



CP2 CENTER NEWS

Newsletter of the California Pavement Preservation Center

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Dr. Shakir Shatnawi,
State Pavement
Engineer

Shatnawi named State Pavement Engineer

Shakir Shatnawi was named the new State Pavement Engineer on March 1, 2009. Dr. Shatnawi was formerly the Chief, Office of Pavement Preservation, one of four offices which now comprise the new Division of Pavement Management.

Shatnawi has been with Caltrans for 20 years, having served in the HQ Materials and Testing lab and in the Divisions of Research and Innovation, Construction and Maintenance. Specifically, he worked in Districts 10 and 4 in project development and construction, respectively. Previous to joining Caltrans, he worked at the FHWA Turner-Fairbank Highway Research Center and in a consulting firm. He received his doctorate from the University of Arkansas, and his bachelor's and master's degrees from Sacramento and San Jose State Universities respectively. He was interviewed by CP2 Center staff and provided responses to the following questions.

Congratulations on becoming the new State Pavement Engineer. Can you discuss your immediate plans for the Pavement Division as it moves forward into the rest of 2009 and beyond?

I see this assignment as an opportunity to improve our pavement practices, and I look forward to the interesting and important work that needs to be done in terms of Caltrans' efforts to move forward into the 21st century with our planned multi-faceted pavements program.

This includes not only pavement management, but also project planning and programming, pavement design, rehabilitation and preservation — all under one umbrella. The Division is responsible for all pavement policies, standards and specifications. Most importantly, our efforts must now largely focus on the importance of pavement preservation and prioritizing pavement projects based on needs, since our natural resources are finite and limited. Additionally, the era of the "green" movement has arrived and we must use all our tools to be good stewards of California's resources.

So my primary focus will be the intelligent use of our limited funds and resources through a pavement management approach, which essentially means proactively preserving the pavement infrastructure to as large an extent as possible.

In this regard, the new division will be embarking on the development of a strategic plan to address

our activities over the next 3-5 years. The strategic plan will include our overall vision and the specific goals and objectives for each of the four offices in the Division. We will have to prioritize work activities and partner with industry and local agencies to make this happen.

Can you discuss the timeline for getting the new pavement management system up and running? How will it be used to estimate life extension associated with pavement preservation?

As we move forward with the development of our new PMS, we must make sure it addresses all of our statewide needs before we forge ahead into using "the first PMS out the door." We are moving forward with contracts on ground penetrating radar to establish our 'as-builts' and with pavement data collection to determine the condition of our network. Once they are complete we will contract for the PMS software with California's specific needs in mind. We expect to have the PMS operational by the end of 2012.

Regarding your second question about estimating the life extension associated with proper pavement preservation, a proper Pavement Management

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System (PMS) is essential to determine the timing for treatments. We have excellent pavement preservation techniques available at our fingertips already, and these techniques are all very good as long as they are applied to the right pavement at the right time. And while we already have a pretty good idea about the treatment life associated with most of our pavement preservation techniques, we don't yet know exactly how to translate treatment life into an actual life extension of the pavement. What we do know, however, is that if the timing is right and the pavement preservation technique is properly chosen and constructed, the life extension will be both maximized and significant. I will strive to insure that the Caltrans PMS we finally implement will identify both.

Do you anticipate more emphasis on pavement preservation and recycling as a part of future efforts? Caltrans still lags in the recycling efforts compared to other states.

Yes, definitely, and this is true — in that order. Pavement preservation already receives major attention statewide from Caltrans and it will continue to expand. Recycling is in its beginning stages and it is not only more cost effective, but also contains many “green” benefits. Based on our statewide need to reduce greenhouse gasses and conserve our rapidly dwindling supplies of raw materials, we want to insure that recycling and reuse of existing pavement materials are paramount to meeting California's long-term environmental needs. Also, we have a pilot program for implementing warm mix asphalt (WMA) and recycled tires.

Do you believe that the so-called “mechanistic-empirical” design procedures will be of use in estimating treatment lives, or pavement life extension for that matter? And if so, how?

By “mechanistic-empirical” I assume you mean the analytical procedures now available to calculate pavement responses from wheel- or axle-loads and the empirically-derived performance models resulting from repeated loads. In the 21st century, it makes little sense to totally ignore the many mechanistic tools available to us to calculate pavement responses to repeated loads — as a function of load magnitude, seasonal effect, and pavement structure. This is but one aspect of the planned PMS that Caltrans would like to implement as soon as we can do so responsibly and effectively.

With regard to the second question, we are now on the way to solving our multi-faceted task of properly managing our multi-billion dollar investment in

highways and pavements through everything we've discussed today.

You mentioned up-front or agency construction and preservation costs. What about user costs? Does Caltrans consider user costs (fuel efficiency, construction delay, and accident costs, etc.) in their overall approach to managing their pavements?

We already consider construction delay costs by factoring in incentives and disincentives for contractors who meet or exceed — or do not meet — construction schedules. We know that the costs to the traveling public are significant when a roadway — especially an urban freeway — is closed for more than a few nighttime hours. Therefore, in an effort to mitigate these significant and important user delay costs, Caltrans often pays construction bonuses to low-bid and responsible contractors who finish the project ahead of schedule. On the other hand, contractors who, through no fault of the Department, fall behind schedule and do not meet the minimum time constraints imposed by the pavement construction or preservation specifications, would have a penalty assessed.

I would like to see an increase in the use of incentive/disincentive pavement preservation and construction pay. Ideally, these would be directly related to user cost savings (or losses) achieved as a result of the project.

Similarly, accident costs due to construction and the final pavement smoothness that results from any given pavement preservation or rehabilitation technique can be properly considered, ideally as a part of the PMS program we will eventually implement on a statewide basis.

How do you see the future of partnering efforts between Caltrans, industry and local agencies?

Partnering is also important and needs to be continued with several groups as we move forward with our initiatives. Caltrans wants to be a leader again in the area of pavements and cannot accomplish this without the cooperation of industry and local agencies. Industry brings lots of experience to the table and Caltrans can learn from this experience through partnerships such as the PPTG, Caltrans-industry task groups, Rock Products Committee, and the Western Pavement Preservation Partnership.

Caltrans also needs to continue working with universities and other agencies through partnerships such as WASTHO, the four-state consortium

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Recycling is in its beginning stages and it is not only more cost effective, but also contains many “green” benefits.

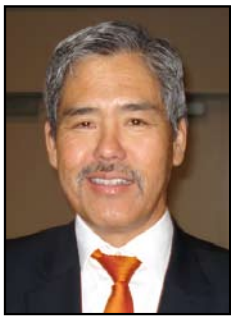
(Washington, California, Texas and Minnesota). Caltrans has strong relationships with the CP2 Center at California State University, Chico (including satellite offices at California State University, Long Beach, and Cal Poly, Pomona) and the UCPRP at U.C. Davis. We will continue to rely on the support of these groups.

Will the CP2 Center play an important role in some of your proposed initiatives?

The term “pavement preservation” has become an integral part of the Caltrans vocabulary of the 21st

century for the reasons mentioned above. As such, pavement preservation — and by extension the California Pavement Preservation Center — will continue to play an increasingly integral role in defining the future of Caltrans’ overall pavement management program, well into the future and, in fact, well beyond my tenure as Caltrans State Pavement Engineer.

