

### **INDUSTRY RESOURCES/RESEARCH REPORTS Two-Pavement System Can Lower Unit Costs** PAVEMENTS Alife .com

The American Concrete Pavement Association has released a document that shows the effects of competition on paving unit costs. Average five-year cost data (Oman Systems) confirms that U.S. states which use a stronger balance of pavement types (asphalt and concrete) get a bigger "bang for the buck" than those who use only one pavement type (asphalt).



In U.S. states where both pavement types are specified on a regular basis, healthy industries with skilled personnel develop. Construction quality improves and risks decline, bringing about more cost-efficient pavement construction and significant savings. Competition between industries also spurs innovation.

АСРА

Figure 1 illustrates that in markets that are more balanced, the average unit costs for both concrete and asphalt pavements are lower. The additional competition fostered by the agency allows the agency to extend its currently available budget, do more, and add long-life pavements to their system.

As an example, assume an agency spends \$200 million per year on pavement items, and 100% of their pavement dollars are spent on asphalt. At this level, with no competition between the industries, the asphalt would cost approximately \$74.80 per ton, and the state can purchase a little under 2.7 million tons of asphalt for their \$200 million budget. Now, suppose the state instills more competition by using concrete pavement by adopting alternate bidding. Assume the state plans to spend the same \$200 million, but this time 15% of their budget is spent on long-life concrete pavement. The additional competition drops the asphalt unit cost to \$67.84 per ton and the concrete pavement would be \$39.56 per square yard. For the same \$200 million budget, the state still gets about the same tonnage of asphalt as before, and they also get 750,000 square yards of concrete pavement. And, if 30% (vs. 15%) of the budget is spent on long-life concrete pavement, then the asphalt unit cost falls to \$61.53 per ton and the concrete pavement to \$30.28 per square yard. The state agency can get about 2 million square yards of concrete pavement!

Instilling competition is just better business practice for a state highway agency. There are no downsides to fostering two healthy industries to compete for state highway projects. The state benefits in terms of cost efficiency, innovation from contractors and network health; the industries benefit in terms of programs that support a quality work force to build quality pavements; and the public benefits from it all.

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To view an additional table and this report #QD033, please go to: http://www.acpa.org/Concrete\_Pavement/Technical/Downloads/QDs.asp or www.acpa.org and click on "Concrete Pavement", "Free Downloads", then "Quick and Direct".

## Under Construction: ACPA's Concrete Pavement Wiki





It will take some time to create a fully populated site, but two must-see established pages include: "History of Concrete Pavements in the United States", from the first concrete pavement in 1892 to concrete pavements in 2012, and "Concrete Pavement Thickness Design". On the ACPA Wiki, Navigation will include a Home Page, Community Portal, Current Events, Recent Change,

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Random Page and a Help Page. <u>Links</u> will include the Main Websites, Web Apps and a Resource Center. The <u>Toolbox</u> will include all tools needed to upload member files, special pages, related changes, wiki links, printable capability and permanent links, and more.

**CONCRETE** If you are already an ACPA member, please contact Robert Rodden at **avement industry**. If you are not an ACPA member and your company's log-in **information**. If you are not an ACPA member and would like to engage in development of this vast resource, please join ACPA by going to: <u>http://acpa.org/join/</u>.

### **Experimental Stormwater Parking Lot Uses 3-Pavement Technology**

The parking lot project has two main goals:

Reduce stormwater runoff by reducing impervious surfaces.

functions and/or address targeted watershed goals and objectives.

- Use the site as a demonstration project to study the effects
  - of three different types of permeable surfaces on stormwater runoff.

The "Region 2 Laboratory" needed a 110-vehicle-capacity parking lot to provide safe and secure parking. The project began as a building and facilities improvement project under the Office of Administration and Resources Management (OARM). EPA's Office of Research and Development (ORD) recognized the project as an opportunity for research and contributed funding that helped to install research instrumentation to evaluate the potential of permeable surfaces to lessen the effects of peak stormwater runoff on receiving streams, including stream bank erosion and negative effects on aquatic plant and animal life. ORD is



evaluating permeable surfaces as part of a long-term research project examining multiple stormwater management practices.

