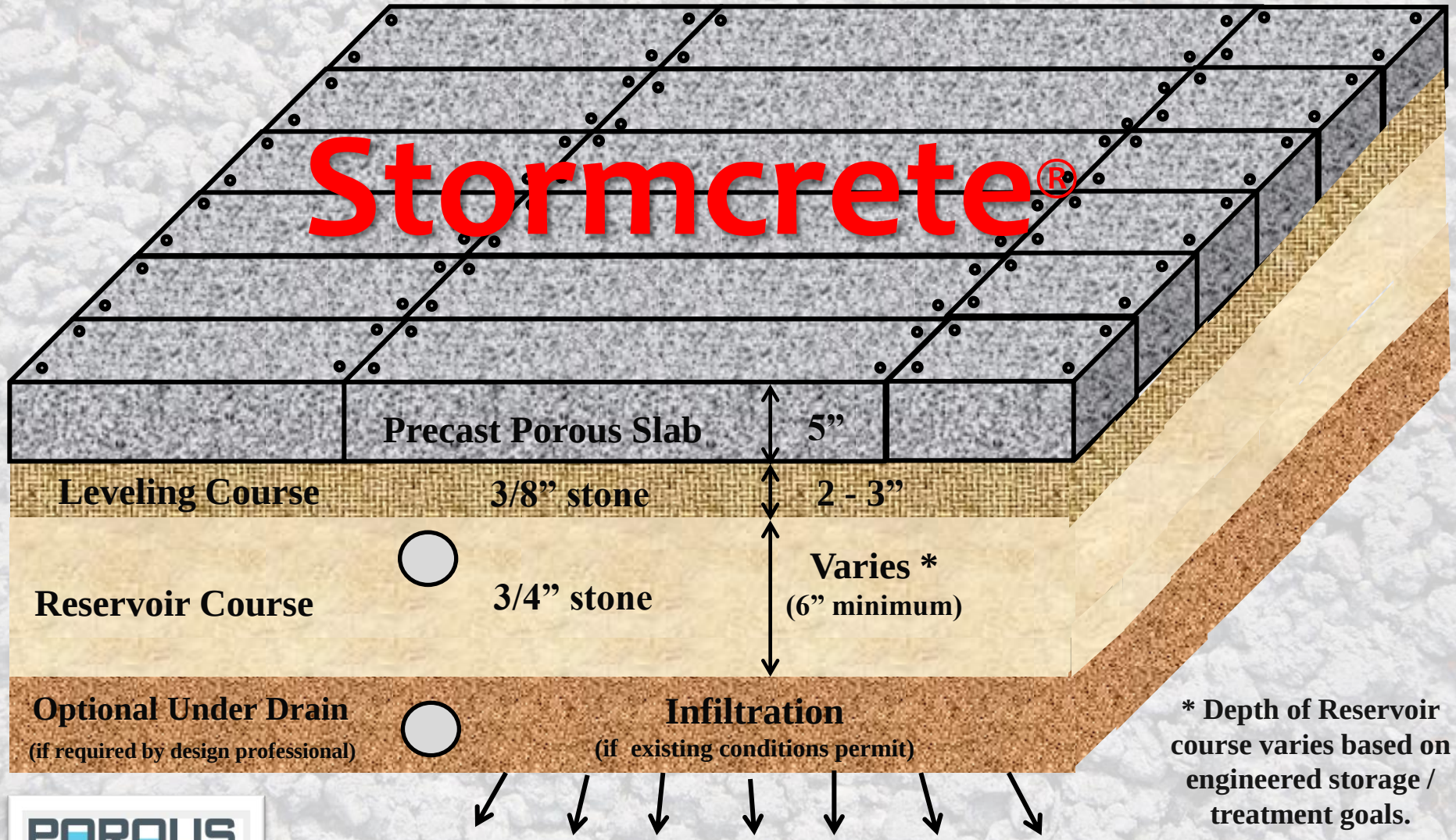
Modular Precast Porous Slab Sections



* Depth of Reservoir course varies based on engineered storage / treatment goals.

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Applications

Sidewalks

Sidewalk

UTC Farmington, CT

Applications

Green Alleys

“Blue Alley”

Baltimore, MD

BLUE WATER BALTIMORE IN PARTNERSHIP WITH CITY OF BALTIMORE DEPARTMENT OF PUBLIC WORKS, BUREAU OF WATER & WASTEWATER AND DEPARTMENT OF TRANSPORTATION, ALLEYS AND FOOTWAYS DEVISION

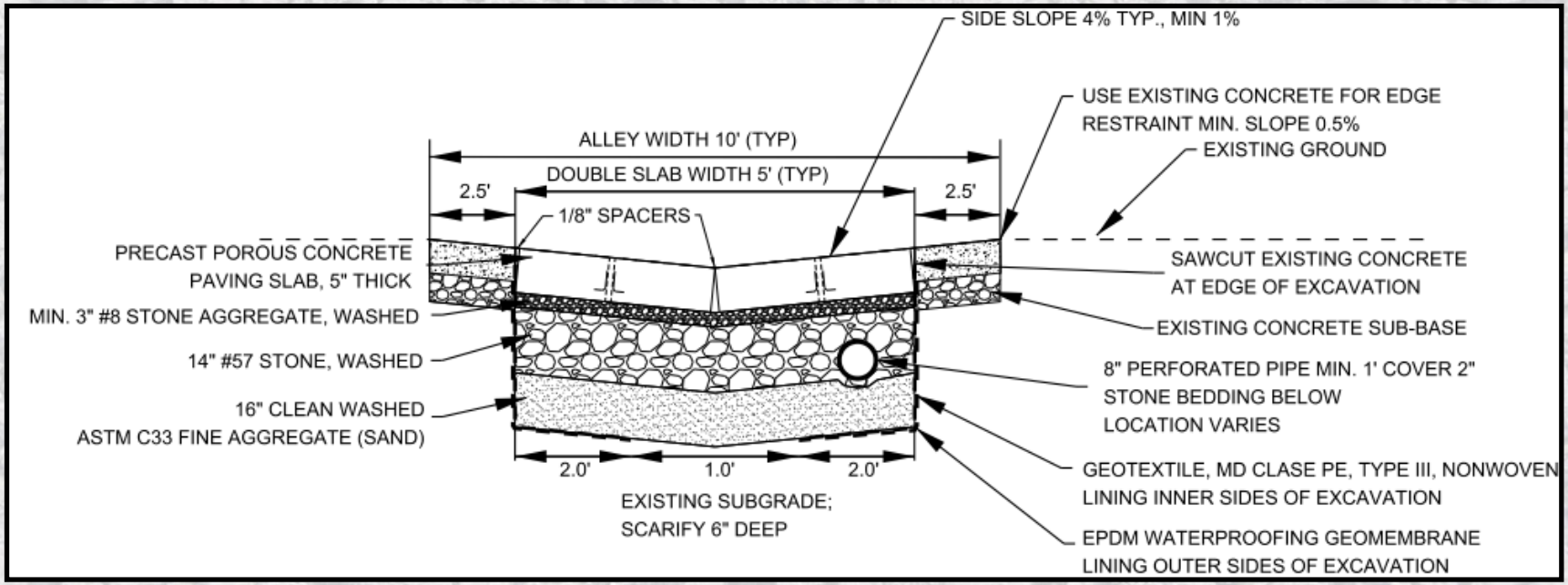
BLUE NEIGHBORHOODS AND ALLEYS: PERMEABLE PAVER ALLEYS AND STREET BIORETENTION BUMPOUTS STORMWATER RESTORATION DEMONSTRATION

