THE OFFICIAL PUBLICATION OF
THE INTERLOCKING CONCRETE
PAVEMENT INSTITUTE

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SPRING 2013

Guerrilla Tactics, Local Markets

LEED v4 Overview

ICPI Releases Tech Spec 18

Geomembranes

volume 20 number 2

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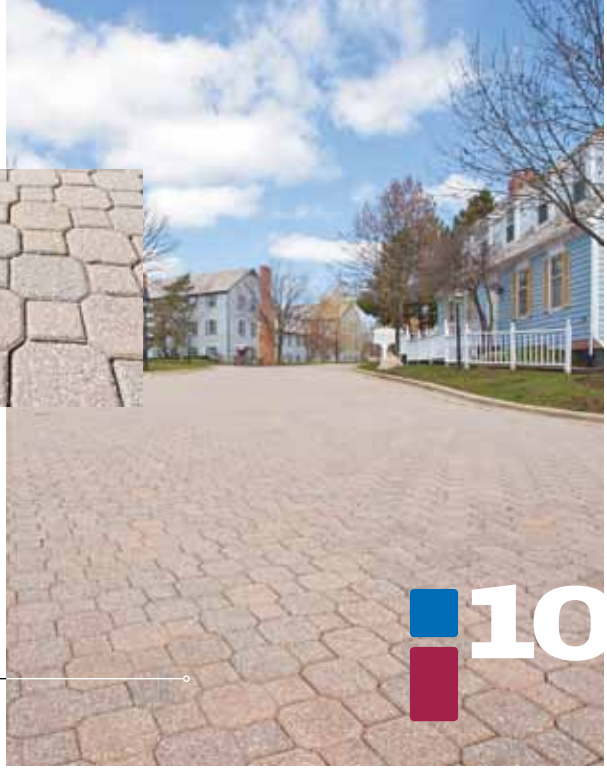

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Photo Credit: Mike Schwartz

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GUERRILLA TACTICS IN LOCAL MARKETS

David R. Smith

Local guerrilla tactics begin with deploying concrete pavers in small, highly visible places.

Invisible Armies

With our world awash in conventional asphalt and concrete, what does it take to get more interlocking concrete pavements built? Former Speaker of the House (1977-89) Tip O'Neill said, "All politics is local." Much design, construction and permitting happens locally as well. The transition of society to interlocking concrete pavement (ICP) and permeable interlocking concrete pavement (PICP) begins and remains local. The incremental process of change involves convincing one designer at time, one city at a time. Over time the industry mission grows, impacting states and eventually entire nations.

This incremental process of change is analogous to guerrilla warfare where what matters most is the ability to shape the story, not the facts on the ground. This is how guerillas are able to lose battles but win wars.

The segmental concrete pavement industry probably has about 300 sales representatives working with designers in Canada and the U.S. This sales army represents around 100 companies, from family-owned to multi-nationals. Collectively, these salespeople make up a guerrilla army. Ideology energizes most guerrillas, and this one believes ICP and PICP provide a cost-effective, environmentally friendly way to pave.

China's Mao Zedong, a master of guerrilla theory and practice, taught that guerilla warfare has three stages. First, there is localized war. This involves ad hoc groups spontaneously forming and resisting local forces. The second stage is a war of movement with small, trained and agile groups of lightly armed soldiers striking strategic enemy positions. The final stage is a general uprising, a war fought with a three-tiered force consisting of local militias, full-time mobile guerillas and a regular army.

The industry seems between the first and second stages. The first stage began with projects from local guerrilla sales force efforts. An early example is the cover story about a road project in Illinois. In the early '80s, a paver installation contractor convinced the developer and eventually the local municipality to accept ICP. For over 30 years now, the only maintenance required on this installation has been the replacement of around 500 pavers. According to the developer, the same roads would have required repaving twice in that same period of time had asphalt been used.

As paver manufacturers and contractors' businesses have grown and matured, some have worked together in promotion and sales. Occasionally, designers have joined with them to convince a client to use ICP or PICP. This continues to be an effective approach. When proposals from manufacturers, contractors and designers become ICP or PICP projects, these warriors are working in the second stage of guerilla tactics. Their success is often replicated for use outside of a single geographic area. Evidence of this success and the geographic impact abounds in the transformation of hundreds of residential streets, downtowns, industrial and port pavements to ICP across the U.S. and Canada.

While there are nations where segmental pavement rules and is not the exception, the industry in North America has further to go. With a range of powerful sales tools, ICPI is working directly with the full-time sales militias who have the mobility to strike in several geographic markets simultaneously. The work consists of additional technical training to better understand where and how to address competitors' weaknesses, and to better satisfy client needs. To bring down the asphalt empire (or coexist by moving it over), state and federal governments must be presented with ICP and PICP specs, guidelines and performance information, as in this issue.

The ultimate goal is to have a regular national army that can accelerate the institutionalization of segmental paving. Even at that point, such an army with its supporting local sales guerillas will work invisibly, continuing to shape the ICP and PICP story, *and* with facts on the ground.