Simply stated, the ever-increasing need for pavement preservation will easily outlive all of us — whether within California or anywhere else on the globe.



Randy Iwasaki was keynote speaker.



Larry Patterson described the pavement program in San Mateo.



Steve Takigawa received a conference award.

Fourth Annual Pavement Preservation Conference is a great success

The new State Pavement Engineer and conference co-chair, Dr Shakir Shatnawi, opened the meeting by welcoming over 300 participants to Oakland to the Fourth Annual Pavement Preservation Conference held on April 8-9, 2009. The keynote speaker started the conference off with a bang. Randy Iwasaki, Chief Deputy Director for Caltrans, stressed the importance of pavement preservation to the State of California and noted the growth of the Caltrans program under the State Maintenance Engineer, Steve Takigawa. He also recognized the unofficial national leader of pavement preservation, James Sorenson of FHWA, who helped get the national program started back in the early 1990's. Larry Patterson, Director of Public Works for the City of San Mateo, followed by describing the successful program developed under his leadership to gain control of their pavement program. He attributed the success to his staff and the pavement management program, which resulted in a growth of the pavement condition index (PCI) over the past few years.

Following the keynote remarks, Randy Iwasaki recognized the winners of the prestigious Pavement Preservation Task Group (PPTG) awards for 2008 as follows:

- Program Award – City of Los Gatos. Accepted for Jim Gustafson, Engineering Services Manager, by Laura Melendy, LTAP.
- Project Award – Caltrans, District 3, “The Fix I-5 Project in Sacramento”, accepted by Joe Peterson, Materials Engineer.
- Individual Awards – Both Caltrans and Industry were presented with the individual awards. Steve Takigawa, Chief, Caltrans Division of Maintenance, and Don Matthews, Pavement Recycling Systems, were recognized for their contributions to pavement preservation.

Attendees were reminded to plan for the 2009 awards. Nomination forms can be obtained from the conference website located at www.cp2info.

[org/conference](http://www.cp2info.org/conference). After the awards ceremony, participants adjourned to the exhibit hall where over 30 exhibitors displayed their wares and/or services to the attendees. All breaks took place in the exhibit hall where participants took time to visit with the vendors.

Breakout sessions on Regulatory Compliance Issues and Pavement Management Systems were well attended and discussed important issues facing agencies and industry. The regulatory issues discussed could have a great impact on the construction industry and it was emphasized that pavement preservation programs are difficult to sustain without a strong pavement management program. The morning session concluded with a discussion of energy and emission impacts of roads which clearly showed that preservation and recycling are green technologies.

The afternoon breakout sessions consisted of Quieter-Greener Pavements and Pavement Distress and Strategy Selection followed by a plenary session on the Economic Stimulus Update and Funding for pavement preservation programs. The Quieter-Greener Pavements session discussed quiet pavements, pavement recycling, and sustainable preservation strategies. The Pavement Distress and Strategy Selection session discussed techniques for selecting appropriate preservation strategies for flexible and rigid pavements.

The first day concluded with an excellent update on the future of the nation's transportation program, followed by two case histories from local agencies in the Bay Area, and a presentation on the California statewide local streets and roads needs assessment. Bottom line, our pavement needs far exceed available funding. We have to look to alternative ways to fund our pavements.

The second day of the conference began with an update on innovations and new technologies.

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Don Matthews, Pavement Recycling Systems, was recognized for his contribution to pavement preservation in California.



Joe Peterson accepted a Project Award for Caltrans District 3.

Dr Mary Stroup-Gardiner started the session by discussing the status of the Caltrans Innovation Program, which is funded at \$5,000,000 per year. This was followed by discussion of the engineering needs for recycling, a major initiative Caltrans is about to embark on, and a discussion by Dr. John Harvey on the economic benefits of pavement preservation.

The rest of the day consisted of breakout discussions on pavement preservation treatments. A number of excellent presentations were given on the benefits of preservation as well as typical treatments used in the State of California. Topics discussed included:

- Concrete Pavements - Overview of pavement preservation, benefits of concrete preservation, diamond grinding, partial and full depth slab repair, and dowel bar retrofit.
- Flexible pavements - Slurry surfacings, chip seals, fog and rejuvenating seals, crack seals, bonded wearing courses, thin HMA overlays (including warm mixes), and rubberized asphalt.

The conference was closed by Larry Rouen, Acting Chief, Office of Pavement Preservation. He concluded by stating the conference was a great success



Speakers for the session on Economic Update were, left to right, Theresa Romell, Butch Waidelich, Margot Yapp, Jerry Bradshaw and Peter Dodsworth.

and reminded all to attend the First International Conference on Pavement Preservation in April 2010. The website for this conference is located at www.pavementpreservation.org/icpp/.



All of the presentations can be found at the conference website at www.cp2info.org/conference.

In closing the conference, Larry Rouen reminded participants to plan to attend the First International Conference on Pavement Preservation to be held in April, 2010.

Innovation projects planned for 2009

This construction season there will be a wide array of interesting innovation projects across the State as summarized below:

- A project in District 5 San Luis Obispo on Route 227 will test a new specification for polymer modified binder for chip seals.
- A cold in-place recycling (CIR) project will take place on Route 36 in Plumas County in District 2. This project is funded with ARRA funds.
- There will be two rubberized emulsion asphalt slurry (REAS) projects placed this year using this pavement preservation technique. One will be in District 7 on Ventura 23 and the other in District 11, on San Diego Route 76.
- A test section in District 6, in Kern County on Route 43, will compare a double chip seal over fabric, a single chip seal over fabric, a single chip seal (without fabric), an asphalt rubber chip seal and a thin HMA overlay.
- Three sets of test sections to evaluate the

effectiveness of various fog seal and rejuvenator products are planned in Districts 1, 2 and 9.

- District 11 will try a New Generation Concrete Surface (NGCS). This is an enhanced method of diamond grinding, which produces a better riding surface than normal diamond grinding.
- District 1 will plan a warm mix asphalt project on Route 1 in Mendocino County. Warm mix uses additives that allow asphalt concrete to be batched, placed and compacted at lower temperatures. There can be significant energy savings realized with the use of this technology.

Caltrans continues to be a leader in innovation. All innovation projects should be included in the Innovation Database on the Center's website located at: www.cp2info.org/center.



Preservation takes the stage in St. Louis

By David Peshkin and Kurt Smith, Applied Pavement Technology, Inc.

In April 2009, almost 150 people from state and federal agencies, industry, consulting engineering firms and academia gathered in St. Louis, Missouri for two days of pavement preservation-related presentations. This conference was an exceptional



St. Louis welcomed pavement preservation practitioners from around the world.

event for two reasons. The first is that the attendance in today's economic environment, as both public and private agencies are operating under severe budget restrictions, is difficult to achieve.

Secondly, with thirty states, Washington, DC, and eight countries represented, both the numbers and the diversity of the attendance could be interpreted as recognition of the importance of pavement pres-

ervation. Perhaps even more exceptional is that this conference focused on the preservation of portland cement concrete (PCC) pavements. Or, more accurately, the preservation, rehabilitation, and repair (PRR) of concrete pavements. Organized by the FHWA under their Concrete Pavement Technology Program (CPTP) and co-sponsored by a variety of agencies and industry organizations, this was actually the fourth in a series of FHWA CPTP conferences that have focused on a variety of concrete pavement-related topics.

