Interlocking CONCRETE PAVEMENT MAGAZINE

May 2010
Volume 17 Number 2
A publication of the Interlocking Concrete Pavement Institute

Design Awards

PICP Construction Tips


When your reputation
is all about quality work...
CHOOSE SNAP EDGE
PAVER RESTRAINT
Snip & Flex™ feature!
One piece works for curves
AND straight installations.
SEK
SNAP EDGE/KERR
800.932.3343
sek.us.com


POLYSWEEP™
Superior Strength Polymeric Sand
• Superior Strength
• Less Hazing
• Prevents Sand Loss
• Deters Weed Growth
• Protects Pavement Integrity
• Reduces Overall Maintenance
A Product Of SEK
SNAP EDGE/KERR
800-932-3343 • sek.us.com

Contents

May 2010 • Volume 17 Number 2

Departments

Features

Contractor Focus

Industry News

ICPI
INTERLOCKING CONCRETE PAVEMENT INSTITUTE ®
13921 Park Center Road, Suite 270
Herndon, VA 20171
Tel: (703) 657-6900
Fax: (703) 657-6901
Email: icpi@icpi.org

ICPI Canada:
P.O. Box 1150
Uxbridge, ON L9P 1N4 Canada

Qualified design professionals and contractors can receive a complimentary subscription – visit icpi.org

ISSN 1087-9862

Canada Post Agreement No. 41567031

Interlocking CONCRETE PAVEMENT MAGAZINE

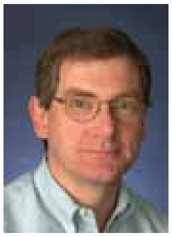
Publishing Director	Charles McGrath, CAE
Editor	David R. Smith
Graphic Design	Debra J. Stover Image Media
Advertising	Angie VanGorder The YGS Group
Circulation Manager	Jessica Chase

Advertising Sales:
THE YGS GROUP
3650 West Market Street
York, PA 17404
Tel: (800) 501-9571 x176
Fax: (717) 825-2171
E-mail:
angie.vangorder@theYGSgroup.com

Manage your subscription at icpi.org

Interlocking Concrete Pavement Magazine is published quarterly by the members of the Interlocking Concrete Pavement Institute (ICPI) for producers, suppliers, contractors, specifiers and users of interlocking concrete pavements.

For further information about this publication or about membership in ICPI, write to the appropriate address, call (703) 657-6900 or fax (703) 657-6901.



From the Editor David R. Smith

Redefining Expectations

Expectations set us up for joy, ambivalence or anger. Joy comes when our expectations are exceeded. There is an element of delightful surprise and sometimes a touch of awe. When expectations are met, we are ambivalent, maybe a little self-righteous in that circumstances and people delivered what we expected. In retrospect, the passing thought of raising expectations slightly might have produced an even better result. Not outstanding, but better.

Finally, when expectations aren't met anger is often the result. Inner reality doesn't match the outer reality of what's said, delivered or built. Anger is accompanied by frustration. In other cases, the emotional response is sometimes one of humiliation where evaluative thoughts ring true on the stupidity of expecting something that wasn't possible in the first place.

I've been writing about interlocking concrete pavements in this column for sixteen years and about permeable pavements for about six years. Scores of projects have been visited, many folks interviewed. The objective is to present projects where expectations were exceeded and explain why and how that happened. In doing this I'd like to offer a few observations.

All successful projects start with a client or owner that has high expectations and demands that they be met. There is often a vision or view of how the world should be—or at least the part owned by that person or organization—expressed through design and construction. That vision defines what is expected from designers and contractors…and they deliver. What is expected from people is what usually comes forth from people who work for someone else. That line of reasoning is called the Pygmalion effect. It is the "you can do it" and "attaboy" messages that bring out superb projects.

This is evident in the annual design awards displayed in the issue and every past and future one. In each project, the owner, designer or contractor likely stated the vision of what the project should look and perform like and everyone

Continued on p. 23

The Concrete Solution...

FOR CONCRETE PAVERS, WETCAST & NATURAL STONES

Introducing the first polymeric sand designed for concrete overlays

NEW FOR 2010

For drainage & non-drainage beds

ANYTIME. ANYPLACE. AND NOW, ANY SURFACE.

Hardscape Solution!

3. FREE Education & Support

Nobody emphasizes hardscaping education like **Gator University,** the industry's top online resource for the hardscaping professional.

Learn how to build a more successful hardscaping business at Gator U.

Ask your Dealer:
For your **FREE**
Top 10 Tips Brochure

ENROLL FOR FREE

By phone: **1.866.212.1611**
Online: **AllianceGator.com**

FREE
- Video tutorials on products and installation
- Business-building webinars
- Exclusive **Gator U** T-shirts

PLUS
Access to the exclusive **Gator U** blog, providing invaluable instructions on:
- Credit-card processing
- Insurance programs
- Direct-mail brochures
- Members-only benefits!