CONTRACT NO. TR13012

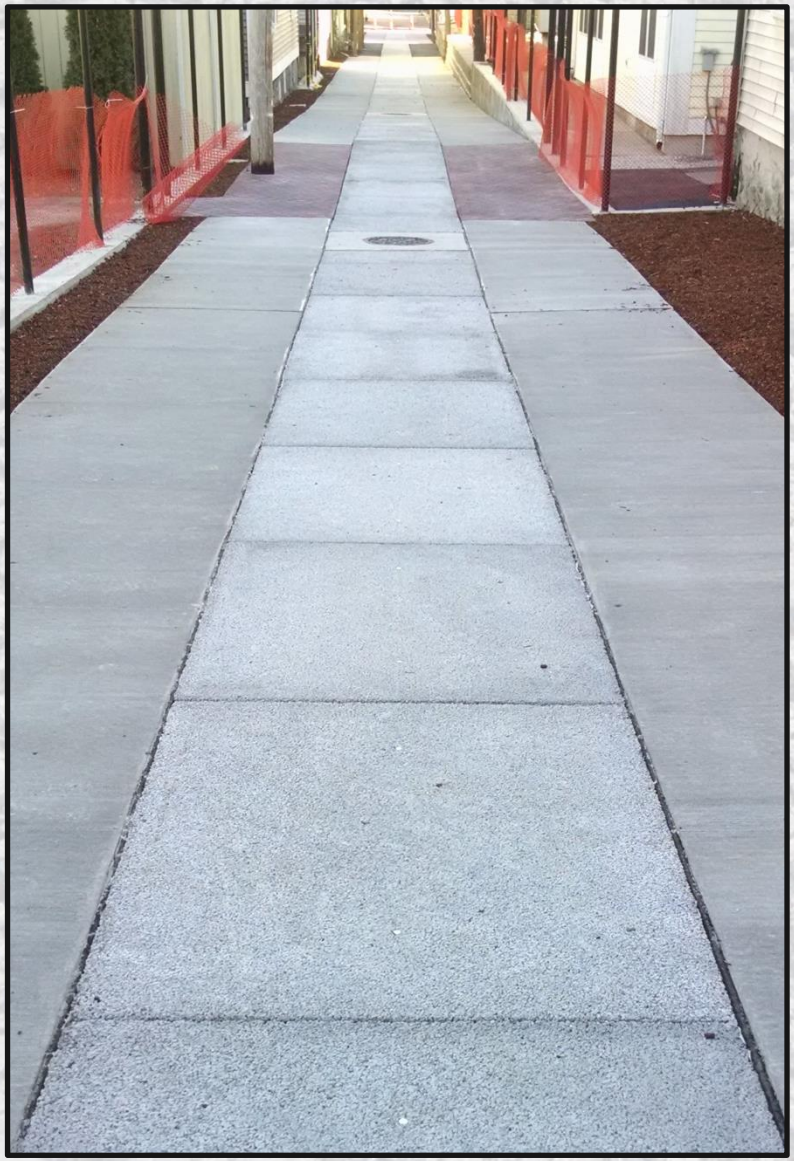
PERMEABLE PAVING DETAILS

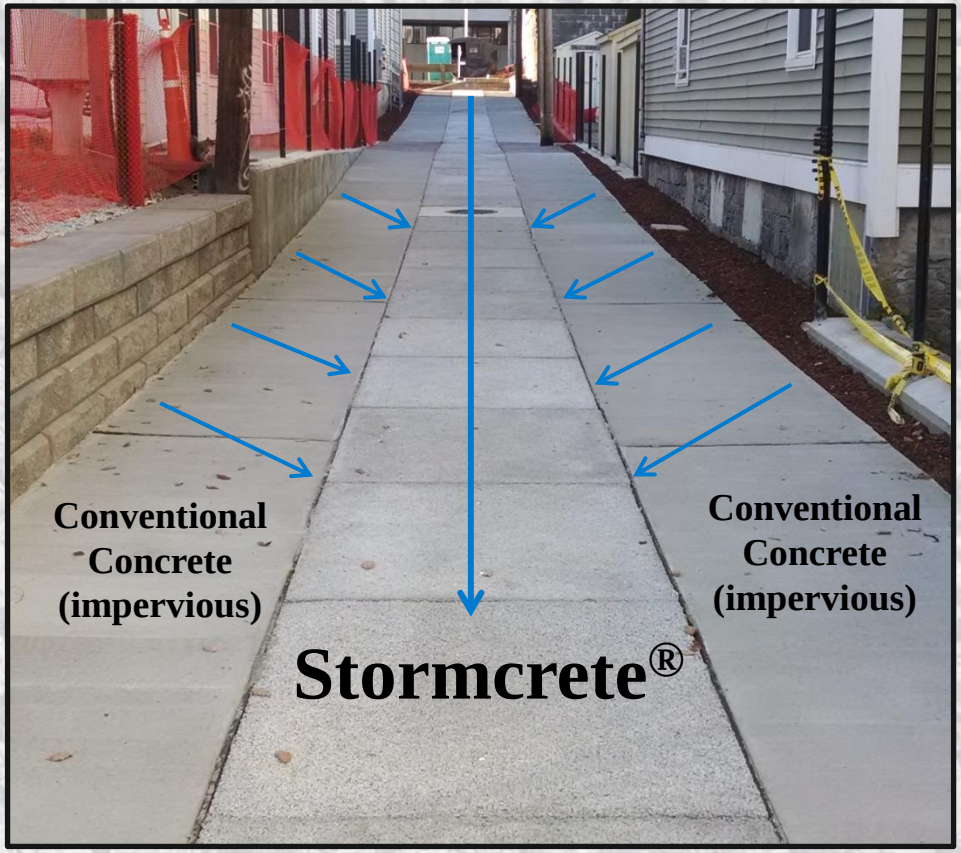
SCALE: DATE: MAY 2013

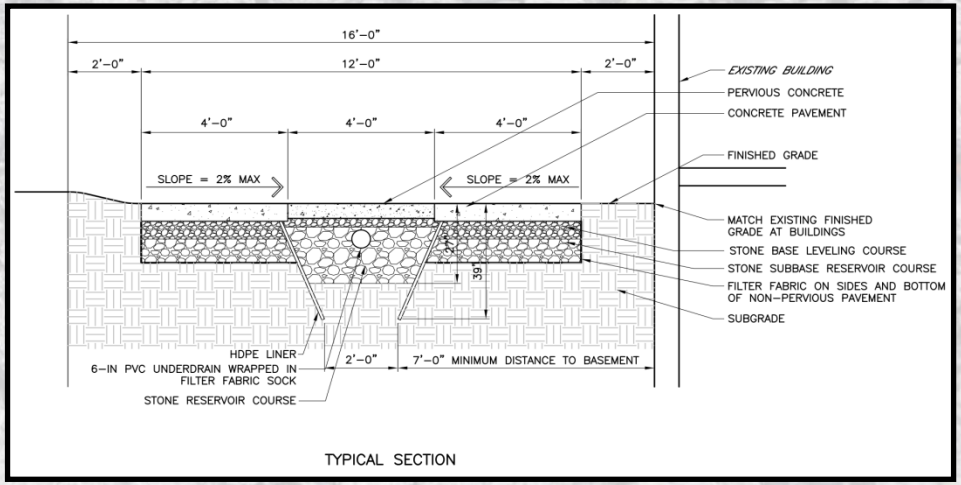
Baltimore, MD "Blue Alley" Design



Green Alley – Lowell, MA



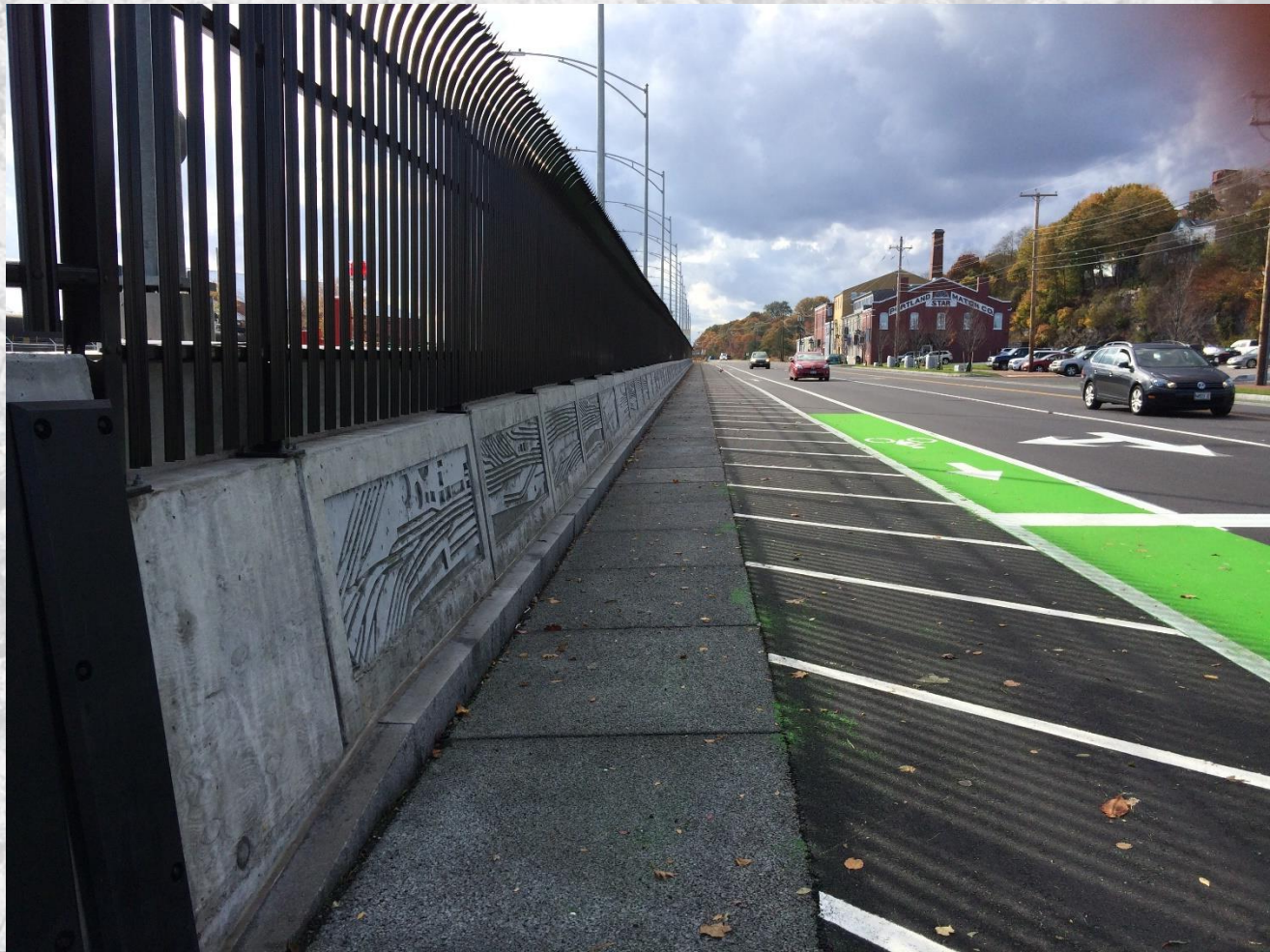




Green Alley – Lowell, MA

Applications

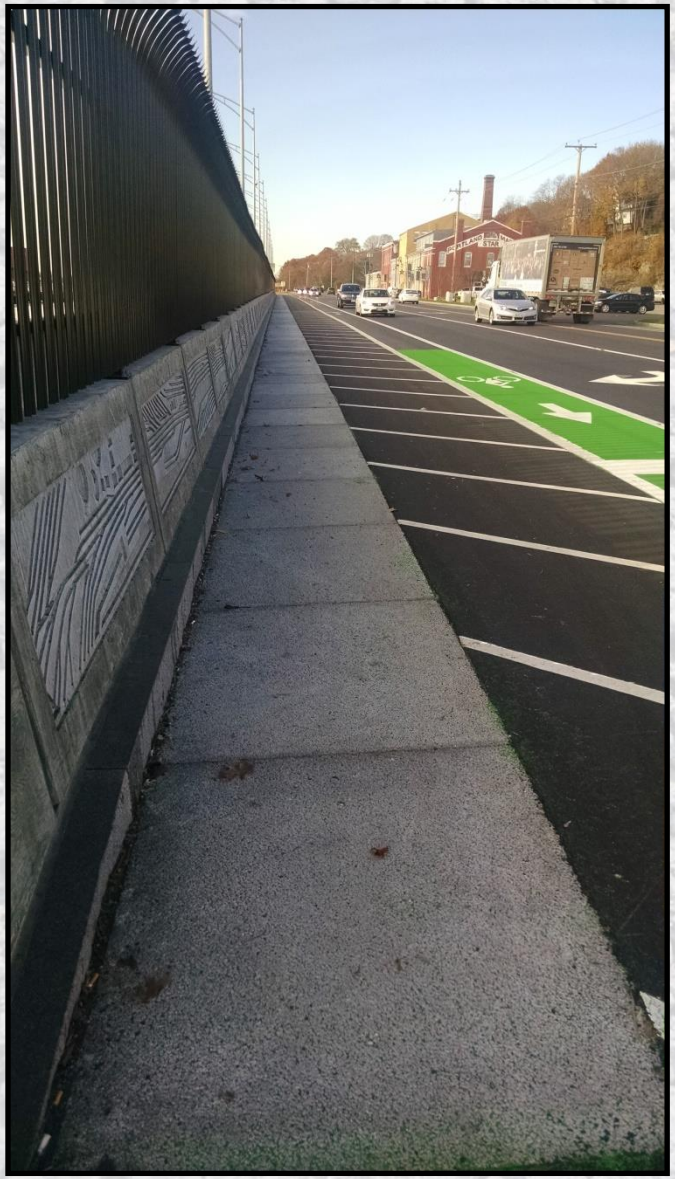
Gutters

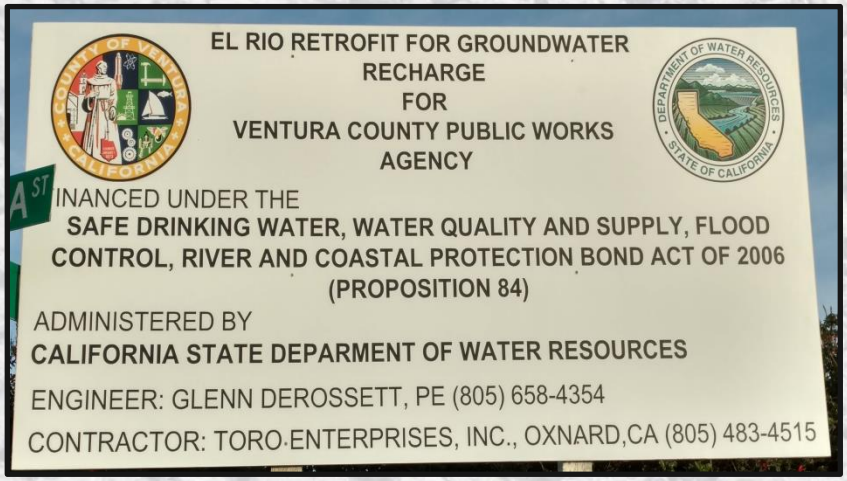


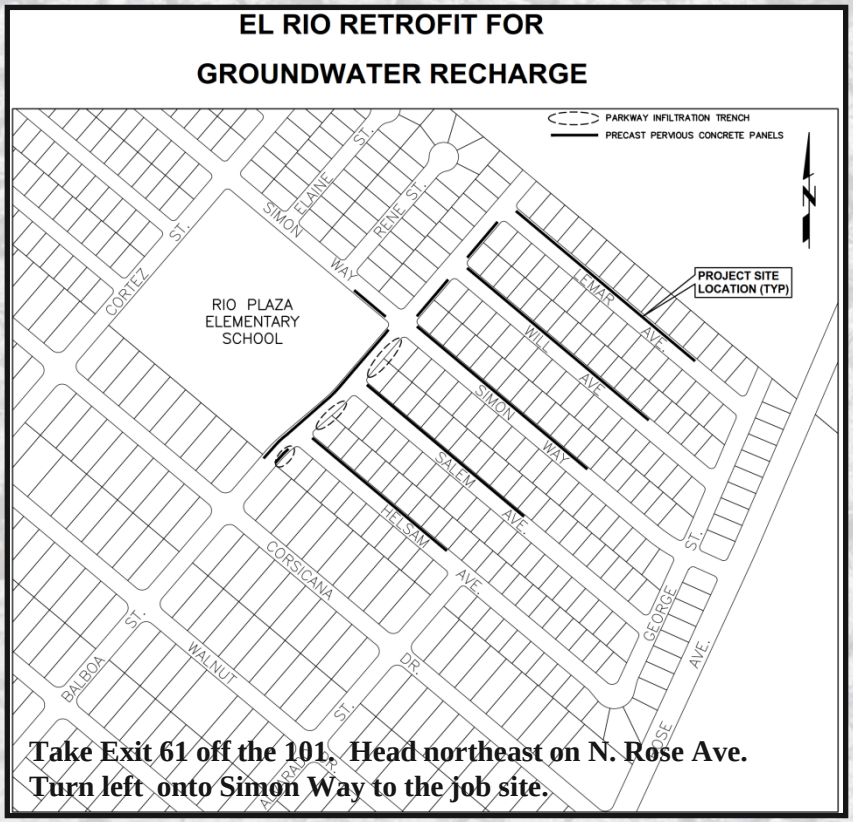
Portland Marine Terminal

Stormcrete®

Porous Concrete Gutter System




EL RIO RETROFIT FOR GROUNDWATER RECHARGE