The conference was organized into a plenary session and the following topical sessions:

- Pavement condition evaluation, impact, and durability.
- Concrete pavement preservation, repair, and rehabilitation.
- Concrete pavement surface texture.
- Concrete pavement repair techniques and experiences.
- Emerging preservation, repair, and rehabilitation techniques.

In addition, there were three "discussion forums" which included presentations and focused largely on experiences of selected highway agencies:

- Preservation, repair, and rehabilitation decision making.
- Preservation, repair, and rehabilitation practices.
- Alternate delivery methods for preservation, repair, and rehabilitation.

In the opening remarks of the plenary session, Mr. Suneel Vanikar, of the FHWA, encouraged participants to seek out the best practices for safer, smoother, quieter, and longer lasting PCC pavements. With the 27 presentations that

followed (not counting discussion forums), it's hard to succinctly capture the conference content in those areas, but here's a try.

What's new

A number of the topics presented (some new or newly emerging ideas and technologies) deserve further attention. These include the following:

- Increased public-private partnerships in the United States, consisting of extended contracts to maintain road networks (some as long as 99 years). This may lead to some interesting developments in the application of preservation treatments to meet performance standards.
- Use of cross stitching to tie together longitudinal cracks on structurally sound pavement. This technique was actually first introduced decades ago, but recently has re-emerged as a rapid and less intrusive means to address longitudinal cracking that may have developed shortly after construction, or to address missing or misaligned tiebars across longitudinal joints.
- Use of precast slabs for pavement repairs is becoming a mainstream activity. There are several different technologies available and improvements are constantly being made in technology, materials, and construction techniques.
- Improved surface texturing and noise suppression are being actively researched and pursued by the concrete industry, agencies, and researchers.
- The concrete industry is promoting finding "buried treasure" by removing hot-mix asphalt overlays of structurally sound concrete pavements and re-exposing the concrete to traffic. The removed bituminous material is sold as RAP to help to pay for the preservation and restoration of the underlying pavement.
- Innovative use of thin concrete overlays continues, including thinner unbonded concrete overlays on lower-trafficked roadways that incorporate smaller panels (typically 6 ft by 6 ft).
- Increased consideration of "surgical" use of PRR methods, in which specific pavement deficiencies are addressed through specific appropriate treatments.
- Application of vitreous-ceramic coating for reinforcement, which holds the promise of increased corrosion protection while also developing a much stronger bond with the concrete.

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What's not

On the other hand, several of the presentations reinforced concepts and approaches that have been around for several decades, including the following:

- There is continued confusion in our industry about the difference between preservation, repair, and rehabilitation. While this conference was supposed to focus on all three areas, most of the presentations were on repair and rehabilitation. Moreover, in many cases the term "preservation" has simply been applied to what used to be called rehabilitation or concrete pavement restoration. Practitioners need to learn that it is not the treatments themselves that are preservation; the timing and the condition of the pavement determine whether an action is preventive.
- Discussions on several techniques that have been used for a long time indicate that these are effective and successful treatments. These include full-depth repairs, diamond grinding, and dowel bar retrofits.
- There is very mixed performance of partial depth repairs. Pavement conditions, available closure times, material variables, and construction installation procedures all play a large part in the ultimate performance of this type of treatment.
- Edge drains have also seen mixed performance. Although sometimes limited by poor design or construction, often these systems become ineffective because they are never maintained over their life. A good rule of thumb for the

installation of edge drains continues to be "don't drain if you won't maintain."

- The debate on the need for joint sealing in new construction continues to rage. Also the topic of a special discussion, it is clear that there is no definitive, accepted guidance on this topic. Keep in mind, however, that Wisconsin, where this debate originated, still promotes maintaining sealed joints if the pavement was originally sealed.

This conference had as much of a California flavor as any out-of-state event in recent memory, as noted by the following:

- Dr. Shakir Shatnawi, Caltrans Pavement Engineer, made a presentation on "California's Perspective on Concrete Pavement Preservation," co-authored with Dr. Mary Stroup-Gardiner and Richard Stubstad.
- Dr. Shatnawi also presented California's perspective on agency practices in that forum.
- Mr. Richard Stubstad presented "Effect of Diamond Grinding on Noise Characteristics of Concrete Pavements in California," a paper co-authored with Shubham Rawool.
- Dr. Shreenath Rao presented "Performance of Edge Drains in Concrete Pavements in California," a paper co-authored by Biplab Bhattacharya, Michael Zola, Karl Smith and Craig Hannenian.
- Dr. John Harvey presented "Tire/Pavement Noise Results from California PCCP and HMA Pavements," co-authored by Erwin Kohler, Linus Motumah and Bruce Rymer.
- Dr. John Harvey presented "Life Cycle Cost Analysis of Dowel Bar Retrofit," based on California's experience (co-authored with Nicholas J. Santero, Erwin Kohler and Bill Farnbach).
- Dr. Chris Ramseyer presented "Highway Panel Replacement: CSA Concrete in California," co-authored with Vincent Perez.
- Dr. Eul-Bum Lee spoke on "I-15 Ontario Project: Technology Implementation for Accelerated Concrete Pavement," co-authored with Seungwook Lim, Jonathan Hartog and David Thomas.

Despite the omnipresent staccato of jackhammers throughout many of the presentations (the hotel decided to undertake major renovations during the conference), the workshop was deemed a success by both planners and participants. If you're sorry you missed it, the proceedings will be available on the CPPC website (www.cp2infor.org/center) at a later date. If you're interested in becoming more involved in the next CPTP workshop, you won't have nearly as far to travel. *Sustainable Technologies for Concrete Pavements* is scheduled for September 2010, in Sacramento, California.

SAVE THE DATE!!

CALIFORNIA PAVEMENT MANAGEMENT WORKSHOPS



Are you interested in learning how to manage your pavement network more cost-effectively?? Learn how to get more funding for your streets!

The California Pavement Preservation Task Group will be providing several Pavement Management Workshops!

Upcoming Events

June 24, 2009	Riverside
September 15, 2009	Santa Barbara
December 2, 2009	Bakersfield

Mark your calendars!!
More Information to follow!

For More Information Contact :

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To Register for the June 17, 2009 Workshop, go to:
<http://alturl.com/8cgg>

A PPTG PAVEMENT MANAGEMENT OUTREACH SERIES

Concrete pavement preservation practices in California

by Craig Hennings, ACPA

Gary Aamold, retired, gave a presentation on rigid pavement distress and strategy selection at the Pavement Preservation Conference in Oakland California on April 8-9, 2009. Gary is the former president of Penhall Company's Highway Services Division. He spoke on behalf of the International Grooving and Grinding Association.

The elements of concrete pavement preservation are:

- full depth repair
- partial depth repair
- slab stabilization
- retrofitting dowels
- cross stitching longitudinal cracks or joints
- diamond grinding
- joint & crack sealing

Full depth repair consists of removal of the failed area, cleaning the grade, and pouring new concrete. For the removal of the concrete, the lift out method is the most prominent in the industry because it assures that the area below the concrete is not damaged by the removal process. This process is used routinely in California.