Work Smart. Grow Strong!
Alliance GATOR UNIVERSITY U

Join the Alliance Team at GATOR U!

Taking Things to the Next Level

We appreciate the efforts by *Concrete Products* Editor Don Marsh, his staff and the judges:

John Evans, Director of Construction Services for Chicago landscape architects Hoerr Schaudt

Adam Lavey, Senior Project Manager for Chicago architect Pappageorge Haymes Partners

The winners of the annual North American Decorative and Durable Concrete Pavement Design Awards contest raised the bar on what can be done with interlocking and permeable interlocking concrete pavements (PICP). Project area makes no difference. Elegance is found in projects with as small as 900 sf (90 m^2) of concrete pavers up to 235,000 sf (23,500 m^2). The winners demonstrate the continued growth of commercial PICP, residential streets in high-end neighborhoods, and the intimate residential entrances and backyard outdoor rooms. We are pleased to present the winning projects and especially pleased that many of the winning contractors and paver suppliers are ICPI members (marked with an asterisk*).

Organized by *Concrete Products* magazine, the contest winners are a result of a response to a call for entries issued last fall that generated 14 precast concrete entries. This was followed by collecting and categorizing the entries, as well as providing judges to select the winners.

The judging criteria include integration of color, texture, patterns with the larger site and architecture. Other considerations included craftsmanship, ecological conservation, historic preservation and the project's contribution to local economic and/or cultural development. Commercial winners include first and second place winners plus an honorable mention. Residential winners include first place and two entries that tied for second place followed by an honorable mention.

Commercial
First Place

Buckingham Fountain Restoration, Grant Park, Chicago

Designer:
Thompson Dyke
& Associates, Ltd.,
Chicago, Illinois

General Contractor:
Burling Builders, Inc.
Chicago, Illinois

Paver Contractor:
LPS Pavement
Company,
Oswego, Illinois

Paver Supplier:
Unilock,
Aurora, Illinois

Fountain Floor

Featured on the cover the August 2009 magazine issue, this 235,000 sf (23,500 m^2) permeable interlocking concrete pavement (PICP) surrounds the historic Chicago landmark fountain and classically designed public space next to Lake Michigan. Some $11.5 million improvements to the fountain and site include ADA accessibility upgrades, utility improvements, landscape restoration and several other stormwater and sustainability improvements. PICP is now a standard pavement option with the City of Chicago.

The designer reviewed various surfaces used in similar public spaces and provided a cost-benefit and design analysis for each. The Chicago Landmarks Commission selected a historically significant and functional surface, and one that happened to replace the existing pink gravel surface. The team nominated a colorful product that provided stormwater infiltration, accessibility and referenced the historically significant pink stone from days gone by. The result was a permeable granite-like concrete paver with joints filled with pink, open-graded highly permeable aggregate.

In order to generate a random laying pattern that satisfied the Chicago Landmarks Commission, the designer developed a 49-paver layout using three paver sizes in a seemingly random arrangement. The surface permeability reduced the number of manholes and drainage structures and lowered overall stormwater infrastructure costs. Great care was also taken by the contractor to develop a matching concrete mix for the replacement of the stairs and the perimeter curb.

PICP with a 12 in. (300 mm) thick open-graded aggregate base/subbase for storage and infiltration satisfied Chicago Department of Water Management requirements for on-site detention. With 40% voids in the aggregate, 85,000 cf (2,400 m^3) created for water storage and infiltration which exceeded City requirements. The Mayor's Office for People with Disabilities wanted a concrete or asphalt surface. Since neither surface would satisfy the aesthetic requirements for the fountain, the design team developed a customized paver solution with minimal joint widths (7 mm) between pavers. This resulted in an extremely smooth surface for wheelchair users.

More awards on page 8

Commercial
Second Place

Owner/General Contractor: TD Desert Development/The Drummond Company

Designer:

Paver Contractor: Farley Interlocking Pavingstones, Palm Desert, California*

Paver Supplier: Sierra Products, Belgard/ Oldcastle, Fontana, California*

**ICPI Member*

Andalusia at Coral Mountain front entry, La Quinta, California (cover photo)

Flamenco Flavor

Designed to reflect Andalusia, Spain, the 30,000 sf (3,000 m^3) entry to this development is the front door to 680 emerging homes, two championship golf courses and club facilities. When completed, the project will tout some 750,000 sf (75,000 m^2) of interlocking concrete pavement. Originally designed as mortared stone on a concrete slab with a tight completion deadline, Farley Interlocking Pavingstones instead proposed concrete pavers at the entrance thereby meeting deadline with a competitive price. The 3 1/8 in. (80 mm) thick concrete pavers are installed over bedding sand and a 6 in. (150 mm) thick Caltrans Class II compacted aggregate road base. As a bonus, all of the homes have pavers in their driveways, walkways and courtyards with pool decks as an option.