FOR
VENTURA COUNTY PUBLIC WORKS AGENCY
A ST
INANCED UNDER THE
SAFE DRINKING WATER, WATER QUALITY AND SUPPLY, FLOOD CONTROL, RIVER AND COASTAL PROTECTION BOND ACT OF 2006 (PROPOSITION 84)
ADMINISTERED BY
CALIFORNIA STATE DEPARMENT OF WATER RESOURCES
ENGINEER: GLENN DEROSSETT, PE (805) 658-4354
CONTRACTOR: TORO ENTERPRISES, INC., OXNARD,CA (805) 483-4515


EL RIO RETROFIT FOR
GROUNDWATER RECHARGE
PARKWAY INFILTRATION TRENCH
PRECAST PERVIOUS CONCRETE PANELS
N
PROJECT SITE LOCATION (TYP)
RIO PLAZA ELEMENTARY SCHOOL
ELAINE ST.
SIMON WAY
RENE ST.
CORTEZ ST.
LEMAR AVE.
WILL AVE
SIMON WAY
SALEM AVE.
HELSAM AVE
CORSICANA
GEORGE ST.
ROSE AVE.
BALBOA ST.
WALNUT DR
ST.
Take Exit 61 off the 101. Head northeast on N. Rose Ave.
Turn left onto Simon Way to the job site.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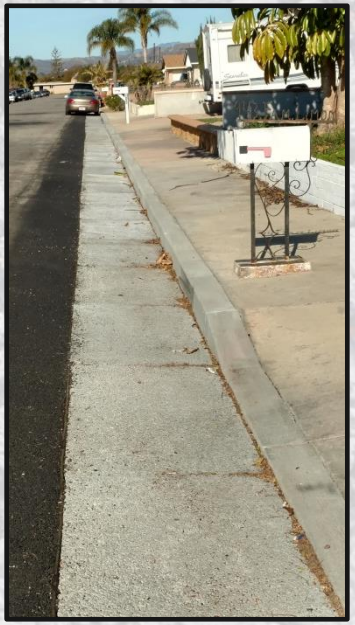
Existing Conditions
Before Stormcrete®



Stormcrete®
Modular

Applications

- Pedestrian Plazas

Applications

Boat Wash Area

Lake George, NY

Applications

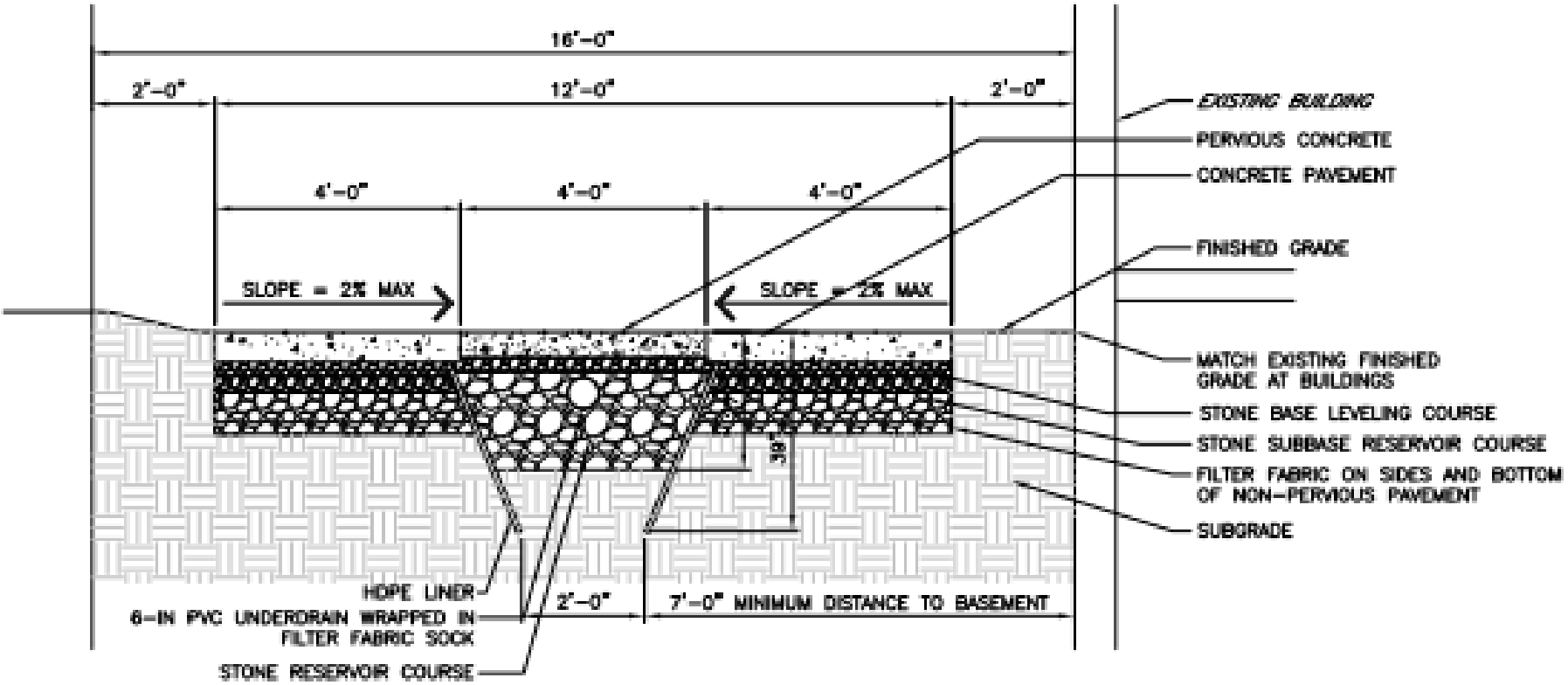
Parking Areas

Applications

Parking Areas

- Location!
- Location!
- Location!

- Location!
- Location!
- Location!