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KNOWLEDGE base

Hardscape North America 2013 Preview

ESSENTIAL INDUSTRY TRADESHOW RETURNS

ICPI is pleased to announce that Hardscape North America (HNA) will be held Oct. 23-25, 2013, at the Kentucky Exposition Center in Louisville, KY.

Produced by the Interlocking Concrete Pavement Institute and endorsed by the National Concrete Masonry Association and the Brick Industry Association, HNA is *the* hardscape show for contractors and dealers/distributors. HNA is colocated with GIE+EXPO (the Green Industry & Equipment Expo), and together they constitute the ninth largest tradeshow in America.

HNA offers a wealth of opportunities that attendees can take back home and immediately implement in their businesses:

- **NEW PRODUCTS –** More than 750 indoor and outdoor exhibits spotlight new products and equipment.
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The HNA Installer Championship challenges the skill, dedication and passion of hardscape contractors. Up to 12 teams are tested on their understanding of industry best practices, safety, quality and craftsmanship by completing an outdoor hardscape installation in a race against the clock. The winner receives $1,000, free tools, the HNA Installer Championship cup for a year, bragging rights and tons of free PR. Details subject to change.

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New product brings cleaner sites and clearer lungs with dustless cutting

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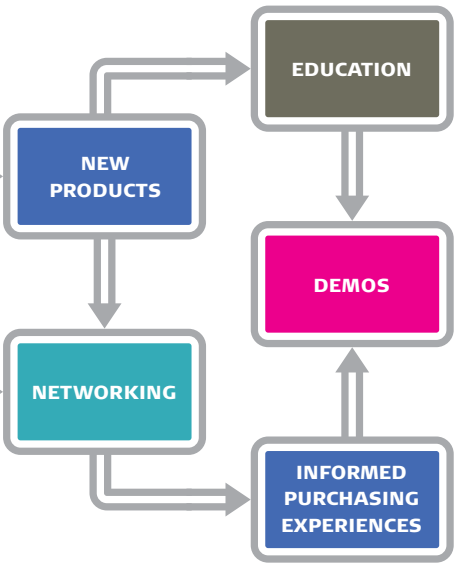
iQ Power Tools introduces dustless saws for cutting concrete and clay pavers, segmental retaining wall units, masonry bricks and blocks. These saws combine diamond-tipped saw blades mounted on a table with a vacuum and filter dust collection system. Developed by a former mason, the saws emit almost no dust, making them compliant with personal exposure limits mandated by California and the U.S. Occupational Safety and Health Administration (OSHA).

While a hand-held chop saw is the quickest means to cut pavers, it is also the dirtiest because of all the dust it creates. Dust inhalation is a hidden, long-term danger that can increase the risk of silicosis in the lungs. With current regulations that limit worker exposure to silica dust, and possible stricter ones being considered by OSHA, compliance is within reach with these saws. **www.iqpowertools.com**



CORRECTION

In the Winter 2013 cover story, Remaking a City, about Oklahoma City's Project 180, we incorrectly identified Howard-Fairbairn Site Design as Howard Site Design.

ICPI RELEASES TECH SPEC 18

The Interlocking Concrete Pavement Institute (ICPI) has published the newest addition to its popular Tech Spec technical bulletins, *Tech Spec 18: Construction of Permeable Interlocking Concrete Pavement Systems.*

This bulletin is for contractors and project inspectors, and assists design professionals in understanding construction requirements for project specifications. Tech Spec 18 covers permeable paver components, benefits, recommended sites and important characteristics, sites to avoid, functional descriptions for full, partial and no exfiltration systems, design considerations and a step-by-step description of the construction process, which is also summarized in a convenient check list.

Permeable interlocking concrete pavement (PICP) is recognized by federal, provincial, state and municipal stormwater and transportation agencies as a best management practice (BMP) and low impact development (LID) tool to reduce runoff and water pollution. In addition, PICP offers unique design opportunities for reducing combined sewer overflows with green alleys and streets, as well as with parking lots and pedestrian surfaces. Tech Spec 18 addresses a growing need to educate contractors on installation best practices for this sustainable pavement system.

ORDER COPIES ONLINE Tech Spec 18: Construction of Permeable Interlocking Concrete Pavement Systems can be accessed at *www.icpi.org*. ICPI members may purchase printed copies in packs of 10 through its online store.

And One for All

ICPI CREATES ACCREDITATION PROGRAM TO RECOGNIZE CONTRACTORS

ICPI is pleased to announce the creation of the Accredited Paver Installation Company Program (APIC) to recognize companies that meet industry best practices.

In 1995, ICPI designed the ICPI Certified Installer Program, which has trained close to 20,000 individuals. A central concept of the ICPI Certified Installer Program is that an *individual* becomes a certified installer, not a company. As a result, some member companies have been unable to effectively promote that they follow industry best practices and ICPI guidelines. The new APIC program recognizes companies that consistently install interlocking concrete pavements in the U.S. and Canada to industry guidelines, best practices and according to professional principles.

Features of the program:

- Marketing to promote APIC participants, including additional company listing and web links on the ICPI website;
- A Construction Task List that requires trained personnel to be present at key construction steps;
- A Code of Conduct that sets a model for businesses to follow.