Commercial
Honorable Mention

General Contractor: Capex Construction and Development, Palm Beach Gardens, Florida

Paver Contractor: Triple M Pavers, Jupiter, Florida

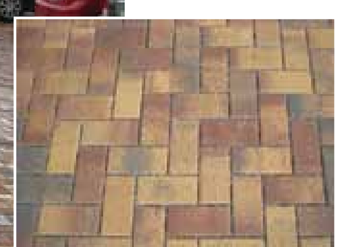
Paver Supplier: Hanson Hardscape Products, Pompano Beach, Florida*

**ICPI Member*

Toyota of Stuart, Florida

Inventory Insurance

After 20 in. (0.5 m) of rainfall over 19 hours in August 2008, 41,000 sf (4,100 m^2) of permeable interlocking concrete pavement (PICP) spared about 200 cars from flood damage at this Toyota dealership. (Do the math: less than a half a million dollars of PICP preserves about $5 million in inventory…and PICP will do this again in future downpours.) The PICP drained the rainfall so well that the areas under the cars remained dry during the storm. The permeable pavement was lower in initial cost than conventional asphalt as it would have required a separate detention pond and land to support it.



More awards on page 10

Residential
First Place

Dobbs Residence/Irish Pub, Jarrettsville, Maryland

Paver Contractor:
Rock Solid Landscaping*, Bel Air, Maryland

Paver Supplier:
E.P. Henry, Woodbury, New Jersey*/
Ernest Maier, Bladensburg, Maryland

*ICPI Member

Backyard Bar Hopping

In this curious backyard setting, some 990 sf (99 m^2) of pavers provides the visual and circulation anchor to a renovated 1880 vintage school house and an authentic reproduction of an Irish pub. Special features include a dry-stack stone fireplace, a waterfall and concrete segmental retaining walls. The pub's home location conveniently eliminates the need for a designated driver.

Residential
Second Place (Tie)

Foley Residence, Omaha, Nebraska

Paver Contractor: Paver Designs LLC, Omaha, Nebraska

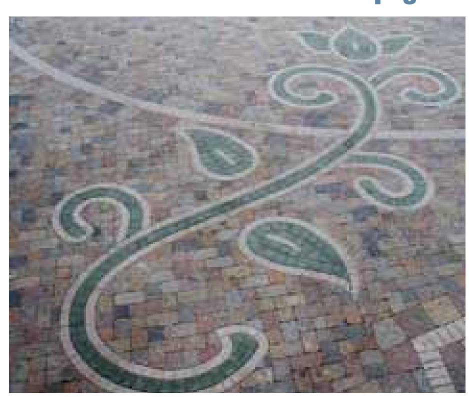
Paver Supplier:
Pavestone Company*/
Watkins Concrete Block Company, Omaha, Nebraska

*ICPI Member

Flowery Statements

Working as father and son, Paver Designs specializes in design and installation of custom concrete segmental pavements. This 1,900 sf (190 m^2) paver driveway replaced a cracked, poured-in-place concrete driveway. The 18 in. (450 mm) thick recycled concrete base supports an inch (25 mm) of bedding and four-piece tumbled pavers at $2\frac{3}{8}$ in. (60 mm) thick. The chamfers on the light-colored pavers within the plants were cut out to provide a clean, contrasting surface and color.

More awards on page 14



ENVIROBOND PRODUCTS CORPORATION

Think green.
Live green.

View product comparison videos at **www.envirobond.com**

ORGANICALLY STABILIZED JOINTING MATERIAL

- resists erosion
- self-healing
- inhibits weed & ant infestation
- water permeable

made from 100% naturally occurring materials

for larger joints

for paver joints

1.8666.ENVIRO (368476)

Residential
Second Place (Tie)

Paver Contractor:
Gappsi Inc.,
Smithtown, New York

Paver Supplier:
Nicolock, Lindenhurst,
New York*

*ICPI Member

Private Residence, Smithtown, New York

Rising to the Occasion

A big height difference in the driveway and front door entrance are minimized with a handsome and leisurely rise using concrete pavers on the stoops and segmental retaining walls enclosing planters. As a frequent contest winner, designer/builder Giuseppe Abbrancati again demonstrates creativity and grandeur in his designs. The steps are natural stone from Gappsi's collection.

Residential
Honorable Mention

Paver Contractor:
Kane Landscaping,
Potomac Falls,
Virginia*

Paver Supplier:
Techo-bloc,
Pen Argyl,
Pennsylvania*

*ICPI Member

Kagan Pool Patio, Leesburg, Virginia

Backyard Beauty

A rich and magical backyard environment emerges from 1,800 sf (180 m^2) of five-piece, light colored pavers randomly placed to create a temperature-friendly summer surface. In order to compensate for elevation differences, the compacted aggregate road base varies between 8 to 20 in. (200 to 500 mm).

2010 HARDSCAPE North America℠

THE Trade Show for Hardscape Contractors and Distributors!

Unparalleled Education Program featuring over 200 hours of Business Management and Hardscape installation/maintenance specific seminars featuring top industry speakers.

