CP² Center News

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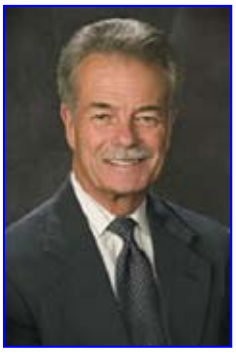
Interview with Will Kempton



Will Kempton, Director of Caltrans

Will Kempton was appointed Director of the California Department of Transportation by Governor Arnold Schwarzenegger in November 2004. He is responsible for managing the day-to-day operation of California's state transportation system, including more than 50,000 lane miles of state highway stretching from Mexico to Oregon and from the Pacific Ocean to Nevada and Arizona.

Director Kempton oversees an annual operating budget of more than $13.8 billion, 22,000 employees, and $10 billion worth of transportation improvements currently under construction. He began his career in transportation with Caltrans in 1973. He has held a variety of management positions within Caltrans including serving as Assistant Director for Legislative and Congressional Affairs during the administration of Governor George Deukmejian. In addition to his service with Caltrans, Kempton served as Executive Director of the Santa Clara Transportation Authority, a contract lobbyist specializing in transportation issues, and Assistant City Manager for the City of Folsom. Throughout his career, Kempton has demonstrated a keen understanding of transportation programs and policies, particularly in the areas of transportation programming and funding, at all levels of government.

Director Kempton was interviewed by the Center staff on July 11, 2008. His responses to a series of questions are presented below.

What are the major challenges facing Caltrans with its pavement?

Caltrans faces a number of challenges including the following:

- *Limited resources and funding categories to maintain our infrastructure*. Although gas prices have increased significantly, the amount of federal and state tax making up that cost has remained the same. Thanks in large part to the rising price for gas, fuel usage is down, which means we have less funding available for maintenance and other transportation improvements. Our challenge in this environment is to pursue more cost effective solutions to protect the multi-billion dollar investment Californians have in their highway system.
- *Environmental impacts of emissions and pollution.* As good stewards of the environment, we have a responsibility to reduce emissions and pollutants into our air and water. The Governor recognizes this critical obligation and has mandated that we do all we can to reduce our carbon footprint. Preservation and recycling are key components in reducing the carbon footprint of our pavement program.
- *Congestion and construction delays*. Congestion is a problem motorists are facing all across California, especially in our major urban areas. That congestion means longer delays, reduced productivity, and increasing costs for commuters and to move commerce. For managers of the highway system, this increasing demand on our transportation system is making it more difficult to perform the necessary maintenance and rehabilitation of our road network. It is imperative, therefore, that we look for innovative ways to perform this work while minimizing delays to the traveling public. A perfect example of where we can facilitate a needed repair while minimizing the disruption to traffic was the recent reconstruction of I-5 in Sacramento in less than two months. It is a repair strategy which we believe could be utilized on other projects around the state.
- *Increase in oil prices and its impact on construction materials.* The price for oil has

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risen dramatically this past year, significantly increasing material costs on transportation construction projects. Those rising costs have eroded our purchasing power, reducing the number of transportation improvements that we can put out to bid. For example, in the past year, the cost for asphalt, concrete and steel increased dramatically, resulting in fewer bidders competing for our jobs.

Bottom-line, we need to preserve the good roads and find innovative ways of dealing with the bad roads.

What are your plans for improving the condition of the pavements statewide?

We are working on a number of fronts to improve the condition of our pavement:

We are developing an improved pavement management system to determine when and where to place our resources in the most cost effective way. This system, which is being developed by the new Caltrans Division of Pavement Management, is expected to be up and running by 2011. It will allow us to monitor the performance of all pavement treatments, preservation and rehabilitation alike.

We are incorporating advanced technology to improve the way we monitor and assess the condition of our pavement. Some of these tools include Ground Penetrating Radar (GPR) to measure pavement thickness, advanced monitoring vans to measure roughness and distress, and additional skid trailers to monitor skid resistance, especially for some of the preservation treatments.

We are applying preservation treatments to new or rehabilitated roads and looking for cost effective, innovative strategies to rehabilitate roads currently in a distressed condition. Some of these possible rehabilitation strategies include surface recycling and full depth reclamation. Bottom-line, we need to preserve the good roads and find innovative ways of dealing with the bad roads.

How can the State improve the overall condition of the pavements using pavement preservation concepts?

Some of the strategies we are pursuing include:

- Apply the right treatment at the right time. We find that some treatments are applied when the level of distress is too great resulting in shortened treatment lives.
- Use sustainable strategies that can extend pavement life such as surface recycling and full depth reclamation, thus delaying the need to employ more costly repair alternatives. Through our innovation program monitored by the new Division of Pavement Management, we have a number of recycling projects planned to 2008 and 2009.
- Provide appropriate related training for all Caltrans staff charged with managing the condition of the state highway pavement.
- Maintain present service levels. In order to accomplish this, we need to obtain much more of our materials (asphalt and aggregates) from our current road system (in-place recycling). We cannot continue the practice of importing our aggregates.

Finally, we want to re-establish Caltrans as one of the leaders in pavement design, construction and maintenance through the new Division of Pavement Management.

How will your plans for a new pavement management system (PMS) incorporate pavement preservation treatments and help the state show the importance of pavement preservation?

The new pavement management system must demonstrate the cost effectiveness of all repair and preservation strategies. We are counting on this system to provide better information on the health of our network as well as the performance of the various preservation treatments. We want to make sure we are using the most cost effective treatments and applying the pavement preservation early on before pavements deteriorate. We want to apply treatments when the cracking is less than 10%.