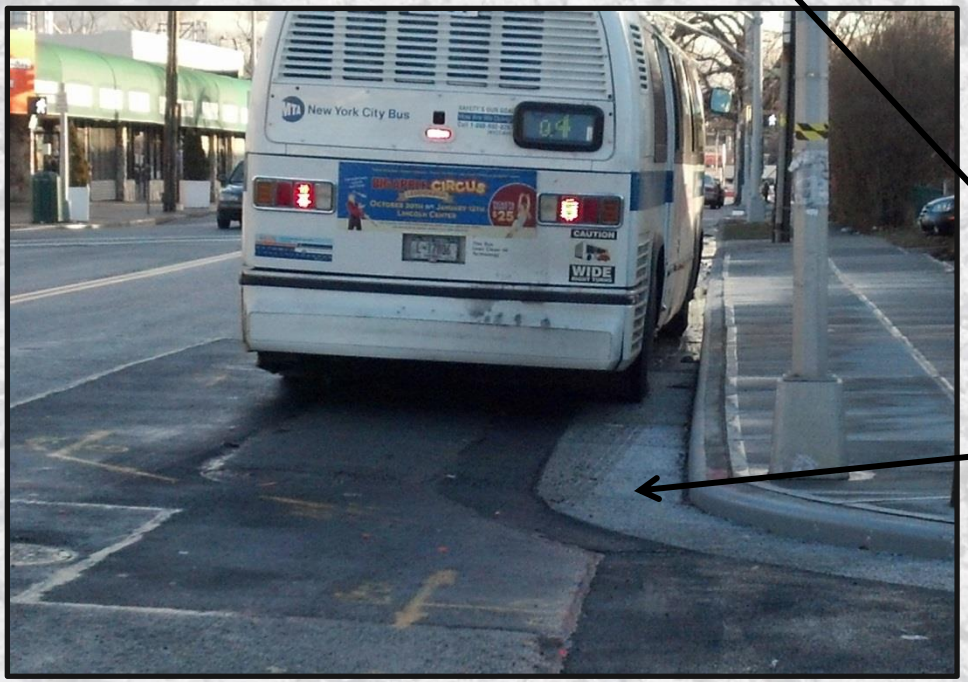


TYPICAL SECTION

DETAIL 1

NOT TO SCALE L-7


CAUTION
WIDE
RIGHT TURNS

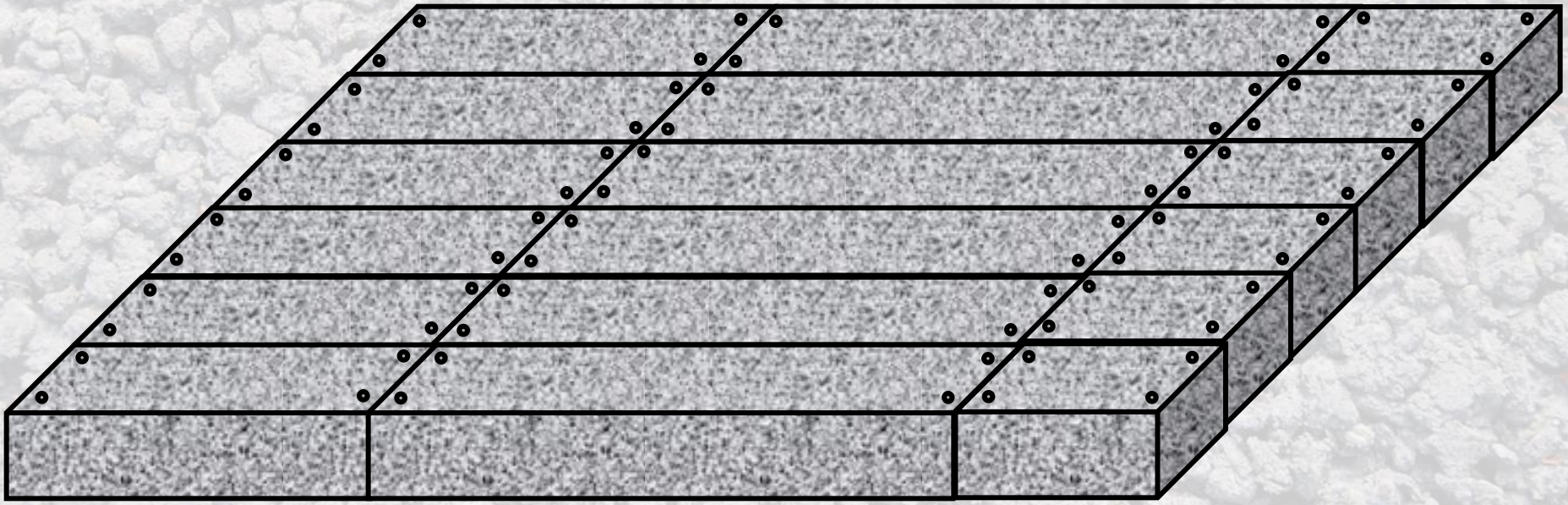

New York City Bus
CAUTION
WIDE


CAUTION
WIDE
Stormcrete™
Modular Porous
Concrete

Stormcrete™ Maintenance

Can be vacuum "swept" with standard equipment

Proper Equipment Selection is Important



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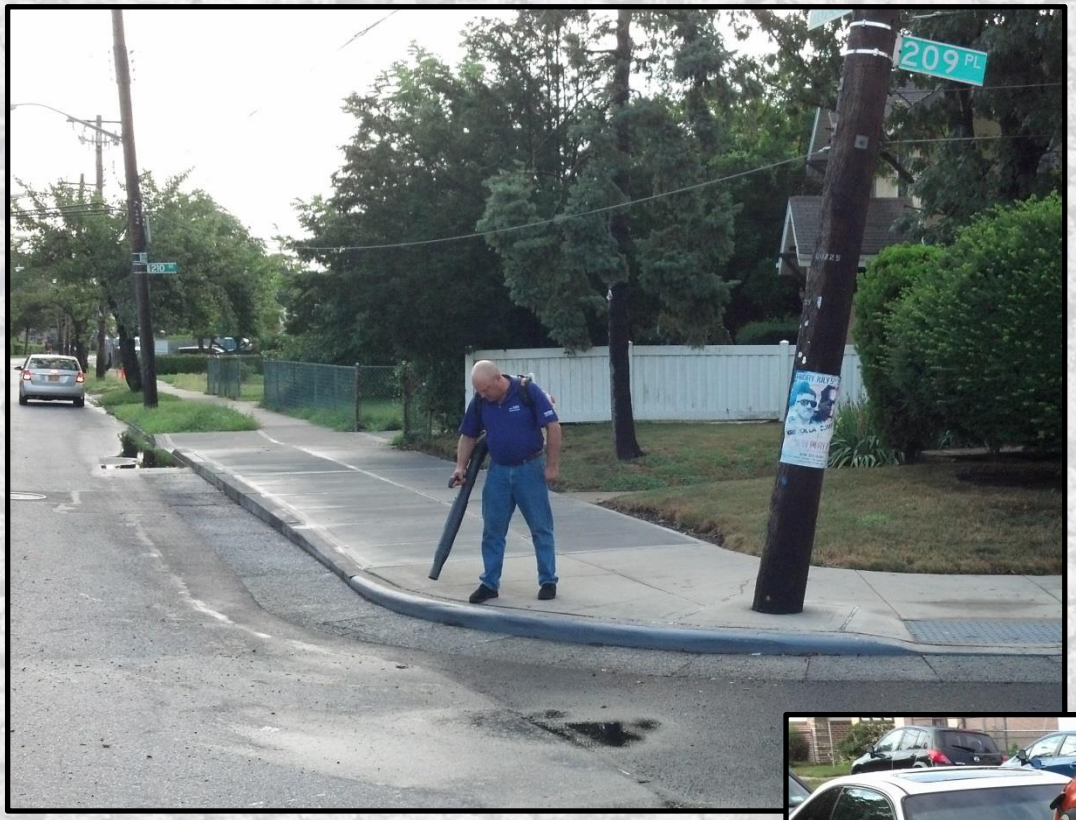
NYC Sanitation Department