Requirements for the program:

- The owner/principal of the company must hold a current ICPI Certified Installer certificate;
- An ICPI Certified Installer must be present on every job site and actively involved in each step identified in the Construction Task List that is part of the company's scope of work;
- The work performed by the company must be within their area of experience and of a scope similar to previous company projects;
- All employees must comply with a company safety program;
- The company must pledge to uphold the APIC Code of Conduct;
- The company must maintain current commercial insurance policies and produce insurance coverage certificates when and where requested by ICPI or a customer.

The fees to participate in the program depend on a company's membership status within ICPI. ICPI membership is not required to participate in the program. For more information on fees and how to sign up, visit ***www.icpi.org/APIC***.

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By Peter Fretty

kickin' asphal

A 33-YEAR-OLD PAVER INSTALLATION DEMONSTRATES OUTSTANDING DURABILITY

Home to 70+ businesses, Williamsburg Village is the only business park located in suburban Chicago's Inverness. The 10-acre park primarily consists of professional services such as architecture firms, dental offices, medical facilities and offices for financial services.

With colonial style buildings reminiscent of historical Williamsburg, VA, the scenic landscape also includes ponds and bridges that create an impression more akin to a residential townhouse community than a business park.

In planning Williamsburg Village, the Inverness-based developer New London Construction Co., who still manages the development today, wanted to recreate some of the charm found throughout Germany. They knew concrete pavers would provide elegance and historic character to the village. After visiting a few U.S.-based paver installations and receiving a five-year guarantee on the work from the contractor, they were sold.

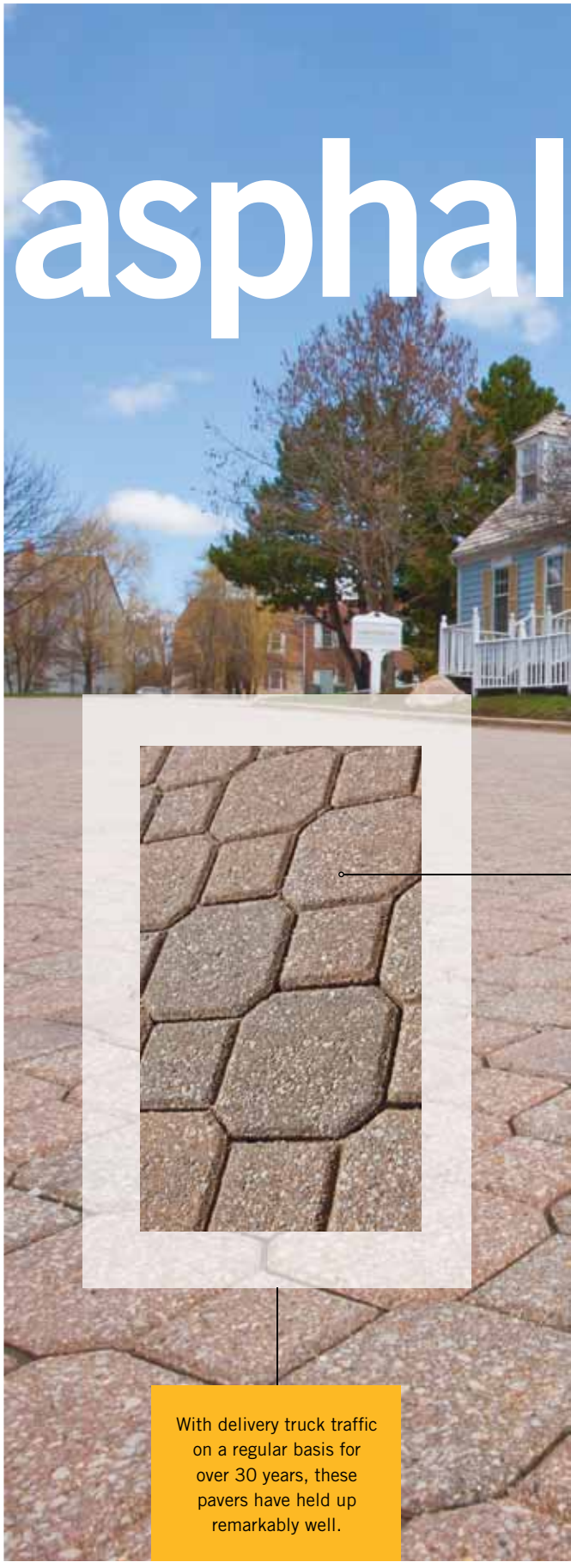
"This is a pretty upscale development with a very themed concept," says New London President Jack Monco. "We have architectural styles to match old Williamsburg. The pavers were a way for us to truly differentiate the project from everything else. It just would not have been possible with concrete or asphalt."

LOW-COST MAINTENANCE

Williamsburg Village includes approximately 130,000 sf (12,000 m²) of interlocking concrete road pavement. Installed in 1979, the paver portion cost $3.50 per sf (m²), including the sand bedding, pavers and labor.