Get up to speed with ICPI paver & NCMA SRW Installer Certifications, the new, daily “Breakfast with Champions” networking roundtables and Best Practices of Segmental Paver Installation.

Learn by Doing with hands-on installation training and outdoor demonstrations featuring subjects like paver and SRW installation, aggregate compaction, stone veneer and raised patio construction.

Pre-Show Full Day Distributor Program highlighting “Secrets of a Successful Hardscape Distributor”.

Additional Opportunities to learn more about “Sustainable Hardscapes” and to attend the 3rd annual Hardscape Project Awards on Saturday.

See New Products in ten acres of indoor exhibits and an 18 acre “try before you buy” demo area.

Free Concerts on Thursday and Friday night plus Hardscape contractor face-to-face power networking.

Two Great Shows in One Location

GIE+EXPO

NETWORKING | DEMO AREA | EDUCATION | NEW PRODUCTS

The 14th Largest Tradeshow In North America

Register Now at

www.HardscapeNA.com

or call Sellers Expositions at (888) 580-9960.

“Hardscape North America and GIE+EXPO is a natural fit. Now I have a single source place where I can find the things that I want as a hardscape contractor. I don’t know of any other place that offers this.”

Fred Adams
Fred Adams Paving
Raleigh, NC

Thursday, Friday, Saturday | October 28–30, 2010 | Kentucky Exposition Center | Louisville, Kentucky

SHOW PRODUCED BY:

ICPI Interlocking Concrete Pavement Institute

SHOW ENDORSED BY:

The Brick Industry Association

National Concrete Masonry Association — Sustainable Concrete Products for Structures and Hardscapes

PLATINUM SPONSORS

Belgard Hardscapes | Hanson HeidelbergCement Group, Hanson Hardscapes | National Concrete Masonry Association | Pavestone — Improving Your Landscape | Pine Hall Brick

GOLD SPONSORS

Pathfinder | SEK Snap Edge/Kerr | SRW products | Techniseal — Protect and Beautify | weber mt

SILVER SPONSORS

Alliance Designer Products, Inc. | Anchor Wall Systems | Seal ‘n Lock System Corporation

Contractor Focus

PICP Construction Tips

Permeable interlocking concrete pavement (PICP) is seeing increased use in residential and commercial projects thanks to U.S. and Canadian municipal governments need to curb stormwater runoff. To increase their assurance of quality installations, the Interlocking Concrete Pavement Institute (ICPI) recently initiated a PICP Installer Technician Certificate course aimed at educating contractors on the specifics of PICP construction (Figure 1). This one-and-a-half day course covers a broad range of topics that help ensure contractors understand that PICP requires a higher level of construction skill and attention to details. The course covers residential and commercial construction including:

Figure 1. ICPI recently launched a PICP certificate course for contractors. Besides meeting training needs within the industry, the ICPI is encouraging PICP course certificate holders as a requirement in federal, provincial, state and municipal construction specifications, as well as private sector projects.

- Comparison of PICP to ICP
- Job planning and documentation
- Job layout, flow and estimating materials including average productivities for various job functions
- Soil and site characteristics
- Subbase and base materials
- Edge restraints
- Bedding and jointing materials
- Selection and installation of permeable interlocking concrete pavers
- Maintenance

The courses are sponsored by ICPI members across North America. Contractors who take the course and pass the exam receive a certificate which is being promoted by ICPI in PICP guide specifications. A recent example is requiring that the contractor have a certificate as part of guide construction specifications submitted to Caltrans. ICPI is planning to submit such requirements in PICP guide specifications to other provincial, state and local agencies. This article provides some construction tips most of which are excerpted from the PICP Installer Technician Certificate course.

Figure 2. Elmhurst College in Elmhurst, Illinois used very thick bases to accomplish underground detention/ infiltration for landscape irrigation in certain parts of a large PICP parking lot. The thick bases provided additional structural support for heavy trucks.

Figure 3. Equipment spreading aggregate and rides on the aggregate to keep it clean.

Figure 4. Truck washing equipment might be a cost-effective solution to keeping mud and sediment from PICP surfaces during construction.

Soil Compaction

Many PICP designs take advantage of the soil infiltration to reduce stormwater runoff even in clay soils. Unlike interlocking concrete pavement, PICP is generally built on native, undisturbed, non-compacted soils in order to promote infiltration. Compaction greatly reduces a soil's infiltration capacity. If the soil subgrade is compacted, the amount of water infiltration decreases 50% to 90% with the higher percentage applying to clay soils. Therefore, ICPI recommends not compacting soils under PICP in many designs beyond grading and trimming for drainage.

PICP design and construction uses nature's compacted soils. The natural (undisturbed) in-place density of native soils increases with excavation depth and infiltration rates generally decrease with depth due to increasing density. While native soil densities are not as high as that resulting from deliberate compaction (as with a vibratory roller compactor), the native densities provide some support to the PICP base/subbase and loads placed on them.