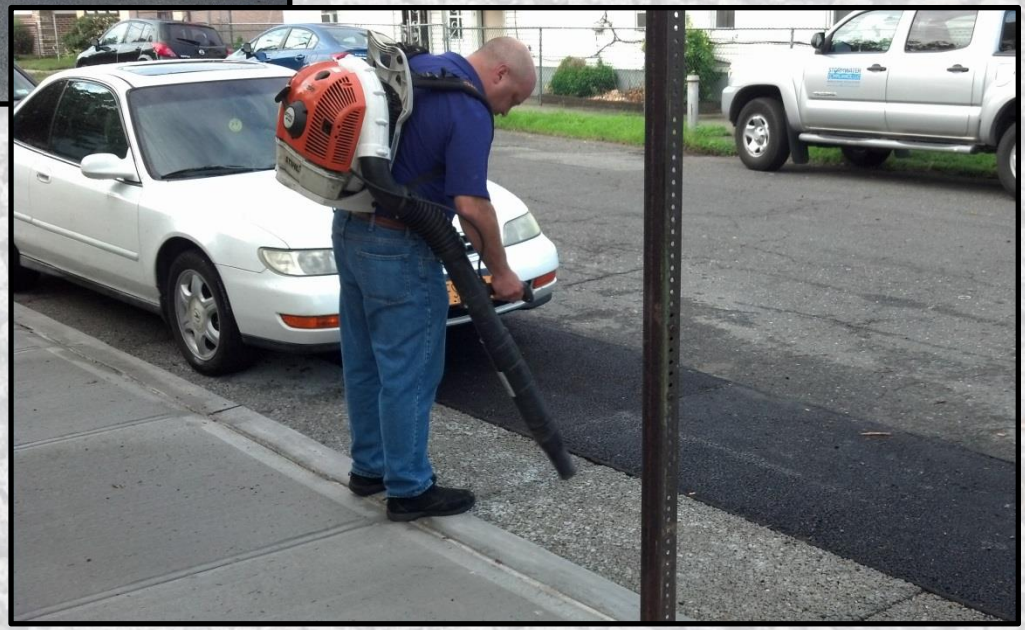
Steel "Gutter" Broom

Steel "Gutter" Broom will damage Porous Concrete Surface

Back Pack Blower



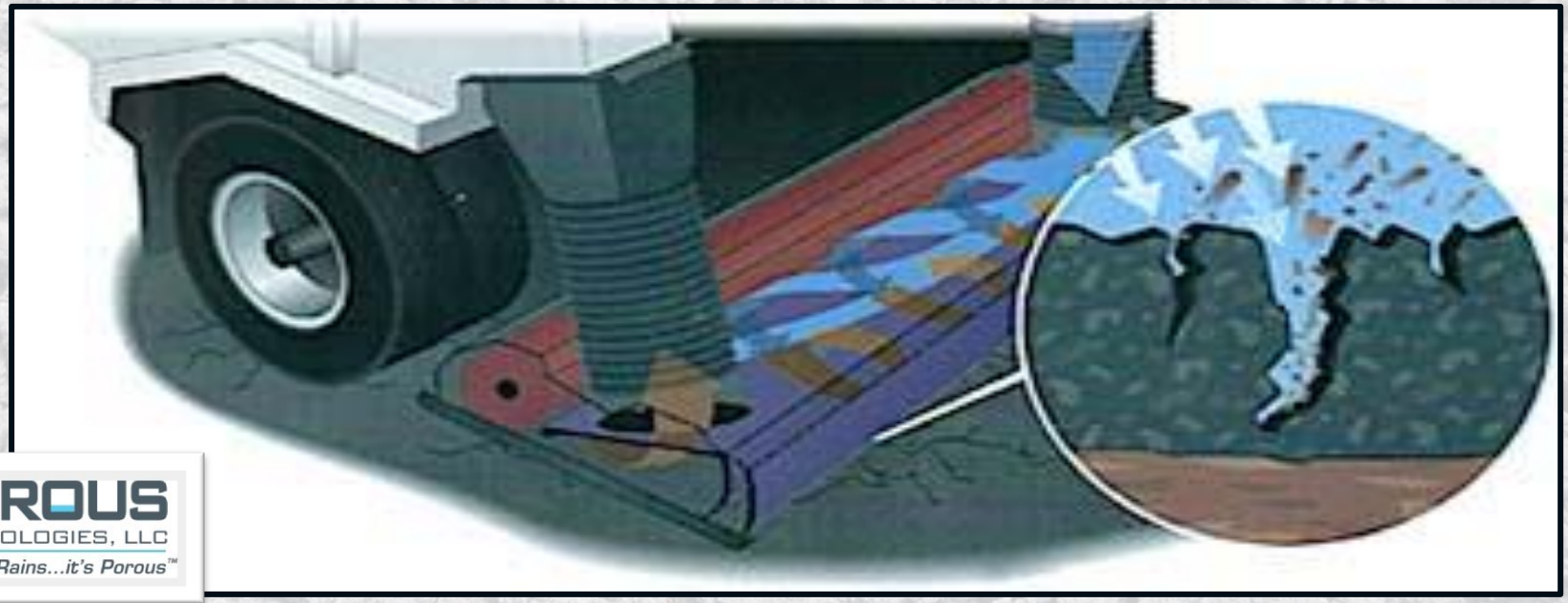
Effective during construction



Billy Goat
Walk Behind

All Terrain Maintenance Vacuum Equipment

Regenerative Air VACUUM Sweeper



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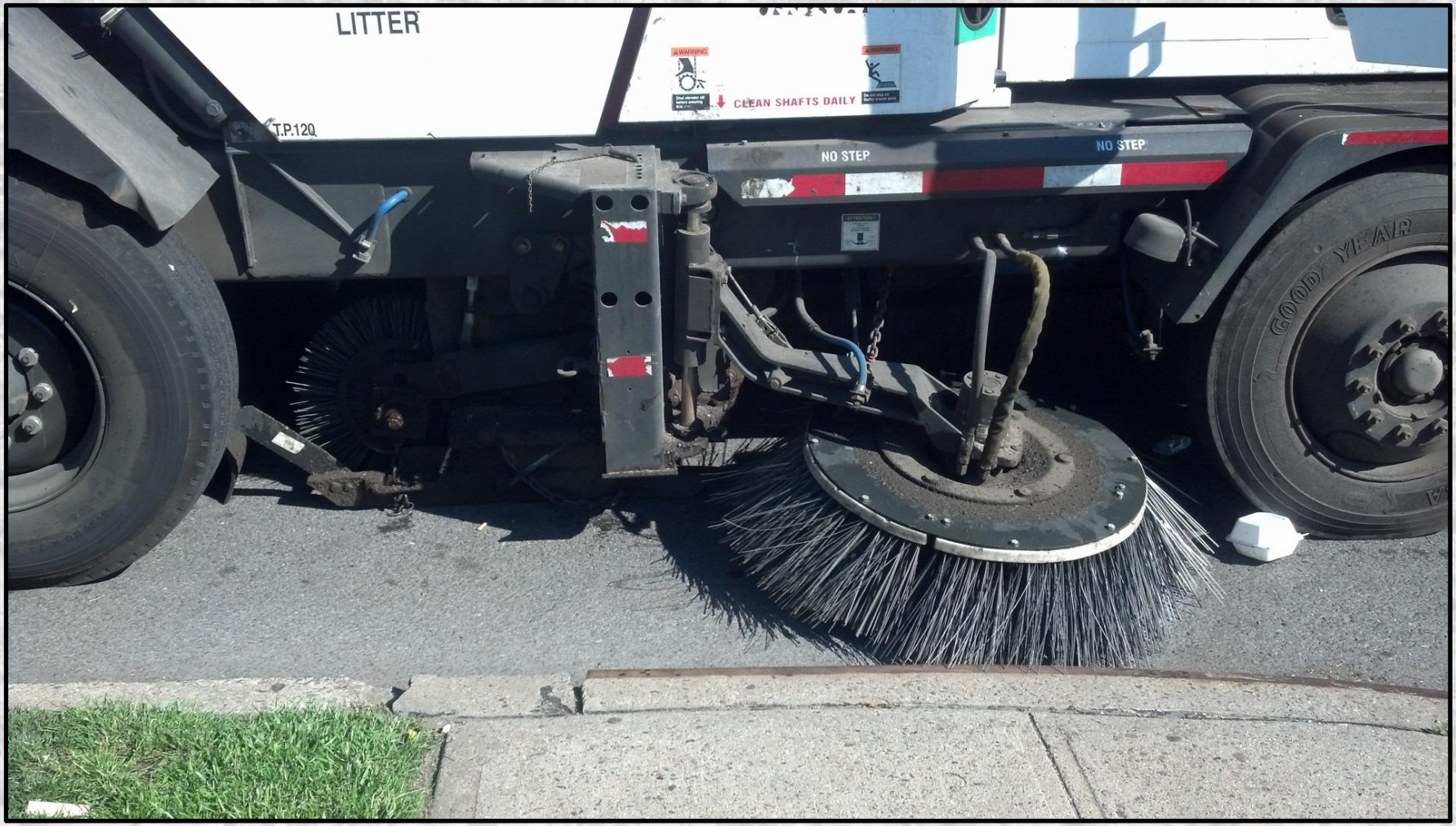
Gutter Broom's are inappropriate for porous pavement and act to drive sediment into pores