Also widely used in California, the partial depth repair is used to make repairs up to one-third the depth of the pavement thickness. The removal process is done with lightweight, 15-pound hammers, to insure that the pavement material below the removed portion is not damaged. When preparing to replace the patching material, it is important to rebuild any adjacent joint(s) so the patching material does not invade the joint.

Another technique, not widely used in California, is slab stabilization, which is done by inserting material, under pressure, to lift the failed area to the pre-failure grade.

Retrofitting dowels extends the life of concrete pavement by creating a load transfer at the joint. Cutting the slots for placing the dowel bars must be done with a gang saw to ensure that the cuts are parallel. Removal of the concrete from the cut slots must be done with a lightweight hammer, 35 pounds or less. Heavy hammers can penetrate the existing concrete below the slot removal. After sandblasting the slot, the dowel bar is placed on chairs with plastic expansion and contraction caps. It is important that the dowel bar is placed at an elevation parallel

to the existing surface of the concrete pavement. The chairs must be such that the backfill material can pass through and completely surround the bar. Again, adjacent joints/cracks must be protected from the backfill material invasion. The successful "Fix I-5" in Sacramento" used this process.

Diamond grinding is a process that works on major interstates as well as local streets and roads. There are no adjustments of existing facilities such as manholes, guard rails, or drainage slopes because the grinding is almost always less than one-half inch removal. Diamond grinding can be done with moving lane closures to insure minimum traffic impact.

Finally, joint and crack sealing is done to minimize moisture infiltration and prevent intrusion of incompressible materials.

Caltrans has been proactive in promoting preservation of rigid pavements. Working with IGGA, ACPA and the CP2 Center, Caltrans developed the *Maintenance Technical Advisory Guide* to provide instruction to districts on the maintenance of PCCP pavements. MTAG training has taken place in several locations in California. Building on their experience with diamond grinding, dowel bar retrofit, and partial and full depth repair, Caltrans has a full tool

box of techniques to maintain the State's extensive PCCP road network.

There are many available treatments for PCC pavements. Each has its advantages and limitations. Performance and costs vary with different conditions. What does not vary is "applying the right treatment to the right pavement at the right time."

Several groups are available for assistance. The CP2 Center at CSU Chico can help with general information at www.cp2info.org/center. For specific information about concrete pavements, the IGGA can assist. The website is www.igga.net. Locally, the ACPA southwest chapter is available for guidance, site visits, and publications. The website is www.acpa-southwest.org.



Full depth patching



Partial depth repair



Slab stabilization



Dowel bar retrofitting



Grinding and texturing concrete

Update on California statewide local streets and roads needs assessment

By Margot Yapp, P.E., Vice President/Principal, NCE, Chtd.

California's local street and road system is reaching a point of crisis. City streets and county roads are where every trip begins and ends. Whether traveling by bike, bus, rail, truck or family automobile, Californians need the local system. As the first comprehensive statewide study of California's local street and road system, this report provides critical analysis and information on the local transportation network's condition and funding needs.

The study's objective was to fully assess the condition of the local system and complete the overall transportation-funding picture for California's transportation network. We wanted answers to the following: What are the pavement conditions of local streets and roads? What will it cost to bring pavements to a Best Management Practice (BMP) or most cost-effective condition? How much will it cost to maintain them once we achieve the BMP or optimal pavement condition? What are the needs

for the essential components to a functioning system? Is there a funding shortfall? If so, what is it? What are the solutions? This study collected existing road condition information to determine the future funding needs necessary to maintain the system in good condition.

As owners and operators of 81 percent of the state's roads (Figure 1), cities and counties found this study was critical for several reasons. While federal and state governments' regularly assess their system needs, no such data existed for the local component of the State's transportation network. Historically, statewide transportation funding investment decisions have not been based on local pavement condition data, or adequate recognition for the local system. Furthermore, recent actions to remove city and county discretion over federal and state funding have diminished resources available to the local system.

Our goal is to use the findings of this study to educate policymakers at all levels of government about the infrastructure investments needed to provide California with a seamless transportation system. The findings of this study will provide credible and

defensible analysis to support a dedicated, stable funding source for maintaining the local system at an optimum level. It will also provide for the most effective and efficient investment of public funds.

The study surveyed all of California's 58 counties and 478 cities in 2007-08. The response was outstanding. Information collected resulted in capturing data from more than 93% of the State's local streets and roads. Furthermore, since the majority of the data submitted came from recognized pavement management systems, the accuracy of the data is very high. Where no data existed, models were developed, tested, and used to estimate the pavement condition and funding needs.

The results show that California's local streets and roads are on the edge of a cliff. On a scale of zero (failed) to 100 (excellent), the statewide average pavement condition index (PCI) is 68 ("at risk" category). If current funding remains the same, the statewide condition is projected to deteriorate to a PCI of 58 in 10 years, and further to 48 ("poor" category) by 2033 (see Figure 2). Even more critical, the unfunded backlog will more than double from \$37 billion to \$79 billion by 2033.

To bring just the pavement condition of the State's local streets and roads to a level where the taxpayer's money can be spent cost-effectively, we will need approximately \$51.7 billion of additional funding.

To spend the taxpayer's money cost-effectively, it makes more sense to preserve and maintain our roads in good condition than to let them deteriorate, which will only make it more costly in the future. Consistent with that approach, the costs developed in this study are based on achieving a roadway pavement condition of what the industry calls Best Management Practices (BMPs). This condition represents improving the roadway condition to a level where roads need preventative maintenance treatments (i.e., slurry seals, chip seals, thin overlays) that have the least impact to the public's mobility and commerce. Further, these treatment types are more environmentally friendly than the next level of construction that would be required (i.e. rehabilitation and reconstruction).

The importance of this approach is significant. As roadway pavement conditions deteriorate, the cost to repair them increases exponentially. For example, it costs twelve times less to maintain a BMP pavement compared to a pavement that is at the end of its service life. Even a modest resurfacing is four times costlier than a pavement in BMP condition. With counties and cities on fixed budgets, employing maintenance practices consistent with

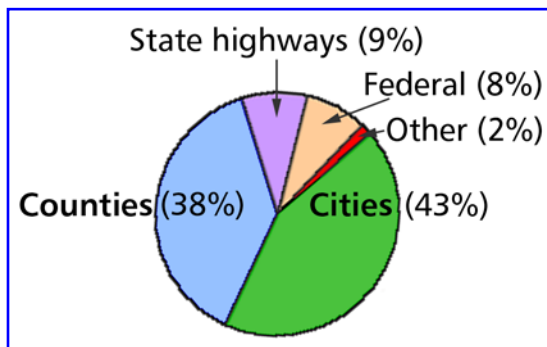


Figure 1. Breakdown of maintained centerline miles



Figure 2. Pavement in poor condition (PCI = 40)

Summary of
10-year needs and
shortfall
(2008 \$ billion)

BMPs results in treating four to twelve times more road area. By bringing the roads to BMP conditions, cities and counties will be able to maintain streets and roads at the most cost-effective level. It is a goal that is not only optimal, but also necessary.