"Even though this has always remained a private road, we had to build it to village specifications in case it ever went public or the village was ever asked to assume maintenance responsibilities," says Monco. "Specifically, this meant the base prep had to be exactly the same whether using asphalt or pavers. The village was a little concerned at the time about the use of concrete pavers. Their concern was understandable since there had not been much use of pavers locally, but we used the fact that European roads have used pavers for decades without problems as persuasion."

His example proved true. Over the 33-year life of the roadway, he has



With delivery truck traffic on a regular basis for over 30 years, these pavers have held up remarkably well.

Photo Credit: Mike Schwartz

CROSS SECTION:

— Install date: 1979
— Paver thickness: 8 cm
— Pattern: Herringbone
— Colors: Brown/Buff/Red

not had to perform any major maintenance, which is impressive considering the consistent delivery-vehicle traffic, the harsh Chicago weather and regular use of deicing materials in the winter. According to weather records, the Inverness community annually averages just over 100 days of precipitation, including 35 in. (87.5 cm) of snow.

"Obviously we have snow every year so we contract companies to handle the plowing. We also apply substantial amounts of salt each winter because we get a lot of freezing rain," Monco says. "Occasionally, we have seen individual pavers pop up that we have had to replace."

"Some of the pavers did sink down near the sewer entrances, but this would have happened regardless of the material used. Still, these were only individual pavers or small sections at the most," he says. "I am confident that if we did not salt the streets, there would be significantly more life in the paver road. To date, Monco estimates his maintenance team has replaced a maximum of 500 pavers.

BUILT TO LAST

ICPI member Bill Schneider, founder of LPS Pavement, the company that installed the pavers, says the secret to the project's longevity came from focusing on designing and building a pavement *system* rather than just emphasizing the paving product.

The longevity of the Williamsburg job alone demonstrates greater value to cities and taxpayers than today's popular residential landscaping use, explains Schneider.

"If you think about how long this job has been in place, it shows the potential for other streets," he says. "Some cities shy away from pavers because they do not think they work. This [installation] is still performing beautifully because it is a superior pavement system."

Schneider points out that there has been some wear on the Williamsburg installation. "While the

Continued on page 12

> If we would have decided to go with asphalt instead for the primary road, we would have had to repave at least twice, and it still would not have looked as nice as the pavers."
>
> —Jack Monco, president of New London Construction Co.

pictures do not show it, there are a few cracked pavers, which could be expected after 30 years," he says. "However, the pavers have performed far beyond the guaranteed five years, as well as beyond the estimated 20 years quoted."

LPS Pavement subcontracted the dense-graded base installation. Prior to placing it, the soil was compacted and then the 12 in. (30 cm) thick base was installed in 6 in. (15 cm) lifts. A 1½ in. (3.8 cm) layer of coarse sand was screeded over the compacted base. After placing the pavers on the bedding sand, the contractor compacted them into it, filled the paver joints with sand and compacted them again.

PAVERS KICK ASPHALT

Monco has his share of experience with asphalt across all of his company's Chicagoland developments. And, specifically within the Williamsburg Village complex, Monco has roughly a 50/50 mix of asphalt and pavers, with extensions from the main road asphalt.

"If we would have decided to go with asphalt instead for the primary road, we would have had to repave at least twice, and it still would not have looked as nice as the pavers."

In addition, Monco only built structures as his team sold them—meaning all of construction took place with the pavers installed. "With asphalt we would have ended up waiting on the topcoat until everything was in place," he says. "Fortunately, we did not end up with any ruts or other problems common when heavy equipment has to travel over a roadway. If the project allows for the extra expense upfront, the quality, durability and look [of pavers] are unbeatable." ○

LEARNING WHILE DOING

The Williamsburg Village project was built well before the interlocking concrete pavement industry formed an association, and well before association guide specifications directed designers and contractors on best practices for materials and installation. Therefore, information on best practices came from other sources. For example, the contractor did not use extremely fine bedding sand thanks to advice from German contractors who had extensive experience building paver roadways.

In the late '70s, little guidance existed on the correct compactor force needed for seating pavers. Fortunately, the contractor gave attention to these kinds of details each step of the way. Bill Schneider of LPS Pavement notes, "We knew that compaction was critical for project longevity, and compactors for pavers need to exert at least 5,000 lbf (22 kN). You cannot use the small compactors and expect the same level of performance. Knowing the right size of the aggregate and sand is also important."

For the commercial and municipal markets to grow, Schneider says that contractors need to decide to operate in the commercial or residential markets. Successful contractors can operate in both markets if they chose, but should use different crews and develop each through different companies.

"If you go to Europe you will see that they use far more pavers than we do here," he says. "In Germany, they do not use residential contractors to do commercial work. When you are doing commercial work, there is more to it than simply laying pavers. The contractor needs to understand that a pavement system is built and that it requires relentless attention to quality control of materials and their installation, verified by testing, all from specifications that follow industry guidelines."