The parking lot will be monitored for hydrologic performance (the ability to accept, store and infiltrate stormwater), water quality performance, urban heat island (urban and suburban temperatures 1° to 6°C (2° to 10°F) warmer than nearby rural areas), mitigation, maintenance effects, and parking behavior.

Existing concrete was removed from the nearly 300,000square-foot parking area, the surface was graded, and then the crushed concrete was reused as a sub-base material. The project included three types of permeable pavement surfaces in the parking lot, including 28 parking spaces made of interlocking concrete paver blocks, 41 parking spaces made of porous concrete, and 28 parking spaces of porous asphalt. Thirteen conventional asphalt spaces were also installed to serve as an experimental control.

The project also included underdrains below each type of paving surface, allowing for testing of each material's performance in achieving ground water recharge and pollutant removal. The parking lot collects a portion of the infiltrating stormwater below the surface, where it is piped to below-grade

 Side-by-side testing of three permeable parking surfaces: Pervious Concrete, Permeable Concrete Pavers and Porous

Asphalt • Evaluation of effect of hydraulic

loading on rain garden hydrologic performance • Continuous and

event-based sampling for water quantity and quality parameters tanks for collection, measurement, sampling, and testing. Stormwater runoff from the conventional asphalt spaces drains into a six-cell rain garden where ORD intends to research rain garden sizing.

ORD intends to continue this research for up to a decade to help determine the effectiveness, durability, and maintainability of each surface type and the overall effectiveness of permeable pavements. Edison's parking lot was also upgraded with a rain garden and energy efficient light emitting diode (LED) fixtures.

For a video demonstration on of the parking lot's porous concrete accepting water and the entire article, please go to: <u>http://www.epa.gov/oaintrnt/stormwater/edison\_parking\_lot.htm</u>. For a poster on the schematic of the parking lot, please go to: <u>http://www.epa.gov/oaintrnt/documents/porous\_pavers\_508.pdf</u>. For a science brief on the parking lot details, please go to: <u>http://www.epa.gov/oaintrnt/documents/edison\_parking\_lot\_science\_brief.pdf</u>.



This Edison, New Jersey Region 2 Laboratory features Green Power & Water Management Plan and supports the activities of various EPA organizations <u>http://www.epa.gov/oaintrnt/</u> facilities/edison.htm









### America's Greenest Street Eats Smog

Chicago lays claim to the "greenest street in America<sup>"</sup> with a new neighborhood streetscape that makes use of sustainable technology from the ground up. On Oct. 9, the Chicago Department of Transportation (CDOT) unveiled the project, which is along Blue Island Ave. and Cermak Rd. in the city's Pilsen neighborhood. The <sup>\$</sup>14 million project includes the CDOT's "first commercial road use of photocatalytic cement" (cement with a white pigment of titanium dioxide).



Using energy from light, T-2 creates two oxidation reactants: hydroxyl radicals and superoxide anion. These reactants decompose toxic organic substances through oxidation. Sunlight starts a chemical reaction that accelerates natural oxidation, and breaks down nitrogen oxides emitted from fossil fuels. Pollutants are reduced within about eight (8) feet of a surface that has been treated. The material gobbles up nitrogen oxide gases from the surrounding air in a catalytic reaction that is powered by sunlight falling on the road surface.

CDOT says about one-quarter of the material for the Cermak/Blue Island streetscape is recycled. In a press release, CDOT Commissioner Gabe Klein said, "This project demonstrates a full range of sustainable design techniques that improve the urban ecosystem. It provides both mitigation and adaptation strategies by reducing its carbon footprint and integrating technologies that allow the infrastructure to address and adapt to climate change."

The project is also designed to keep about 80% of rainfall from going into the sewer system. To cut energy consumption, the streetscape includes LED lighting that makes use of solar power and wind power (the singular resource of "Chicago: the Windy City"). Even the sidewalks alongside the roadway are

constructed from 30% recycled content. The project costs were covered by city capital improvement funds and grants from the Federal Highway Administration, and the Illinois EPA.

The <sup>\$</sup>14 million project includes what CDOT calls "the first commercial road use of photocatalytic cement".

For this MSN article (© 2012 Microsoft Corporation. All rights reserved.), please go to: http://specials.news.msn.com/americas-greenest-street-eats-smog.