Transportation Asset	Needs	Funding	Shortfall
Pavements	\$ 67.6	\$15.9	\$ 51.7
Essential Components	\$ 32.1	\$12.4	\$ 19.7
Totals	\$ 99.7	\$28.3	\$ 71.4

What are the pavement conditions of local streets and roads?

California's local streets and roads are on the edge. Currently at a PCI of 68, the pavement condition will drop to 48 (poor condition) by 2033 based on existing funding levels available to cities and counties.

What will it cost to bring pavements to a BMP or most cost-effective condition?

It will cost \$67.6 billion to reach BMP in 10 years.

How much will it cost to maintain them once we achieve the BMP or optimal pavement condition?

It will cost approximately \$1.8 billion per year.

What are the needs for the essential components to a functioning system?

The transportation network includes essential safety and traffic components such as curb ramps, sidewalks, storm drains, streetlights and signals. These components require \$32.1 billion over the next 10 years.

Is there a funding shortfall? If so, what is it?

The table on the left shows a shortfall of \$71.4 billion over the next 10 years.

What are the solutions?

To bring the State's local street and road system to a best management practice level where the taxpayer's money can be spent cost effectively, we will need up to approximately \$51.7 billion of additional funding for pavement alone and more than \$71 billion, including the essential components, for a functioning system over the next 10 years. The sooner this is accomplished, the less funding will be required in the future.

The conclusions from this study are inescapable. Given existing funding levels available to cities and counties for maintaining the local system, California's local streets and roads will deteriorate rapidly within the next 25 years to a poor condition. Unless this condition is addressed, costs to maintain our local system will only continue to grow, while the quality of California's local transportation network deteriorates.

In order to bring the local system back into a cost-effective condition, thereby preserving the public's \$271 billion pavement investment and stopping further costly deterioration, at least \$7 billion annually in new money going directly to cities and counties is needed to stop the further decline and deterioration of our streets and roads. This is equivalent to about a 38-cent gas tax increase. It is imperative that cities and counties receive a stable and dedicated revenue stream for cost effective maintenance of the local system to avoid this crisis.



Pavement preservation test section performance after 19 years of service

By Gary Hildebrand, Road Science, R. Gary Hicks, CP2 Center, and Larry Rouen, Caltrans

As part of the Strategic Highway Research Project, numerous SPS-3 sections were placed throughout the U.S. and Canada in the late 1980's and early 1990's. The SPS-3 projects were designed to evaluate the "Preventive Maintenance Effectiveness of Flexible Pavement Treatments" and each included a number of test sections with varying treatments and control sections. The projects were divided into four different climatic zones, and exhaustive information was recorded at the time of construction and performance data captured periodically for several years thereafter by the Long Term Pavement Performance team. After 19 years of service, what conclusions can be drawn? What is the effectiveness of preventive maintenance



Continued, next page

Control section after 19 years.



Slurry seal section.

treatments? Included here is a review of one SPS-3 project (06A3 GPS Section 061253, Butte – 32 PM 15.96 – 18.71, Average Annual ADT 2900) in California, where the sections were observed by the authors on February 12, 2009, after 19 years of service.

History

A brief history of the SPS section is

as follows:

- 1980 Roadway paved
- 1985 Conventional chip seal placed
- 1990 SPS 3 maintenance test section constructed
- 1990 – 2000 No maintenance done during this time with the exception of the crack seal test section and control sections being crack sealed
- 2000 Entire site crack sealed by Caltrans Maintenance forces
- 2003 Surveyed by Hildebrand and Dmytrow in June
- 2009 Project is 19 years old and scheduled for a thin overlay

Strategies placed and current condition

Different preventive maintenance strategies were applied to eleven segments of the test section in 1990. One segment was routed and crack sealed, one was slurry sealed, five had different chip seals applied, and four were overlaid with different hot mix asphalts. One segment was a control section where no preventive maintenance was applied.

Thirteen years later, the rout and crack seal segment shows only marginal improvement over the control section. It had to be crack sealed during the first few years in addition to year 2000 due to adhesion problems. Ride quality on this section does not seem to be any better than that of the control section. Additionally, a section of this roadway has deteriorated badly due to an underlying condition.

The slurry seal has performed well and there has been no delaminating or raveling and the roadway remains protected. Most of the cracks seem to have reflected through the slurry at this time, but have been crack sealed, preventing moisture intrusion and base damage. Overall, the five different chip seals have all performed well with minimum raveling, aggregate loss, flushing or bleeding, although some allowed more reflective cracking than others.

The four hot mix asphalt (HMA) overlays have also performed well, although reflective cracking has occurred in the two conventional HMAs. The

fiber and asphalt rubber HMAs appear to have an increased resistance to reflective cracking.

Discussion

In contrast to the eleven test segments, the “official” control section or “do nothing” section is in very poor condition. The ride quality is bad and the section is in need of a strategy well beyond the PM category. It appears that the only thing keeping this section intact is the crack filler. Between each test section is an “unofficial” control section. Each of these sections is also in very poor condition and will need a strategy well beyond the PM category in order to maintain them.

With the exception of the crack sealing section, all of the various maintenance strategies are still providing service to the public. They have extended the life of the pavement upon which they were placed and left the roadway in a condition that is acceptable to the motoring public. In addition, it is our belief that each of the maintained sections could be extended even further with the use of another maintenance treatment at this time. The slurry and seal coat sections are in need of a thin blanket or leveling course in order to restore their ride quality. The thin overlay sections could utilize a seal coat strategy since their ride quality is generally still good. In order to get any type of long term service out of the crack seal or control sections, extensive and costly rehabilitation strategies will, most likely, be required.

It is our belief that the PM strategies placed at this test section definitely demonstrate the benefits of placing PM on good condition roads. At the time the SPS-3 strategies were placed, the existing 1985 chip seal was in good shape, the ride quality was good and the distress consisted of transverse and longitudinal cracks at approximately one-quarter inch wide. Although these PM strategies have been in service for the past 19 years, almost all of the sections are still serviceable. We would like to note that this is a very low volume roadway in a non freeze-thaw area. Although many of these treatments were successful, prior to placing any of these strategies elsewhere would require a determination of traffic and weather conditions in order to achieve the same magnitude of success this site has seen.

Conclusions

These test sections provide proof of the viability of preventive maintenance treatments. It is our belief that by placing another PM treatment on these sections at this time the life of this roadway could be extended out another 5-10 years or more. When looking at the big picture, this site shows that an overlay placed in 1980 can be maintained for 30+ years in a condition that is acceptable to the general public and the taxpayers for the cost of a few PM treatments.



Thin, open-graded asphalt mix after 19 years.

Slurry/micro-surface mix design procedure

by Ruben A. Carrasco and James S. Moulthrop, Fugro Consultants, Inc., Austin, Texas

Background

Slurry seals and micro-surfacing are widely used as preservation treatments to extend a pavement's life. These pavement preservation treatments are becoming more popular as agencies incorporate them into their pavement preservation strategies. Currently, designing and testing slurry seals and micro-surfacing is more of an art than it is a science. There are mix design procedures in place for slurry seal and micro-surfacing by the International Slurry Seal Association (ISSA) and the American Society for Testing and Materials (ASTM). However, these procedures originated in the 1980's before polymer modified emulsions were used in slurry seals. For the most part, current tests and design methods are empirical and have no relation to performance in the field.