IN 33 YEARS, LESS THAN

500 pavers

HAVE BEEN REPLACED OF THE 500,000+ IN SERVICE

Photo Credit: Mike Schwartz

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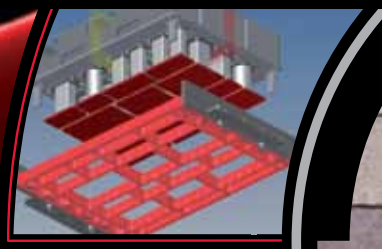

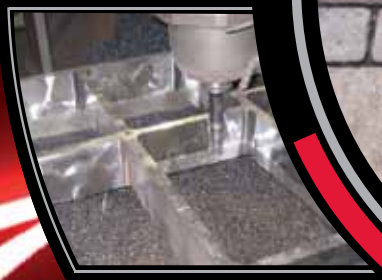

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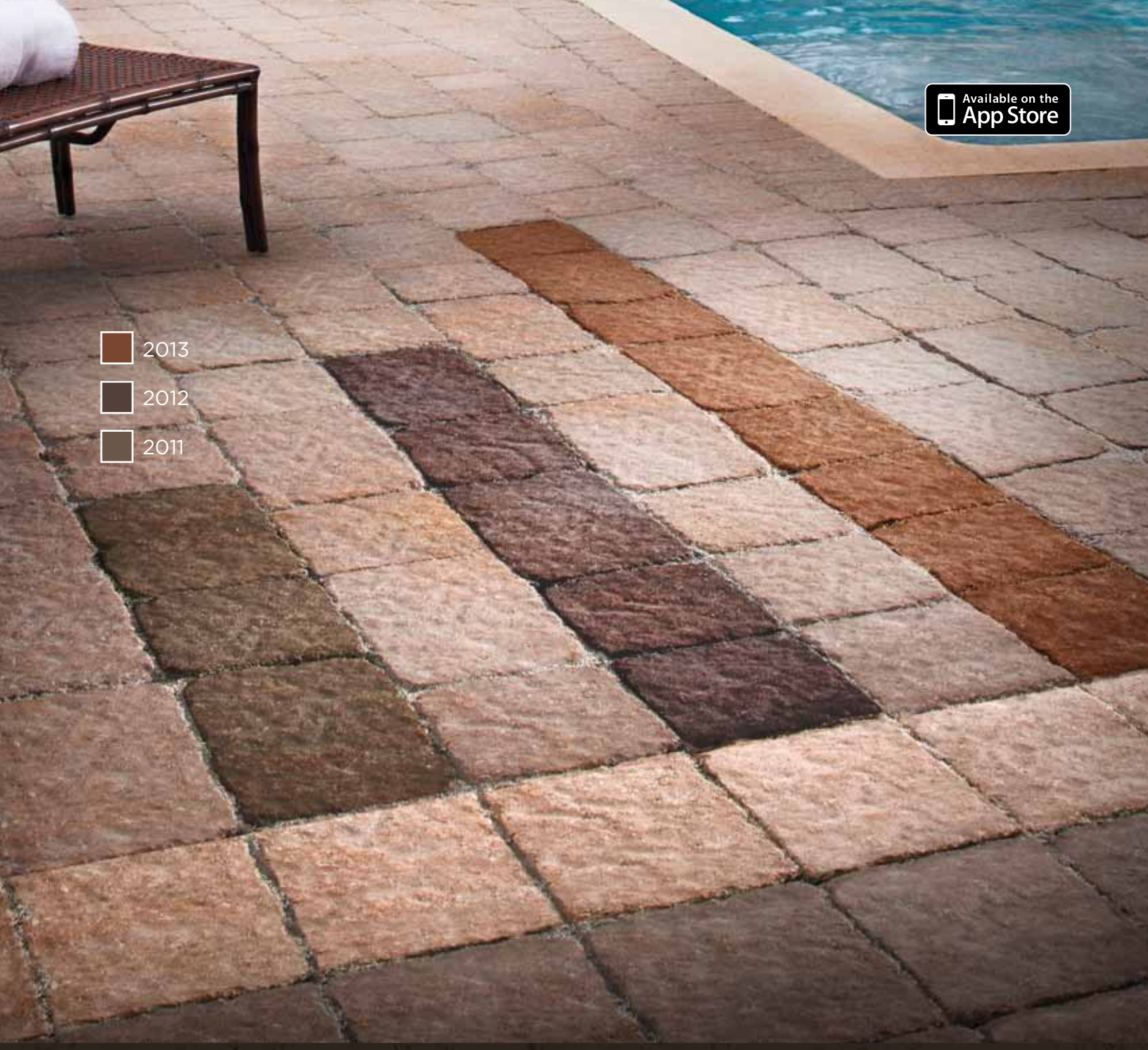