All Terrain Litter Vacuum

Sweeper Types

Mechanical Sweepers

They effectively remove gross pollutants and large debris (i.e. appropriate for spring clean-up), dirt and fine particles are actually forced into cracks by the broom head. The broom also tends to "push" the finer particles creating large amounts of dust. Mechanical broom sweepers are not typically recommended for porous surfaces.

Mechanical Broom Sweepers

Sweeper Types

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Vacuum Sweepers

Vacuum sweepers utilize a windrow broom to push debris over to a vacuum suction nozzle. Only a small area is actually vacuumed, the majority of the pass is swept with a broom (creating the potential for dust). Vacuum sweepers are acceptable for use on porous surfaces.

Mechanical Vacuum Sweeper

Sweeper Types

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Regenerative Air Sweepers

A controlled jet of air is directed into the cracks to dislodge dirt and fine particles. At the same time, a debris pick-up head vacuums particle across the entire length of the pass. Because there are no internal brooms and they utilize a closed loop system, dust is minimized. Regenerative Air sweepers are an acceptable method for sweeping porous surfaces.


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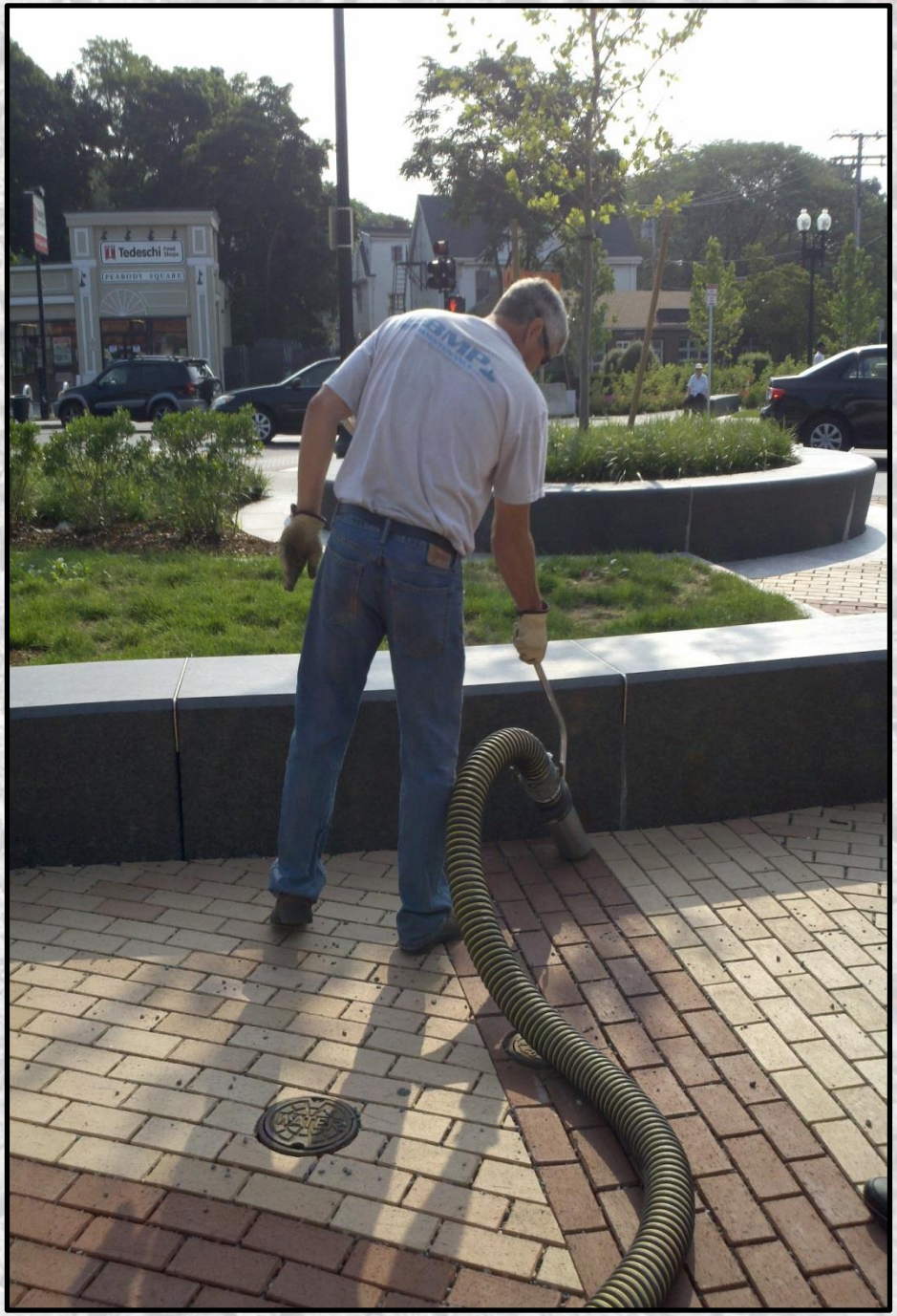
Tedeschi
PEABODY SQUARE
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& Rentals
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“Spring Clean-up”

Regenerative Air Sweepers

- **Effective at removing trash, dirt and fine particles from surface.**
- **Closed loop, brushless system reduces dust.**
- **A controlled blast of air dislodges debris and fines from the porous surface while the pick-up head vacuums the material.**
- **Recommended for use on porous pavement.**


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COMPLIANCE LLC
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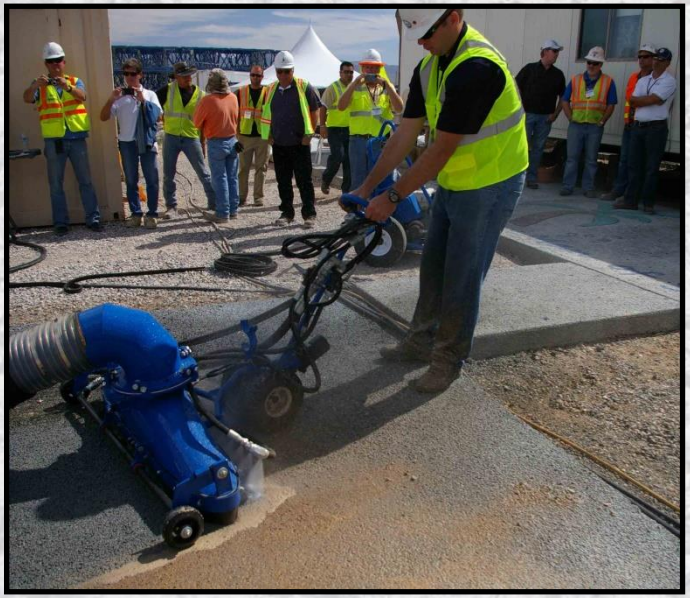
Focused Cleaning