Excavation and grading equipment passing over the soil subgrade surface results in some compaction and increased density results in decreased soil infiltration. Compaction incidental to construction equipment passing over soil is generally not to the same depth from deliberate soil compaction with equipment typical to parking lot or road construction. Nonetheless, such incidental compaction helps defeat the infiltration benefits of soil in PICP. Designers need to consider this condition and provide reduced soil infiltration in their base and drainage designs. Better still, designers and contractors can specify ways to preserve or restore soil infiltration during construction and some ways to accomplish this are presented here.

If a contractor inadvertently compacts the soil subgrade with construction equipment, the soil can be raked with the teeth of a bucket to loosen the compacted soil layer. An interesting research project by engineer and University of Tennessee Professor John S. Tyner examined the potential for restoring infiltration rates in clay Tennessee soil prior to installing pervious concrete pavement. The researchers' summary noted the following:

Several types of treatments were applied to the clay soil prior to placement of the stone aggregate base and pervious concrete in an attempt to increase the exfiltration rate, including:

(1) control – no treatment;
(2) trenched – soil trenched and backfilled with stone aggregate;
(3) ripped – soil ripped with a subsoiler; and
(4) boreholes – placement of shallow boreholes backfilled with sand.

The average soil infiltration rates from lowest to highest were:

(1) control – 0.013 in./hr (0.8 cm/day)
(2) boreholes – 0.0625 in./hr (4.6 cm/day)
(3) ripped – 0.375 in./hr (10.0 cm/day)
(4) trenched – 0.4375 in./hr (25.8 cm/day)

Continued on p.18

Figure 5. Vacuum equipment draws out dirt and soils stone from a PICP. The openings are refilled with stones. Such equipment would likely be required in removing dirt and sediment pressed into PICP openings during construction.

While the aggregate-filled trenches drained the fastest due to their 9+ ft. (3.05 m) depth, the ripped soil cut to over 17 in. (45 mm) deep drained reasonably well using a soil ripping device on a bulldozer. Clean course sand was spread across the surface to fill in cracks in the soil which of course further facilitates infiltration. While the depth of the ripped soil in this research project is substantial, the effects of ripping demonstrate some infiltration improvement over the control which was native, uncompacted soil. Its infiltration rate could have been lower still if compacted by construction equipment.

When there is a period of time between excavation and aggregate placement, sometimes excavating all but the last 6 in. (150 mm) of soil can help in preserving soil infiltration. The open excavation can collect water and sediment, and this area can be traversed with construction equipment. When the aggregate is ready to install, the final 6 in. of soil can be excavated and the base/subbase aggregate installed.

Another approach is using equipment that can excavate from the sides of the opening without entering it and compacting the soil subgrade. Power shovels with a long reach can accomplish this. The horizontal and vertical reach of these shovels is limited so their effectiveness is governed by the dimensions of the excavated area.

For PICP subject to regular truck traffic, deliberate compaction of low-California Bearing Ratio soils (CBR<4%, typical slow-draining clays) may be necessary to attain sufficient structural support and minimize rutting. These soils should be compacted to at least 95% of standard laboratory Proctor density. Subdrains in the open-graded base will likely be required to remove water, since compaction will greatly reduce the soil's permeability. As previously noted, the design engineer determines the compaction required for weak soils. Most low CBR soils have low infiltration rates so compaction to achieve additional structural support may not greatly impact infiltration.

Another approach is to use thicker bases or place deep bases (over 2 ft. (0.6 m) thick) that function as detention facilities while providing additional base thickness to support concentrated loads from trucks. Figure 2 on page 16 illustrates this at a parking lot in Elmhurst College near Chicago, Illinois. A portion of the parking lot provides underground detention to provide water for landscape irrigation.

Keeping Aggregates Clean

One of the big challenges in PICP construction is keeping the aggregates clean during delivery, storage and placement. If dirty aggregate for the subbase or base is installed in sufficient quantities, the dirt can reduce subgrade soil infiltration. Dirty aggregates (and the fines on them) may also impair their ability to lock together during compaction and remain as such during service. A best practice is clean tires and tracks on equipment that pushes the aggregate