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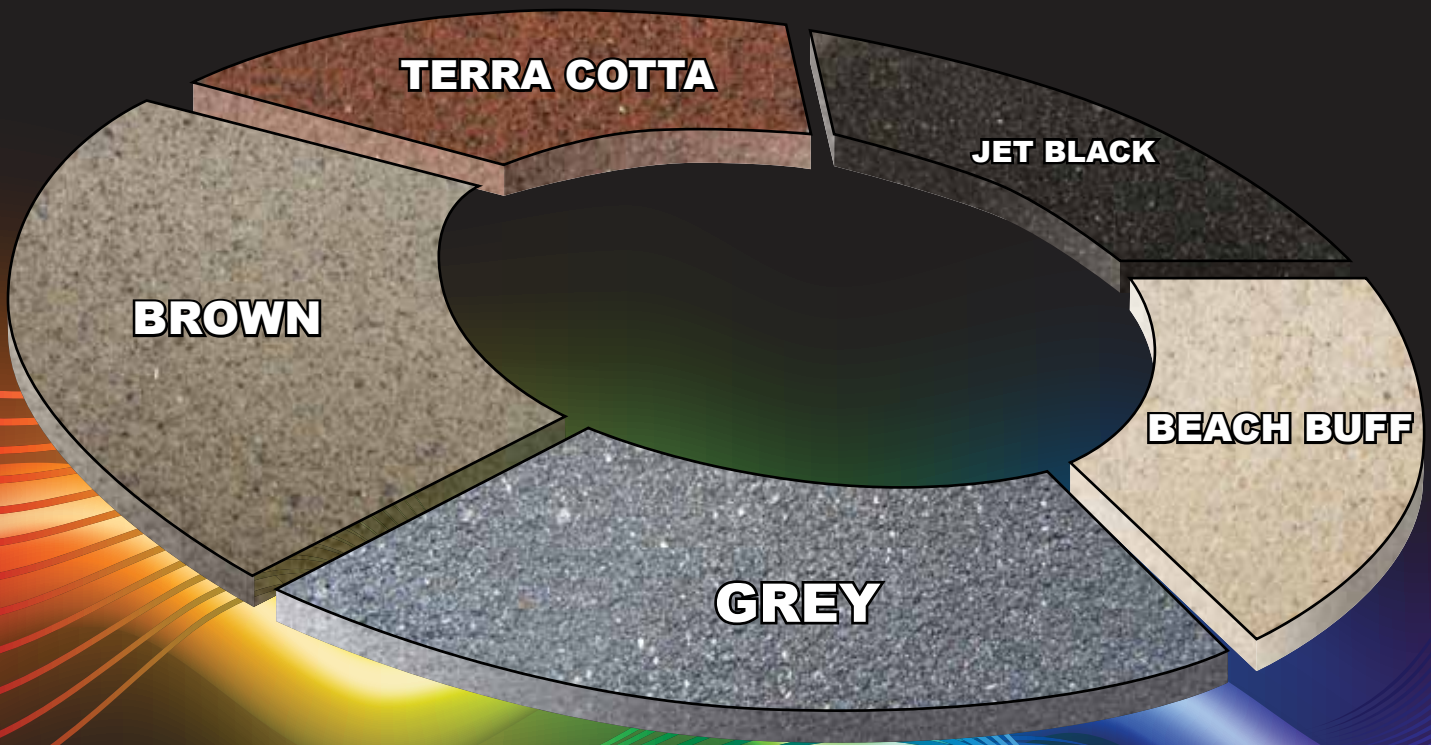

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By David R. Smith

follow the LEED-er

WITH THE UPCOMING RELEASE OF LEED V4, SOME IMPORTANT CHANGES ARE IN STORE

As a market transformation catalyst, the next version of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program further incentivizes energy conservation and reduced carbon emissions for products selected for neighborhood, site and building design, construction and maintenance. LEED v4 will be balloted and published later this year. This article reviews some important changes that apply to segmental concrete paving products.

One of the most notable changes is the application of environmental impact analysis to building and paving products.

LEED v4 grants points to products whereas the paving industry, or more importantly, the concrete paver manufacturer issues an environmental product declaration (EPD). Some in the industry have described an EPD akin to a nutrition label on food packaging. Instead of nutrition characteristics, building products will list energy use, carbon emissions and other environmental impacts. This information provides designers and project owners with some basis for product comparison. Though building material selection isn't strictly based on EPDs, it is still an important consideration regarding cost, performance and appearance.

ABCs OF EPDs

A key notion behind EPDs is that the environmental impacts of various products can be compared as long as the basis of measurement and the analysis boundaries are the same.

Analysis boundaries of environmental impacts include extraction, manufacturing, construction, use and end-of-life. Unlike other construction products (e.g., stainless steel doors), construction, use and end-of-life for concrete products (and other paving materials) have wide variations that are difficult to quantify. Thus, boundaries are generally drawn around extraction and manufacturing, often called cradle-to-gate impact analysis.

EPDs are based on two other key documents. The first is a life cycle assessment (LCA) that quantifies environmental impacts of a product. Per ISO 14040, environmental impacts include:

- Carbon footprint (emissions)
- Fossil fuel depletion
- Eco-toxicity
- Water depletion
- Metal depletion
- Smog
- Ozone depletion
- Eutrophication
- Acidification

The second document is a product category declaration (PCR). This is standard method for reporting an LCA and defines what impacts must be reported in an EPD. PCRs help ensure that similar products quantify impacts the same way. Bases for measuring environmental impacts are also included. For example, for concrete materials, energy consumption is often reduced to kilowatt-hours per cubic meter of concrete.