The ISCP July, 2012 Newsletter reported on a several U.S. Green Alley Projects in Washington, D.C.; Seattle, Washington; Chicago, Illinois; and Detroit, Michigan; as well as The Chicago Green Alley Handbook. To view the ISCP July 2012 Newsletter and these projects and booklet, please go to: <u>http://www.concretepavements.org/Membership/Newsletter/JULY2012Newsletter.pdf</u> For an article on photocatalytic cement in the ISCP October 2011 Newsletter (page 3), please go to: <u>http://www.concretepavements.org/Membership/Newsletter/OCTOBER2011Newsletter.pdf</u>.

### Fractionated Reclaimed Asphalt Pavement (FRAP) as a Coarse Aggregate Replacement in a Ternary Blended Concrete Pavement ???



With increasing focus on sustainable and "green" pavements, the Illinois State Toll Highway Authority (the Tollway) has been examining various methods to improve pavement recycling efforts, with an ultimate goal of a 100% recycled construction site. No studies have been reported in the literature on using fractionated reclaimed asphalt pavement (FRAP) in concrete, but a number of studies have been published on using reclaimed asphalt pavement (RAP) in concrete. A distinction must be drawn between typical RAP and FRAP. RAP is the

traditional term used for asphalt milled from the roadway, while FRAP is the result of additional processing (i.e., washing and screening/fractionating). Old asphalt pavements that are milled by the Tollway are reprocessed to produce FRAP, a process through which a #4 sieve screen separates the coarse and fine aggregate into two distinct stockpiles. In addition, a 1/2- or 5/8-inch coarse screen removes larger-size agglomerations and aggregates that are then discarded. These large coarse FRAP stockpiles have to be used in order to reduce the potential for large disposal costs.

A research study was undertaken to investigate the prospects of using the FRAP as a partial replacement of virgin coarse aggregate in concrete for pavement applications. Four concrete mixtures were evaluated for fresh and hardened properties at coarse FRAP contents of 0%, 20%, 35%, and 50%. To further improve the sustainability aspect of the project, two supplementary cementitious materials were used as a partial replacement of Portland cement: Grade 100 ground granulated blast furnace slag and Class C fly ash. The fresh properties evaluated were slump, air content, and unit weight. The hardened properties evaluated were slump, air content, and unit weight. The hardened properties evaluated were drying shrinkage, restrained ring shrinkage, rapid chloride penetration, freeze/thaw durability, and fracture properties. The aggregates were also evaluated for alkali-silica reactivity.

In this study, as the FRAP content increased, it was found that the workability increased (even with lower water-reducing admixture dosages), the unit weight decreased, and the air content remained relatively unaffected, although somewhat more variable. The freeze/thaw durability test concluded that changes in temperature and frequency did not significantly affect the concrete dynamic modulus at all testing ages and FRAP contents. The concrete fracture properties with single-edge notched beam specimens revealed that the critical stress intensity factor was generally reduced with the addition of FRAP. The concrete free drying shrinkage was found to be unaffected by the coarse FRAP replacement levels and total cementitious content utilized.

VOLUME 9, NUMBER 10

**REPORT HIGHLIGHTS:** 

LITERATURE REVIEW OF:

RAP in Concrete RAP in Lean Concrete

RAP in Concrete Field Studies of RAP in Concrete Pavements

CONCRETE FRESH & HARDENED PROPERTIES

LABORATORY MIX

Fresh Properties

Strength Properties Elastic & Dynamic Modulus Shrinkage Rapid Chloride

Penetration Freeze/Thaw Durability Fracture Properties Alkali-Silica Reactivity "Dirty" FRAP Studies

Dirty FRAP Study at UIUC Dirty FRAP Study by Independent Lab

CONCLUSIONS

Summary Recommendations

DESIGN





Table 29.	Mix Designs	for Trial Batch	(Round 1)

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	Mix 575	Mix 620	
Cement	375.05	393.25	
Slag	144.25	151.25	
Fly Ash 1	57.7	75.6	
Total Cementitious	577	620.125	
Total Coarse Aggregate (SSD)	1876.5	1876.5	
FRAP (SSD)	375.3	375.3	
Virgin Coarse Aggregate (SSD)	1501.2	1501.2	
Virgin Fine Aggregate (SSD)	1271.3	1190.0	
Water	211.5	227.3	

compressive and split tensile strengths of the concrete relative to unprocessed dirty FRAP concrete, but all dirty FRAP mixes, processed and unprocessed, up to 50% coarse FRAP met the the Illinois Department of Transportation (IDOT) strength requirements at 14 days. Mixes tested independently confirmed that IDOT strength requirements can be achieved by using dirty FRAP. This result demonstrates that costly



processing and washing of the FRAP may not be necessary, based solely on the strength results, in order to obtain the desired concrete properties.