AMT prototype

The Federal Highway Administration (FHWA) recognized the need to update the current design method and testing practices in order to reflect the changes and evolution that slurry seals and micro-surfacing have gone through in the last decades. For this purpose, the FHWA enlisted the California Department of Transportation (Caltrans) to set in motion a pooled fund study directed by Fugro Consultants, Inc. The states that participated in the study included: California, Delaware, Georgia, Illinois, Kansas, Maine, Michigan, Minnesota, Missouri, New Hampshire, New York, North Dakota, Texas, and Vermont. The objective was to develop a rational mix design procedure in conjunction with guidelines and specifications for slurry seals and micro-surfacing. There are distinct differences between these two systems; however, current tests are similar for both. Due to this fact, it was determined by the project team that the two systems had to be studied together.



ACT prototype

The study began with a literature review and a survey of the industry and agencies currently using slurry seals and micro-surfacing. The second part of the study consisted of evaluating the current design and testing methods, considering potential tests and methods, proposing a new rational mix design procedure, ruggedness testing on recommended equipment and procedures, and a summary report with findings and recommendations. The last part of the study would consist of the development of guidelines, specifications, construction of pilot projects, and a training program.

After reviewing the current recommended laboratory test methods and design practices, it was found

that there is poor repeatability, limited relation to field performance, and that important factors in field conditions such as temperature and humidity were not being considered. The objective of the proposed test methods was to achieve repeatable results, relate to field performance, and to reproduce the field conditions that may occur during placement, and the long-term performance of the pavement.

The main desirable characteristics of the slurry seal and micro-surfacing mix evaluated in the mix design are: mixability, workability, and performance. The proposal of a new mix design must also consider important factors such as ease of use, cost, and the ease of implementation by users.

Slurry seal versus micro-surfacing

Since differences exist between slurry seals and micro-surfacing, the research team discussed the possibility of separate mix design procedures. However, for the purpose of mix design, the differences in the chemistry of the systems are not relevant. The main differentiator was the degree to which each system met the performance requirements in the field. Therefore, the mix design must attempt to identify and quantify performance requirements.

As a result of the considerations previously discussed, the project team decided to use a single mix design procedure for both systems. The proposed specification was named "S3" from Slurry Surfacing Systems.

Tests for materials properties

The first step in the mix design process is the selection and testing of aggregate, mineral filler, emulsified asphalt, control additives, and water. The goal in this step is to determine the individual properties as well as the compatibility of the materials with one another. The existing ISSA specification guidelines for slurry seal and micro-surfacing were evaluated and the changes considered necessary are reflected in the new S3 specifications. In short, the current specifications were determined to be acceptable, and only a few additional tests for some of the components of the mix were incorporated. Also some current acceptance thresholds were modified.

Tests for mixing, spreading and setting properties

One of the most remarkable deficiencies of the current tests for slurry seals and micro-surfacing is that the results are operator dependent. This also explains the high variability and poor repeatability of the results. The research team developed

Continued, next page

automated tests to eliminate operator's variability. The Automated Mixing Test (AMT) is based on a mixing test developed in Europe. The mixing of the components is carried out with an automated motor, and the change in viscosity (torque) with respect to time is recorded during the mixing process by the AMT software. Two very important parameters can be determined from this test: the mixability (cohesion limit where coating is more than 95%) and workability (cohesion value where the mix will still flow). These parameters could be measured over a range of shear values, temperatures, and other parameters. The ISSA TB 113 is the current method for mixing. However, the mixing and the assessment of the viscosity is operator dependent.

The Automated Cohesion Test (ACT) is used to determine the time to allow traffic. The ACT device applies a twisting torque on a sample after one hour of cure and measures the resistance to shear force. The applied force is motorized, constant and recorded by the ACT software. The current measurement of cohesion is done following ISSA TB 139. In this test, the torque is applied manually using a wrench.



CAT prototype

The Cohesion Abrasion Test (CAT) is a modified version of the ISSA TB 100, Wet Track Abrasion Test (WTAT). The set up of the CAT incorporates a set of wheels instead of the abrasion head. The abrasion lost and the short-term stone retention may be measured in this test. The test can be performed under different cure conditions to determine the effect of early water intrusion in the pavement due to rain.

The Loaded Wheel Test (LWT), currently the ISSA TB 109 test, is used to specify the upper limit of bitumen content by determining the amount of sand adhesion. No changes to the existing test were considered necessary. However, it was determined that conditioning the samples to reflect changes in shear or field temperatures was essential.

Long-term performance tests

The main properties of interest for long-term performance of slurry systems include: abrasion resistance (raveling), water resistance (stripping), and deformation resistance (rutting). To measure these properties, the S3 specifications proposed the CAT test to quantify abrasion and water resistance. In general, the CAT test (modified TB 100) includes a different setup, higher testing temperatures, extended testing times, and different sample conditioning. For deformation resistance, the ISSA TB 109 will be used with no changes.

Summary

The proposed S3 mix design procedure addresses the shortcomings of the existing procedures by examining mix properties that relate to field performance issues. In summary, the new S3 mix design is as follows: selection of materials, create a mix matrix and determine mix constructability, determine short-term constructability properties, determine optimum binder content, evaluate cohesion properties at various conditions, and finally evaluate the long term performance properties of the mixture.

To evaluate the proposed S3 mix design and test methods, the project team used combinations of three asphalt emulsions and three aggregate sources to create five different systems (mixes). The set-up variables for the different testing devices were investigated and refined to perform and produce repeatable results.

The new S3 specification is believed to be suitable. However, the project team considers that pilot projects to evaluate and contrast the S3 procedure against the current practices would be necessary to complete the study. The new S3 specifications and a training program are in the final stages. In conclusion, the pooled fund study made possible S3, which is believed to be more practical, repeatable, and up to date for slurry seals and micro-surfacing design and testing.



The future of in-place recycling in California

by Larry Rouen, Caltrans, and R. Gary Hicks, CP2 Center

Caltrans has placed several in-place recycling projects, including full-depth reclamation (FDR), hot in-place surface recycling (HIR) as well as cold in-place surface recycling (CIR) projects, in various locations as shown on the right.

Continued, next page

Type of recycling	Project identification
FDR foam projects	Col-20, 36 Lane Miles Completed 2001 Sie-89, 23 Lane Miles Completed 2003 Sol-220, 2.3 Lane Miles Completed 2004 Cluster Maintenance Yard, Completed 2004 Sta-132, 11 Lane Miles, Completed 2004 Sta-108-120, 16 Lane Miles, Completed 2005 Slo-SB-33, 21 Lane Miles, Completed 2005 Gle-32, 17 Lane Miles, Completed 2006 Ven-33, 18 Lane Miles, Completed 2006 SB-166, 26 Lane Miles Construction 2008
CIR foam projects	Pla-80, 58 Lane Miles (LM), Completed 2005
CIR emulsion projects	Imp-79, 6 Lane Miles, Constructed 2006 Col-16, 12 Lane Miles, Construction 2007



Figure 1. HITONE process being readied for work.