CRADLE-TO-GATE EVALUATION

Once a PCR has been written, like an EPD, it should be reviewed and certified as compliant with ISO requirements by an independent third party. From a practical perspective: First a PCR is written and receives a third-party review; then

Continued on page 18

PAVERS SCORE MORE POINTS

Other proposed changes in LEED v4 continue to affirm segmental concrete pavement as a sustainable product and pavement system.

Under Sustainable Sites, Rainwater Management credits continue to be awarded for using permeable interlocking concrete pavement (PICP) for stormwater volume and pollutant reductions. LEED v4 raises the bar by requiring management of the 95th percentile storm. This can require increased PICP use to earn two points. Three points can be earned in dense urban areas with zero lot line buildings if designs manage the 85th percentile storm.

Solar reflective index (SRI) minimum values are increased from 29 to 33 for new non-roof and roof surfaces. The increase accounts for SRI reductions due to aging. SRI 29 can be used if the supplier can provide data demonstrating an SRI 29 for materials that have aged for three years. Paving on low-sloped roofs, such as roof plaza decks should have an SRI of 82 for new surfaces or a 62 for three-year old surfaces. Grid pavements continue to be an at-grade option for reducing the urban heat island. All of these approaches for roof and non-roof designs can earn two points.

In Materials and Resources, several existing material conservation practices are grouped under a credit titled, Building Product Disclosure and Optimization – Sourcing of Raw Materials. This credit grants one point for material extraction and manufacturing within 100 miles (160 km) of a site and provides a two-fold multiplier for valuing materials supplied within this radius.

One point is still offered for recycled content, especially if used as a substitute for cement. Likewise, one point is offered for obtaining raw materials from suppliers who commit to long-term ecologically responsible land use and extraction.

follow the LEED-er

an LCA is conducted; and from that an EPD is developed, which also receives outside review and ISO-compliance certification.

LEED v4 offers ¼ credit for EPDs from a product manufacturer with no third-party review or certification. If third-party certification is provided, then ½ credit is earned for an industry-wide product EPD and 1 credit for an EPD provided by the product manufacturer.

While the expense to obtain a PCR and EPD seems large in relation to the number of credits offered, LEED v4 may develop additional credits based on these environmental impact assessment tools in the future. For now, LEED v4 is a first effort in quantifying the environmental impacts of products. Another benefit is that an LCA and EPD can help manufacturers identify areas for cost-saving conservation measures.

In summary, LEED v4 provides a more complex structure for evaluating sustainability of building products, including concrete unit paving products. The introduction of PCRs and EPDs can enable some comparison among pavement materials, at least within cradle-to-gate boundaries. With LEED v4, the industry can expect further affirmation of segmental concrete paving products as environmentally sustainable. One thing that hasn't changed is the crediting categories. They remain:

- 40-49 = Certified
- 50-59 = Silver
- 60-79 = Gold
- 80+ = Platinum

To learn more about the LEED v4 changes that address new market sectors, increased technical rigor and streamlined services, go to ***www.usgbc.org/v4***.

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ENGINEER'S view

By Robert Bowers, P.Eng.

Geomembranes in Permeable Interlocking Concrete Pavement

INSTALLATION CONSIDERATIONS AND ADVICE FOR USING GEOTEXTILES

Permeable interlocking concrete pavement (PICP) systems can be designed and constructed to accommodate three drainage conditions:

- Complete infiltration of water into to the high infiltration rate soil subgrade with no underdrains;
- Partial infiltration of water into low infiltration rate soil subgrade with some outflow through underdrains;
- No infiltration into the soil subgrade with all outflow exiting through underdrains.

All conditions have similar surfacing, and base/subbase reservoir construction. No exfiltration designs, however, use a geomembrane on the sides and bottom of the base/subbase reservoir to contain storm-water and prevent it from infiltrating into the soil subgrade. Commonly called an impermeable liner, **Figure 1** illustrates a typical PICP design using such a membrane.

A no infiltration design with a geomembrane is typically used in the following conditions:

- The soil has very low permeability, low strength, or is expansive;
- High depth to a water table or bedrock;
- To protect adjacent structures and foundations from water;
- When pollutant loads are expected to exceed the capacity of the soil subgrade to treat them.

By storing water in the base/subbase and then slowly draining it through pipes, the design behaves like an underground detention pond with the added benefit of reducing contaminants. A no infiltration retention design may be used for water harvesting. The water may be piped to an underground cistern for reuse on site. Harvested rain-water reduces landscaping water requirements and in some cases it can be used for gray water within buildings.

Geomembranes are a class of geosynthetic fabricated to create a sheet barrier that is relatively impermeable and is installed to prevent the flow of liquid or gas across that barrier.

Geomembranes can be manufactured from a range of polymers including polyvinyl chloride (PVC), chlorosulfonated polyethylene (CSPE), chlorinated polyethylene (CPE), or, more recently, polypropylene (PP), ethylene propylene diene monomer (EPDM), high-density polyethylene (HDPE) and linear lower density polyethylene (LLDPE), very flexible polyethylene (VFPE). Each of these polymers is unique and provides varying levels of resistance to acids, alkalis or petrochemicals. Some polymers can also function in extreme heat or cold. Normally, the surface of a geomembrane is smooth, but some sloped applications can benefit from a textured surface that provides greater friction with the adjacent geotextiles or soil.