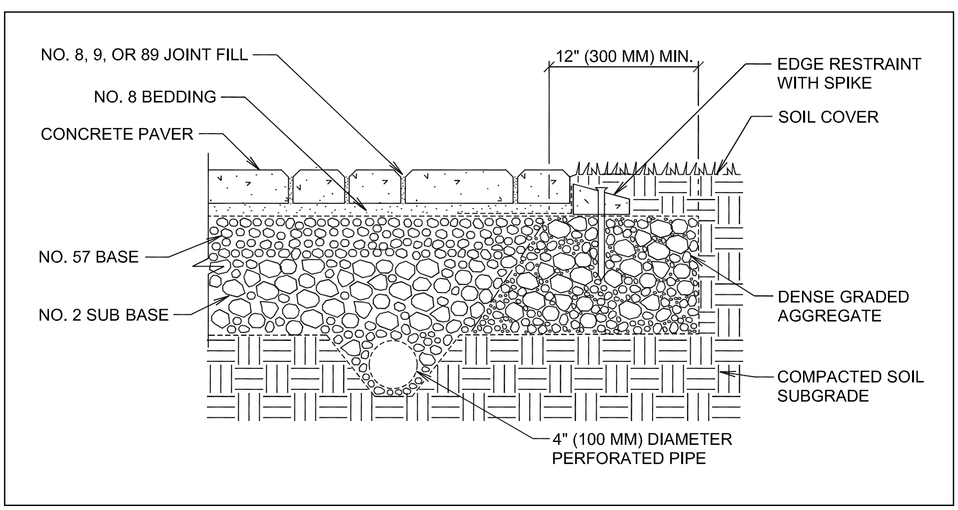


Figure 6. Typical cross section of a residential driveway using dense-grade base berms for anchoring edge restraints. Drainage at the lowest end (typically at the street) can be handled with a pipe running into the adjacent lawn with a pop-up drain at the surface.

in front such that the equipment rides on aggregate during distribution and spreading. The equipment does not ride over the bare soil subgrade. See Figure 3 on page 16.

If aggregates are stored on the job site, they should be placed on an impervious pavement, on a finished portion of PICP, or over geotextile if stored on grass or bare soil. The best situation is having aggregates delivered and dumped into an excavated area for a residential driveway, commercial parking lot or road. A prepared excavation means one graded to specified elevations with drain pipe and geotextile in place as specified by the designer. While geotextile may or may not be specified to cover the top of the soil within the excavation, it is a best practice to cover the sides. This helps prevent soil eroding into the base and subbase materials over time.

Project planning before and timing during construction are important to keeping aggregates clean. Most PICP is built just before or during the construction of buildings or site features. It is rarely installed last. Therefore, PICP can be incorrectly designated as an access road and be subject to dirt deposited from truck tires or from minor soil erosion with no specifications (or funds) to clean the surface. Here are some options that should be included in the projects specifications and discussed at the preconstruction meeting. They are given in the order of most preferred to least preferred with relative costs.

Option 1: Establish a temporary road for site access that does not allow vehicular traffic to contaminate the PICP materials and surface. Post signs and inform all trades to use the temporary road rather than the PICP. Cost: High

Option 2: Construct the PICP aggregate subbase and base. Protect the surface of the open-graded base with

Continued on p.20

 Continued from p.19

Figure 7. Dense-graded aggregate base material forms berms along the sides of this PICP residential driveway. Open graded aggregate base is placed in the center to store and infiltrate water.

Figure 8. Both bases—dense-graded and open-graded—are compacted to the same elevation.

geotextile and place a ~2 in. (~5 cm) thick layer of the same base aggregate over the geotextile. Thicken this layer to match elevations at adjacent impervious pavement surfaces where vehicular traffic enters/exits the PICP area. This should provide a transition to and from existing driveway, parking lot and road surfaces. When other construction around the PICP is completed, remove geotextile and soiled aggregate and install the remainder of the PICP system (i.e. bedding, pavers and jointing materials). Any settlement due to construction traffic can be repaired prior to placing the bedding, paver and jointing materials. Cost: Low

Option 3: Allow construction vehicles to use the finished PICP system (i.e. paver joints and/or openings filled with aggregate). Prior to opening, cover the surface with a geotextile and a 2 in. thick open-graded aggregate layer. This "sacrificial" layer is the riding surface during construction. Transition areas to other pavements will require additional aggregates for vehicles to from ride from impervious pavements to PICP. Remove the soiled aggregate and geotextile when construction is complete. Cost: Low.

Option 4: Allow construction vehicles to use the finished PICP. At the conclusion of construction activities, vacuum

Figure 9. A plastic edge restraint is nailed into the compacted, dense-graded base material. Permeable pavers are installed per manufacturer and ICPI recommendations.

Figure 10. PICP that meets asphalt should be separated with a concrete curb or beam.

Figure 11. PICP and poured-in-place concrete meet. A best practice is to separate the bases between these two pavement systems with an impermeable liner.

out the dirt from the joints. The vacuuming process should also remove some of the stones, at least the portion that jammed with sediment. Refill the cleaned out joints with clean stones. The vacuuming operation requires use of powerful true vacuum equipment. Regenerative air vacuums or sweepers will not be effective in removing dirt jammed in the joints. The operator of the vacuum equipment will need to adjust the vacuum force such that the dirt is drawn out with some stones, but not so much that all the stones are withdrawn from the paver joints and/openings. Figure 5 on page 18 illustrates this type of equipment cleaning PICP openings and joints. Cost: Low to medium.

Another option is providing a truck washing system on the job site. These are portable systems (in various sizes) that wash mud from truck tires and undercarriages and capture the sediment for later removal from the site. These systems require a water source and are very effective in reducing sediment deposits on PICP from construction equipment. Figure 4 on page 16 illustrates this equipment in action.