The compressive, split tensile, and flexural strengths all decreased with increasing coarse FRAP contents. Based on the third-point (four-point) flexural strength results, it is expected that up to 50% FRAP would meet the IDOT center-point (three-point) flexural strength requirement of 650 psi at 14 days. Similar to the

strength properties, both the static and dynamic elastic moduli decreased with increasing FRAP content. Many other tests were conducted throughout this study, including a rapid chloride penetration test and a test for alkali-silica reactivity (ASTM C1260).

To view the other tests, results and for the entire report on FRAP, please go to: <u>http://www.ict.illinois.edu/Publications/report%20files/ICT-12-008.pdf</u>. To see the featured ISCP August 2012 Newsletter Thesis Abstract from this study (page 3), please go to: <u>http://www.concretepavements.org/Membership/Newsletter/AUGUST2012Newsletter.pdf</u>. Prepared by Alexander S. Brand, Jeffery R. Roesler, Imad L. Al-Qadi and Pengcheng Shangguan, University of Illinois at Urbana-Champaign

# **CONFERENCE NEWS**

ACPA's 49<sup>th</sup> Annual Meeting to be held in Marco Island, Florida, USA



Registration is now open for The American Concrete Pavement Association's (ACPA) 49<sup>th</sup> Annual Meeting to be held from November 26-30, 2012, at the Marco Island Marriott Beach Resort, Golf Club & Spa located in Marco Island, Florida, USA. To register, please go to: www.events.acpa.org.

The ACPA Annual Meeting is the U.S. concrete pavement industry's premier event for technology transfer and information exchange. This five-day event includes discussions of important and timely issues that directly impact the concrete paving industry as well as presentations by leading authorities who help shape public policy - influencing best practices and guiding the specifications and standards



used in the construction, rehabilitation and preservation of concrete pavements throughout North America. The event is also an opportunity to learn, to network, to celebrate, and to build even stronger relationships as we shape our industry's future.

The popular "Concrete Pavement University" (CPU), the U.S. industry's premier tech transfer, professional development and training event, is a 1 1/2-day program that focuses on current and emerging technology, best practices, research results and more.



The Annual Meeting includes the distinguished "Excellence in Concrete Pavement" Awards Banquet which honor quality concrete pavement projects across North America and Canada each year. For more information and a preliminary program, please go to: <u>http://www.acpa.org/Events\_and\_Programs/Events/2012/2012-ACPA-Annual-Meeting.pdf</u>.

## 16th Argentine Congress on Roads Attended by 1400

The 16<sup>th</sup> Argentine Congress on Roads and Transit was held in Cordoba, Argentina on October 22–26 and was attended by more than 1400 delegates. Invited speakers included ISCP President Mark Snyder, who presented "Best Practices for Concrete Pavement Construction in the USA", and ISCP Honorary Member Michael Darter, who presented "The New AASHTO DarWIN-ME Program for Concrete Pavement Design".

An International Seminar on Concrete Pavements was held concurrently with the Congress and was attended by nearly 200 delegates. This event was organized by the Argentina Portland Cement Institute under the direction of M. Enrique Romero. Invited ISCP speakers comprised much of this two-day program, again including Mark Snyder and Mike Darter, as well as ISCP Vice-President José Balbo (who spoke on whitetopping and the use of fibers in concrete pavement construction) and John Roberts (who spoke on techniques for concrete pavement preservation). Other invited speakers included Charles Grady of Crafco Inc., and Stefan Höller of BASt (Germany).