Geomembranes come in a range of thicknesses depending on the polymers and the manufacturing process. For example, HDPE

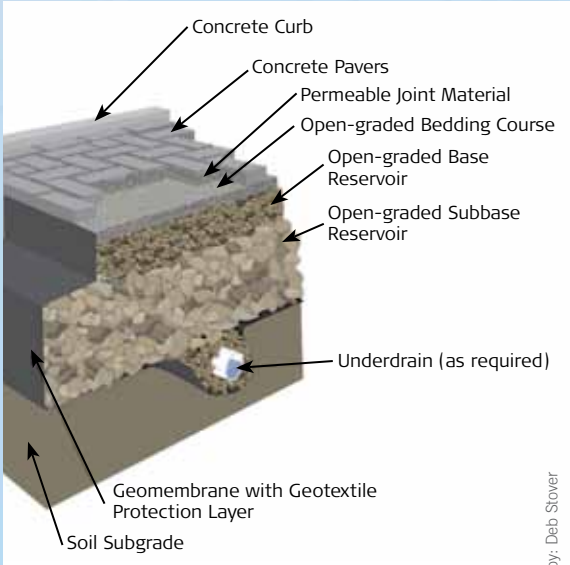

Figure 1. Typical geomembrane application in PICP.

GEOMEMBRANES COME IN A RANGE OF THICKNESSES DEPENDING ON THE POLYMERS AND THE MANUFACTURING PROCESS. HDPE COMES IN

40, 60 and 80 mil

(1.0, 1.5 and 2.0 mm)

THICKNESSES AND IN A RANGE OF ROLL WIDTHS.

Figure 2. Geotextile is placed over a geomembrane for protection against the aggregate subbase in a green alley in downtown Richmond, VA.

geomembrane is typically available in 40, 60 and 80 mil (1.0, 1.5 and 2.0 mm) thicknesses and in a range of roll widths. Geomembranes have different engineering properties depending on polymer type, thickness and manufacturing process. Typically the nominal thickness, density, tensile strength, tear resistance, dimensional stability and puncture resistance are provided in manufacturers' literature and referenced in product specifications.

Geomembranes for PICP are typically fabricated on the job site and this requires cutting, fitting and seaming to create waterproof joints. Different seaming techniques are used depending on the polymer, environmental conditions and project requirements. Materials like EPDM and PVC are routinely seamed using adhesive or double-sided tape. Before two panels are joined, the areas to be joined are usually cleaned and primed. HDPE and other polymers are typically welded together with extrusion welders or hot wedge welders. Seams for all materials should be field-tested to ensure their integrity, especially around underdrains penetrating the geomembrane. For smaller projects, it might be possible to have the supplier prefabricate the geomembrane to meet site requirements. Prefabricated geomembranes are typically delivered to the site folded on a pallet.

When preparing a site for a geomembrane application, remove rocks, roots, and other sharp objects from the subgrade that may damage the geomembrane during installation, aggregate compaction, or use. Such areas should be filled with dense-graded aggregate and compacted before placing the geomembrane over them. A layer of non-woven geotextile is commonly used to protect one or both sides of the geomembrane. The thickness of the geotextile is typically selected based on the materials placed next to the geomembrane and the importance of preventing punctures of the geomembrane. **Figure 2** illustrates a green alley in Richmond with a geomembrane that is protected by a non-woven geotextile before placing and compacting the subbase aggregate.

When designing a no infiltration PICP system, there are many factors that must be considered in selecting the geomembrane and protection materials. For most projects, consultation with an engineer familiar with the design of a geomembrane is recommended.

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PAVEMENT AGLOW, NO POWER REQUIRED

Noctilucent Design

By Andrew Conner

NighTec Company from Germany has made a business of making ordinary pavement, furniture and other products glow-in-the-dark. NighTec offers a wide array of products for industrial users and industrial consumers. Their products range from a mix that illuminate concrete to "effect yarn" which can be used like any other yarn to make items like furniture or rugs luminescent.

UV light powers NighTec's noctilucent (i.e., glow-in-the-dark) products. Just like the constellations on your child's bedroom ceiling, NighTec products need to be "charged" to achieve the full effect. This charging requires no actual power and occurs naturally if the product is in the sun. NighTec encourages designers to keep this in mind when they incorporate noctilucent products in their designs.

Made for darkness, these products have many practical applications. For example, pavers made with noctilucent concrete mix can be used to delineate parking spaces that change from gray during the day to neon blue (or other colors) at night. The pavers can also be used to make paths and stair steps easier to see at night. Of course, they also make great ornamental accents, allowing hidden designs and colors to pop up in the evening. Effects last 8 to 12 hours, depending on the environment.

Noctilucent pavers also make great ornamental accents, allowing hidden designs and colors to pop up in the evening.

Effects last **8 to 10 HOURS** depending on the environment.

Paintless parking stalls, delineated by glow-in-the-dark pavers from Germany's NighTec Company.

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