Edge Restraints

Like interlocking concrete pavements, edge restraints for PICP are essential. Commercial vehicular areas should use cast-in-place concrete, precast concrete or cut stone curbs. Commercial and residential pedestrian applications and residential driveways can use these types as well. A less expensive alternative can be installing a compacted base at the PICP perimeter with plastic or metal edging spiked on it with typical 3/8 in. (10 mm) diameter by 10 in. (250 mm) long nails. The center area of the driveway or pedestrian application utilizes open-graded base materials. Figure 6 on page 18 illustrates a typical cross section. Figures 7, 8 and 9 illustrate the construction process.

When concrete curbs are poured, they are often positioned over a layer of open-graded subbase material such as ASTM No. 2 stone. The bottom of the curb formwork

Continued on p.22

PICP Construction Tips *Continued from p.21*

will need to be choked with No. 57 stone to prevent loss of wet concrete. Without the No. 57 stone to stop the concrete, it will easily migrate into the openings among the larger No. 2 stones. When using precast curbs or granite curbs, a cradle-type footer of concrete haunches to support the curbs should be considered.

When PICP pavement abuts a compacted, dense-graded aggregate (DGA) base (typically surfaced with asphalt), a vertically-placed impermeable barrier is recommended to segregate it from the open-graded aggregate supporting the PICP. An at-grade concrete beam is sufficient to divide asphalt from the PICP surface. See Figure 10 on page 20. The beam is minimum 6 in. (150 mm) wide, resting on the No. 2 subbase or extending to the bottom of the No. 57 material. The DGA should have geotextile under it separating it from the soil subgrade.

The PICP surfaces that abut poured-in-place concrete slabs without a curb (as shown in Figure 11) will need a vertical liner to segregate the DGA aggregates and soils from the PICP base materials. Whether next to asphalt or concrete pavements, the PICP subgrade should slope away from the DGA area at a minimum of 1%. This helps move water away from the DGA under the impermeable pavements.

Conclusion

PICP construction requires special attention to details not normal to constructing interlocking concrete pavements. Avoiding soil compaction, keeping aggregates and the PICP surface clean, plus using edge restraints appropriate to the application require cost and execution planning when preparing a bid. This article only covered a part of many PICP construction aspects. The ICPI PICP Installer Technician Course is an opportunity to fully dive into project planning, execution and maintenance. Visit icpi.org to find out ICPI member sponsors, locations and dates of the PICP courses. Contractors attending the course must hold a current ICPI Level I Concrete Paver Installer Certification. ❖

References

Tyner, J.S., Wright, W.C. and Dobbs, P.A., "Increasing Exfiltration from Pervious Concrete and Temperature Monitoring," *Journal of Environmental Management*, Vol. 90 (2009), pages 2636-2641.

PICP Installer Technical Certificate Course Student Manual, First Edition, Interlocking Concrete Pavement Institute, Herndon, VA, 2009.

Redefining Expectations *Continued from p. 2*

delivered beyond those expectations. What is miraculous is when expectations are exceeded with the project budget and schedule intact.

It is magical when everyone doesn't state expectations and just works to exceed them. That takes an unusual familiarity with everyone involved in a project. An analogy is superb jazz musicians who know each other's skills, style and musical vocabulary. They all build on each other's creative and desire to make beautiful music. Everyone is taken to the next level of audio and emotional joy. Of course, the experience, practice and work for musicians…artists, designers and contractors…to get to that place are not an easy path.

Perhaps a striking example of expectations being exceeded lies with permeable interlocking concrete pavement (PICP). I recently attended a conference where several papers on pervious concrete preceded my sole presentation on PICP. Several presenters of papers spoke to classic pervious concrete issues like variability in delivered materials due to a tenuous mixing process from a concrete truck, freeze-thaw durability especially when exposed to deicing materials, cleaning clogging from sediment, and the means and length of time required (7 days) to cure the material prior to use. The unspoken message was "you can expect these issues and we are trying to mitigate them with research, test methods and acceptance criteria."

PICP (and indeed all permeable pavements) has a transformative effect on people by redefining expectations. This is especially evident on a project's opening day. The PICP contractor might bring a water truck onto the project, or better still, make a donation to the local fire department. That results in a 5,000 gal (10,000 l) pumper truck visiting the site. The fire hose spews forth an enormous fountain of water that immediately disappears into the PICP surface. Project officials and onlookers gasp in awe at the water actually going into the pavement instead of running off.

Their reaction of awe and joy is that their mental landscape of expecting pavement to generate runoff is immediately changed. The reliability of water, gravity, concrete and aggregate is at work yet with redefined roles. Runoff and pollution are reduced. Winter ice diminishes. Puddles are non-existent. We hope our industry continues redefining and raising expectations. Progress in changing the way we think and build then follows. ❖

With the help of the Chicago Fire Department, PICP at White Sox stadium parking lot redefines expectations.