The 2012 Argentina Roads Expo was also held at the Congress venue, and it included more than 75 Exhibits and Displays from materials and equipment manufacturers, contractors and consultants from around the world, including ISCP member organizations Holcim and Dynatest Consultants (represented at the Congress by ISCP Board Member Erwin Kohler).



Photo 1: The concrete session speakers and session moderators - L to R: **Stefan Höller** (BASt), **Michael Darter** (ARA Consultants), **Edgardo Souza** (ICPA), **Carlos Brunatti** (ICPA) and **Mark Snyder** (ACPA/ISCP).

Photo 2: by **Erwin Kohler**: The Argentine Exhibition



The 17<sup>th</sup> Argentina Congress on Roads and Transit is expected to be held in 2016 at a location to be determined.

### **Call for Papers & Abstracts Digest**

**November 30, 2012** Due date for papers for the the SCC2013 to be held May 12-15, 2013 in Chicago, Illinois. (for the authors whose abstracts were selected for submission). The Theme is "The New Normal - Innovation, Application and Production", and bridge recent research advancement, innovation, and applications in the field of self-consolidating concrete (SCC). For information, please go to:

http://www.intrans.iastate.edu/events/scc2013/papers/ **December 31, 2012** Due date for abstracts for the 14<sup>th</sup> International Winter Road Congress to be held to be held February 4-7, 2014 in Andorra-la-Vella, Pyrenees. The theme is: "*Reconciling road safety and sustainable development in a context of climate change and economic constraints*". For information, please go to: http://www.aipcrandorra2014.org/?lang=en.

**May 15, 2013** Due date for papers for the 12<sup>th</sup> International Symposium on Concrete Roads -"*Innovative Solutions - Benefitting Society*" to be held in Prague, Czech Republic, September 24-26, 2014. For the Symposium website, please go to: <u>www.concreteroads2014.org</u>

# UPCOMING EVENTS



**2012 International Pavement Engineering Conference (IPEC)** November 1-3, 2012 in Busan, South Korea <u>http://www.ipec2012.or.kr</u>

2nd International Conference on Civil Engineering and Building Material (CEBM 2012) November 17-18, 2012 in Hong Kong <u>http://www.iasht.org/cebm/</u>

### ACPA's 49th Annual Meeting

November. 26 - 30, 2012 in Marco Island, Florida, USA http://www.pavement.com/Events\_and\_Programs/Events/index.asp



FEBRUARY

### ISCP Annual Membership Board Meeting January 12, 2013 in Washington, D.C., USA

http://www.concretepavements.org/calendar.htm

**92nd Annual Meeting of Transportation Research Board (TRB)** January 13-17, 2013 in Washington, D.C., USA http://www.trb.org/AnnualMeeting/AnnualMeeting.aspx

**9th Concrete Conference & Exhibition: Concrete for Sustainable Construction** February 11-13, 2013 in Manama, Kingdom of Bahrain, <u>http://www.concrete9.org</u>

**UKIERI Concrete Congress: Innovations in Concrete Construction** March 5-8, 2013 in Jalandhar, Punjab, India, <u>http://www.ukiericoncretecongress.com</u>

8th International Conference on Fracture Mechanics of Concrete and Concrete Structures (FraMCoS-8) March 24-28, 2013 in Ciudad Real, Spain <u>http://www.framcos8.org/</u>

For events taking place in April 2013 and beyond, please go to: http://www.concretepavements.org/calendar.htm.





The ISCP Newsletter is produced monthly by: Editor-in-Chief & Art Director: Amy M. Dean\_newsletter@concretepavements.org Technical Editors: Corey Zollinger, Nancy Whiting, Cristian Gaedicke and Robert Rodden Chief Correspondent: Neeraj Buch, Ph.D secretary@concretepavements.org

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ISCP invites ISCP members and friends to submit articles and calendar items to the Editor-in-Chief for future issues.

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Please visit the **ISCP Website** at <u>www.concretepavements.org</u> for more information about ISCP.

Maps, globes: <u>National Geographic Family Reference Atlas of the World</u> ©2002 National Geographic Society, Washington, D.C. & <u>Concise Earth Book World Atlas</u> ©1987 Graphic Learning International Publishing Corporation, Boulder, Colorado, Esselte Map Service AB Stockholm. All additional sources noted on perspective pages.