In the summer of 2008, Caltrans piloted two hot in-place recycling projects using a Japanese process called Hot In-place Transforming (HIT) known by the acronym HITONE

(see Figure 1). The purpose of these projects was to evaluate the viability of hot in-place recycling on various types of material. This equipment has the ability not only to recycle, but also to separate the recycled material into two layers; a mastic (as the

bottom layer) and an open-graded mix (as the top layer). The first project consisted of recycling a polymer modified, open-graded HMA on SR 99 in Tehama County. It was determined that the HITONE process did not work well with these types of materials. The second project consisted of recycling a conventional dense-graded HMA on SR 62 in Riverside County near Palm Springs.



Figure 2. full-depth reclamation, Delano Calif.

This project was successfully constructed

as test sections consisting of HIT, a traditional HIR process, and a mill-and-fill with conventional dense graded hot mix asphalt (HMA). These sections were placed side-by-side for comparison. Findings from this study can be found on the Center's website located at: www.cp2info.org/center.

A report recently completed by the CP2 Center¹ reviewed the HIR processes. The report found that the

cost for HIR could be 40 to 50 % less than for a mill-and-fill HMA strategy. Also, the report shows significant energy savings when using HIR as compared to conventional dense-graded HMA overlays. These findings should encourage highway agencies to seriously

consider recycling as an alternative to mill-and-fill or HMA overlays.

In addition, Caltrans is looking into FDR as an alternative to pavement rehabilitation. Caltrans and many local agencies have already used this process on several projects.

Some of the processes that have been used include the following:

- Foam FDR costs about \$10.00 per square yard or some \$ 71,000 per lane mile (includes bitumen, cement, recycling, grading and compaction). This process has been used widely in California.
- Emulsion FDR costs about \$13.00 square yard or \$ 92,000 per lane mile (includes emulsion, recycling, grading and compaction). This process has been widely used by local agencies.

The benefits of full-depth reclamation have now been clearly demonstrated. Figures 2 and 3 illustrate some of the equipment used in the cold in-place recycling process.

Caltrans is planning an ambitious in-place recycling initiative over the next 3 years. The initiative calls for placing projects using in-place recycling techniques to capitalize on the cost and energy savings as well as reduced emissions associated with these techniques. The desired number of projects will be at least three throughout the State per year, each with an adequate project length to thoroughly evaluate each process. Based on the experience gained from previous projects (Figure 4), the proposed initiative projects will only be constructed on conventional dense graded HMA pavements.

Specifically, the plan will include the following:

- Place pavement preservation projects using HIR and CIR strategies and pavement rehabilitation projects using FDR.
- Monitor the equipment, construction, performance and cost of each project. Evaluate the energy consumption and cost for each of the construction processes.
- Develop guidance to implement these technologies statewide. The California Pavement Preservation (CP2) Center at CSU Chico will be responsible for developing these guidelines.
- Identify project constraints that would restrict the use of these technologies (e.g. train length, curves, grades, etc.).

At the end of the three-year period, Caltrans will have completed the proposed projects. Caltrans personnel will then determine the viability of using these techniques as main strategies. The long-term performance will be monitored annually throughout the life of these projects. The pilot projects will be beneficial in establishing the following:

- Documented measures of the cost effectiveness of the various processes.
- Estimates of energy consumption and emissions for determining the carbon footprint of each process.
- New updated specifications.

In summary, because of limited financial and material resources, Caltrans will be using more in-place recycling than it has in the past. We continue to look at innovative ways to do "more with less" and thus reduce the carbon footprint of pavement preservation and rehabilitation processes.

Figure 3. cold-foam equipment for full-depth reclamation.



Figure 4. CIR process on SR 16.

¹ Terrel, Ronald L. and Gary Hicks, 2008 "Viability of Hot In-place Recycling as a Pavement Preservation Strategy", California Pavement Preservation Center, Chico, Calif.

Federal highway funds – ARRA and SAFETEA-LU reauthorization

By Steve Healow, P.E. Asset Management & Pavement Engineer, FHWA, California Division

By now nearly everyone has some familiarity with the American Recovery and Reinvestment Act (ARRA) of 2009 which was signed into law on Feb. 17th.

The Act includes a stimulus spending plan which will make available up to \$787 billion. Of particular interest is Section 3(a) "Purposes of the Act"; item #4 reads "... Invest in transportation, environmental protection, and other infrastructure that will provide long term economic benefits...". On March 3rd President Obama and Vice President Biden joined USDOT Secretary LaHood in announcing that \$26.6 billion of this funding was available to the states for highway investment. As of this writing, approx. \$10.3 billion (39%) has been obligated on 2,992 highway and bridge projects. You can view these progress charts at www.recovery.gov.

State DOTs are highly motivated to spend the money in a timely manner since the law contains a use-or-lose stipulation at 120 days. Any state which hasn't obligated 50% of their apportioned funds into a project agreement by June 30, 2009, will lose those funds which will be redistributed. This is no longer an issue in California, which met this requirement within 60 days. In addition, funds not obligated by September 30, 2010 will lapse and funds not expended by September 30, 2015 will expire.

The framers of ARRA targeted projects which were ready to go, or "shovel ready." Prospective projects had completed or nearly completed environmental reviews, final design, PS&E and are in an approved TIP or STIP. They are on the shelf waiting for funding, or nearly so. In addition "...priority shall be given to projects that are projected for completion within a three-year timeframe, and are located in economically distressed areas." It will be difficult living up to that objective. An Associated Press article dated May 11 makes the case that counties with the highest unemployment are least likely to have projects waiting on the shelf. Mayor John Carroll of Perry County, TN, said he's disappointed his community, which has 25.4% unemployment, is not slated to receive any ARRA stimulus money.

"It's pretty easy to draw a connection between the high unemployment rate and the lack of any four-lane highways," he said.

However, State DOTs and Metropolitan Planning Organizations will be expected to demonstrate that consideration of Economically Distressed Areas has been given in the distribution of ARRA fund-

ing. ARRA funded projects are required to follow all normal Federal-aid funding requirements, including Davis-Bacon wage rates.

California has big plans for its ARRA share. \$2.6B will go to highways and local streets, \$1.0B for transit, and \$300M for discretionary spending. Eighty projects will benefit state-wide. On April 30th the first California ARRA-funded project broke ground on I-80 in Solano County. The \$13.5 million project will resurface and repair the freeway in the vicinity of Fairfield, and employ 200 workers through December. In a sign of the times, the winning bid was 40% under the engineer's estimate.

For some state DOTs the stimulus money will merely fill a gap. For others it will mean a substantial increase in the size of their program and the volume of their road work. Drivers in Florida will likely see an estimated 25% more work zones, while New York's 2009 program will be 60% greater than in 2008.

Meanwhile, time is running out on the current highway bill, SAFETEA-LU, which expires on September 30. Critical players in developing the next highway bill are James Oberstar (D-MN), Chairman of the House Transportation and Infrastructure Committee, and Barbara Boxer (D-CA) of the Senate Energy and Public Works Committee. The House T&I Committee includes California Representatives Filner, Tauscher, Richardson, and Miller. They have been working on the new bill for two years. Oberstar has expressed an interest in expediting the permitting process for new infrastructure projects. He and Boxer have several common priorities: reduce congestion; curb emissions; and reduce fuel consumption. Consumers have responded to higher fuel prices by switching to more fuel efficient vehicles and cutting their vehicle miles traveled. Consequently the federal gas tax no longer generates sufficient cash flow to the federal highway trust fund. Oberstar is considering a mileage-based tax to fill the gap, but hesitates to implement the new tax before the economy recovers. Other recommendations include doubling or tripling the current eighteen cents per gallon gas tax, or tolls, or increasing private investment in roads.