ICPI Co-sponsors PICP Maintenance Workshop

As Low Impact Development (LID) continues to increase in popularity, a better understanding of the technologies incorporated into LID is needed. One of the emerging technologies across the USA is permeable interlocking concrete pavements or PICP. Like all stormwater practices, PICP needs to be maintained. Research has shown that with relatively simple and reliable maintenance, this best management practice will continue to reduce runoff and clean water.

This workshop provides an overview of PICP, discusses recent permeable pavement maintenance research, introduces maintenance needs and equipment, and ends with a demonstration of various maintenance techniques including street sweeping, stain removal, and vegetation control. The ¾ day event will be held in Monterey, California at the Naval Post Graduate School on June 4, 2010. The event is sponsored by North Carolina State University Department of Biological and Agricultural Engineering, Advanced Pavement Technology, Elgin Sweeper and ICPI. To register, visit http://www.bae.ncsu.edu/stormwater/training/permeable_pavement.html. This event follows last year's successful workshop held at Morton Arboretum in Lisle, Illinois which was attended by over 100 persons including engineers, landscape architects, municipal, county and state officials, and industry representatives. ❖

Concrete Paver Industry Calendar of Events

May 26, 2010
ICPI Federal Officials Seminar
Capital Hilton Hotel
Washington, DC
www.icpi.org

June 4, 2010
PICP Maintenance Workshop
Monterey, CA
www.bae.ncsu.edu/stormwater/training.htm

June 7-10, 2010
ASTM Meetings
St. Louis, Missouri
www.astm.org

August 25-28, 2010
ICPI Summer Meeting
Ottawa, Ontario
www.icpi.org

October 28-30, 2010
Hardscape North America
Louisville, Kentucky
www.hardscapenorthamerica.com

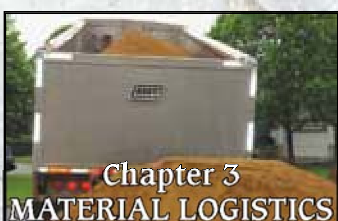
ICPI Webinars for Design Professionals, Contractors and Suppliers
For registration details or more information, visit www.icpi.org or call ICPI at 703-657-6900.

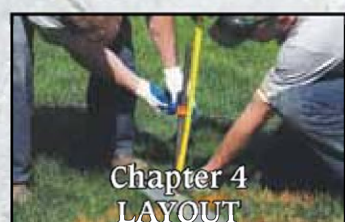
See www.icpi.org for a listing of 2010 ICPI installer certification schools.

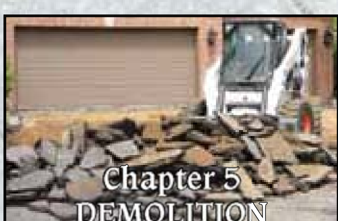
Advertisers in this Issue

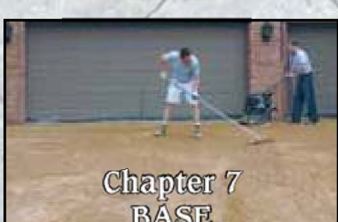
FOUNDATION SKILLS

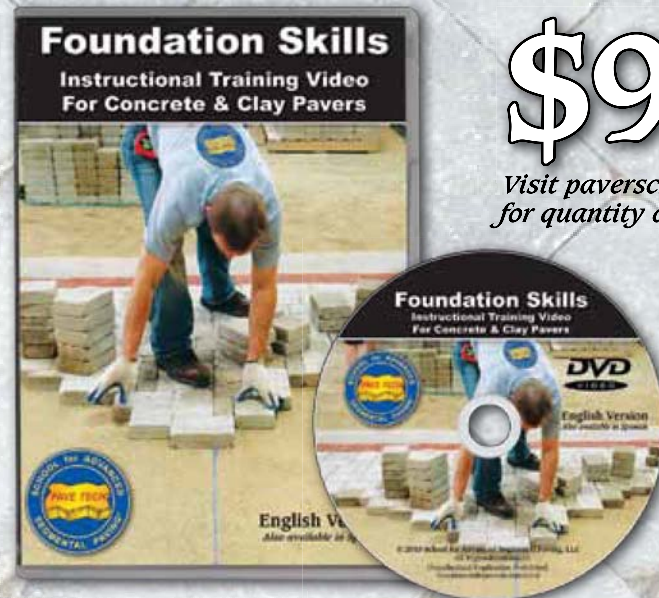
Instructional Training Video for Concrete & Clay Pavers











$99

Visit paverschool.com for quantity discounts

Advantages

- Building block for in house training program
- Improve crew efficiencies
- Better profitability
- Structured training format
- Raises expectations for higher level of detail & quality
- Cost effective training format
- SASP Certification
- **Available in English and Spanish**

Using industry best practices, techniques, and technology, this training video will allow you to increase the quality and efficiency of your crews on all your segmental pavement projects. With the help of SASP's Founders, the industry's best paver contractors, you will also learn specialized installation techniques.

For more details about this
NEW Paver Installation Training Video,
please visit our website.

paverschool.com

To order your copy of the video, please call.

800-728-3832