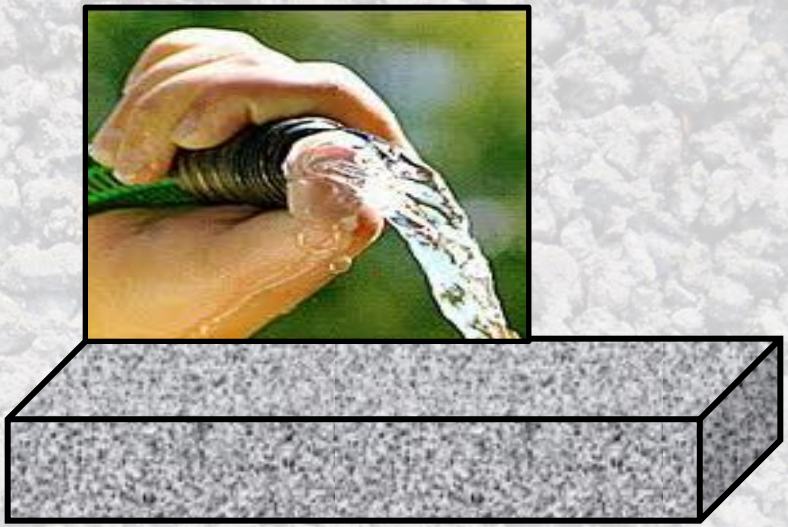
B.I.R.D.

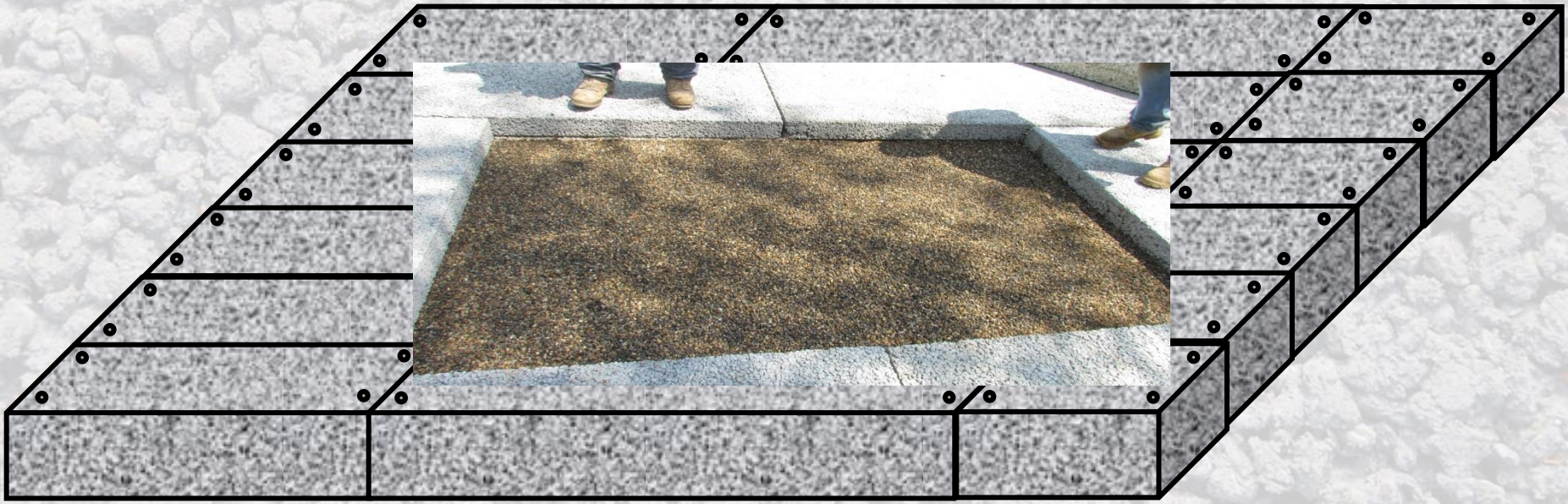
Bunyan Infiltration Restoration Device



STORMCRETE™

Can be removed and backwashed to "regenerate" and REUSE





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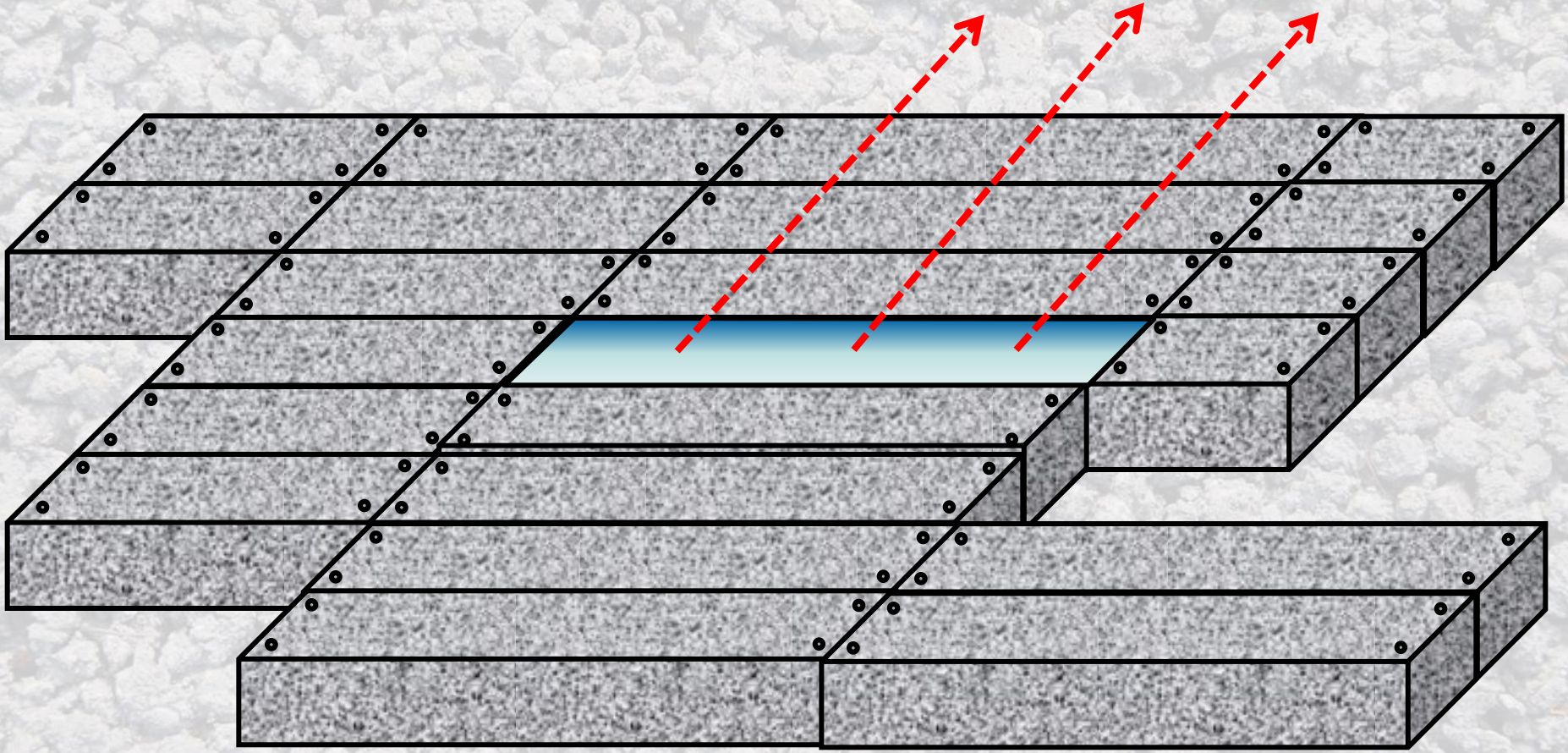
When it Rains...it's Porous™

Each precast porous segment is REMOVABLE and REUSABLE



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Modular Precast Porous Concrete Stormwater System