Since August 10, 2005, highway spending under SAFETEA-LU will amount to approximately \$286B. Oberstar envisions the next bill may authorize spending up to \$500B over the next six years. He plans to complete the House version of the transportation bill late in May and have a full House vote early in June, 2009. Oberstar and Boxer want to have the next bill signed into law on schedule, no later than the first of October. The reader will recall the 22 months of prolonged debate which delayed enacting SAFETEA-LU.



The California Integrated Waste Management Board Education Project

By Ding Cheng, CP2 Center



Each year, there are about 40 million waste tires generated in California. When utilized properly, waste tires become very useful civil engineering materials because they have some desirable engineering properties. The materials have been successfully used as asphalt rubber, light weight fill, retaining wall backfills, landfill tire derived aggregates, light rail vibration damping materials, and more. Civil engineering applications are the fastest growing market for waste tire products. In order to promote sustainable and successful waste tire applications in civil engineering, a curriculum development and dissemination project was funded by CIWMB. The primary

purpose of this project was to develop and disseminate teaching materials that could be used in undergraduate civil engineering courses. A series of course modules have been developed for a variety of undergraduate civil engineering courses including: Introduction to Civil Engineering Design; Mechanics of Materials and Materials Testing Lab; Soil Mechanics and Foundations; Contract and Specifications; Environmental Engineering; Solid Waste Management; and Transportation and Pavement Materials. The teaching modules have been taught in real classroom scenarios at CSU, Chico. The course materials are available to be



CIWMB members Sheila Kuehl, Rosalie Mulé John Laird and Carole Migden (far right) awarded certificates of appreciation to Chico students Julian Storelli, and Cody Menefee at the CIWMB board meeting.

purpose of this project was to develop and disseminate teaching materials that could be used in undergraduate civil engineering courses.

A series of course modules have been developed for a variety of undergraduate civil engineering

courses including: Introduction to Civil Engineering Design; Mechanics of Materials and Materi-



Chico State students presented their CIWMB education project. Left to right are Professor Ding Cheng with students Cody Menefee and Julian Storelli.

integrated into various courses in the undergraduate civil engineering curriculum and serve to introduce students to sustainable building practices and "green" construction.

On April 14, 2009, two Chico State students gave a presentation of their student project on using waste tire in rubberized asphalt pavement, and the use of tire derived aggregates as retaining wall back-fill materials on a hypothetical SH 99 widening project at the CIWMB meeting in Sacramento.

Three professor training workshops have been given for professors who are teaching classes related to the waste tire application in California. One workshop was conducted in Sacramento, Calif., on December 19, 2008, for universities in Northern California. Another workshop was held in Pomona, Calif., on January 5, 2009, for universities in Southern California. About 26 professors from 14 different universities attended these two workshops. The third workshop was held in San Luis Obispo on April 17th and was very successful, with 22 professors from nine different universities attending. The participants completing an evaluation of the workshops gave high ratings for the content. Attendees indicated the teaching materials are very useful and can be incorporated into their teaching tasks. Presentations from the workshop may be viewed at the following website: www.ecst.csuchico.edu/cp2/ciwmb/education.

For more information about the project please contact Professor Ding Cheng at: dxcheng@csuchico.edu.



Waste Tire Applications professor training workshop in San Luis Obispo. First row, from left: Khatree Sikandar, Ding Cheng, Sudeshna Mitra, Tonya Nilsson, Ali Oskoorouchi, Ashraf Rahim, Chandrasekhar Putcha; second row: Hany Farran, Bing Qu, Ghassan Tarakji, Anurag Pande, James Hanson, Nazli Yesiller, Nilanjan Mitra, Binod Tiwari, Sam Vigil, Rob Chai; third row: Mladen Yucetic, Joel Arthur, Albert Johnson, Ayman Mosallam, Yuwei Li, Lubo Liu, Yarrow Nelson, Jim Putnam.

Center staff participates in local agency workshops

Center staff continues to work with industry to promote pavement preservation with local agencies. Gary Hicks and Scott Dmytrow delivered a four-hour workshop at an APWA event in Chico on April 24, 2009, to 50 city and county personnel and consultants. Topics covered included presentations on Pavement Preservation 101, Scrub Seals, and Asphalt Rubber Hot Mixes and Chip Seals.

On April 29, 2009, Yolo County sponsored a training session for their personnel and staff members from the City of Davis and Woodland. Topics covered included:

- Asphalt binders and emulsions – Hans Ho
- Surface Seals – Scott Dmytrow
- Full depth reclamation – Jim Emerson
- Pavement Management: Options and Issues – Gary Hicks

One of the missions of the Center is to promote pavement preservation through work-

shops. If you are interested in workshops such as these, please contact the Center.

Both workshops received positive reviews from the participants.

Yolo County workshop participants, left to right, Jim Emerson, Scott Dmytrow, Nancy McKee and Hans Ho.



Upcoming pavement related events

Twelfth AASHTO/TRB Maintenance Management Conference, July 19 – 23, 2009, Annapolis, Md. www.transportation.org/meetings/215.aspx.

International Road Federation conference, Preserving our Highway Infrastructure Assets, August 4 – August 7, 2009, Orlando, Fla. [www.irfnet.org/eventdetail.php?catid=1&id=102&title=Preserving our Highway Infrastructure Assets](http://www.irfnet.org/eventdetail.php?catid=1&id=102&title=Preserving%20our%20Highway%20Infrastructure%20Assets).

Public Works Congress and Exposition, September 13 – 16, 2009, Columbus Ohio. www.apwa.net.

International Conference on Perpetual Pavement, September 30 – October 2, 2009, Columbus, Ohio. www.ohio.edu/icpp.

Asphalt Rubber 2009, November 2 – 4, 2009, Nanjing, China. consulpav.com/ar2009.

Developing a Research Agenda for Transportation Infrastructure Preservation and Renewal, November 12 – 13, 2009, Washington, D.C. www.TRB.org/conferences/2009/Infrastructure.

ACPA Annual Meeting, November 30 – December 4, 2009, Orlando, Fla. www.acpa.org.

California Chip Seal Association Annual Meeting, January 2010. www.chipseal.org/2010_conference.htm.

Transportation Research Board Meeting, January 10 – 14, 2010, Washington, D.C. www.trb.org/meeting/2010/default.asp.

NAPA's 55th Annual Meeting, January 17 – 21, 2010, Maui, Hawaii. www.hotmix.org.

Association of Asphalt Paving Technologists 85th Annual Meeting, March 7 – 10, 2010, Sacramento, Calif. www.asphalttechnology.org/annual-meeting.html.

First International Conference on Pavement Preservation, April 12 – 16, 2010, Newport Beach, Calif. www.pavementpreservation.org/icpp/.

International Conference on Sustainable Concrete Pavement Technologies – Practice, Challenges, and Directions, September 16 – 18, 2010, Sacramento, Calif. For additional information contact: Shiraz Tayabji, Fugro Consultants at stayabji@aol.com or (410) 997-9020.

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