We feel that pavement preservation, including surface recycling, will be more cost effective in the future especially in light of the rising cost of pavement materials. That is why we are implementing trials using both cold and hot in-place recycling. We also want to place trials using full depth reclamation. We have to be innovative to determine the most cost effective pavement preservation treatments.

What is the expected role of the CP2 Center in the new Division of Pavement Management and with the PMS effort and how can it help Caltrans even more than it does now?

The Center, established in July 2006, has been instrumental in promoting pavement preservation statewide. We are proud to have established the Center at California State University, Chico and look forward to supporting it more in the future. For example, we envision that the Center will complement the efforts of the U.C. Davis program for fundamental research. We expect both the Center and the Partnered Pavement Research program at U.C. Davis to work together on implementing the new pavement management system that we are developing.

Through the Center, we hope to reach out to other state public universities to help train Caltrans staff and provide for short term needs (applied research, problem solving, documentation of innovation, technical support, and training). Our goal is to

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build upon the outstanding partnership we have in place with academia to expand the teaching and research into pavement preservation and repair.

It is acknowledged that far too few of California engineers have any formal training in pavements. This situation is exacerbated by the fact that there are only a few university programs that teach undergraduate or graduate programs in pavements. How does Caltrans hope to influence this situation and what role might the Center play in this plan?

As mentioned before, we need to establish more training in pavements and materials. This can be accomplished by:

- Marketing the use of online training in pavements using the Center's certificate and rotational programs.
- Encouraging the implementation of the Center's growth plan* to involve other universities in training, particularly in Southern California.

The Center's online certificate program in pavement preservation is tailored for the field practitioner and provides a solid overview of pavement preservation technologies. How do you envision Caltrans supporting staff participation in this program?

The department will encourage the district training coordinators to have staff participate in this program. We also will share information about the program directly with the Caltrans workforce. We feel this type of program can provide the needed just in time training our staff needs.

The Center's rotational (or visiting engineer) program can provide on- the- job training on pavement preservation. How can Caltrans encourage staff to participate?

We will work with the training coordinators to establish the Center as part of the rotational program in pavement preservation. Pavement preservation and asset management are keys to our success in protecting the state's transportation infrastructure. We also will share information about the program with the Caltrans workforce and encourage staff to participate.

The Center's growth plan and vision for California is ambitious. How can we partner with Caltrans to accomplish this?

Caltrans is very interested in the Center's growth plan to provide services to all 12 district offices. We will work with the Center to provide a vehicle for funding the growth plan to other satellite offices in other parts of the state. However, it is important that the Center coordinate its efforts with the Partnered Pavements Research and LTAP Programs at the University of California to make sure there is not unnecessary duplication of effort.

* *The growth plan envisions several satelite offices for the Center in several universitiy campuses in southern, central and northern California. See* www.cp2info.org/center *for more details.*

The effectiveness of diamond grinding concrete pavements in California

By Richard Stubstad, ARA and PPTG Co-Chair on Diamond Grinding

Introduction

With the rising costs of both construction and user delays during pavement rehabilitation projects, more attention is being given to cost-effective and simpler ways to preserve our concrete pavements with minimal impact on road users. One pavement preservation alternative that is now commanding nationwide attention on concrete pavements is diamond grinding.

In fact, the technique was first used in this country in 1965 on a 19-year old section of I-10 in Southern California to mitigate excessive step faulting. This pavement was again ground in 1984, and once again in 1997, and it is still carrying heavy traffic today—more than 60 years after it was first constructed.

Through diamond grinding, it is possible to extend the service life of many of our aging concrete pavements at a relatively low cost and with minimal

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disruption to traffic flow. In the past, many states have employed diamond grinding as a viable pavement preservation technique with excellent results. The question is: Exactly how effective is diamond grinding as opposed to other alternatives, and how much does it cost relative to other alternatives?

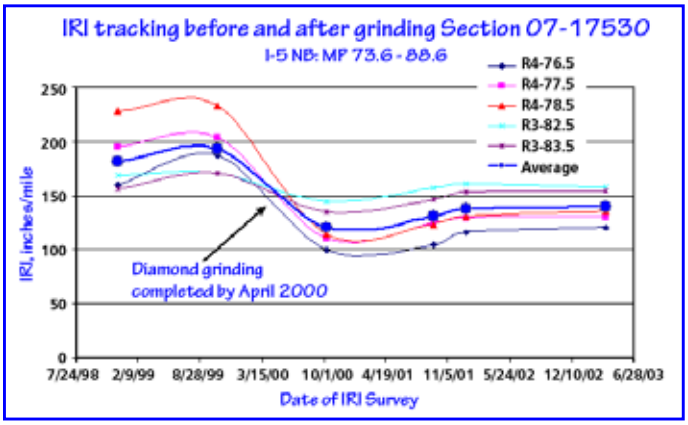

Figure 1. Measured IRI values before and after grinding a section of I-5 in 2000.

Diamond grinding studies

Nationwide, previous studies have shown that the average longevity of a diamond ground project is around 14 years, or about 11 years at an 80% certainty (or reliability) level. Seventy-six test sections involved in a recent nationwide study included freeze-thaw zones and other adverse conditions not normally encountered in California. Thus it was expected that the dry-no freeze zone of California would yield even better results, due to the milder climate.

Figure 1 shows the before- and after grinding International Roughness Index (IRI) of a typical Caltrans diamond grinding project.

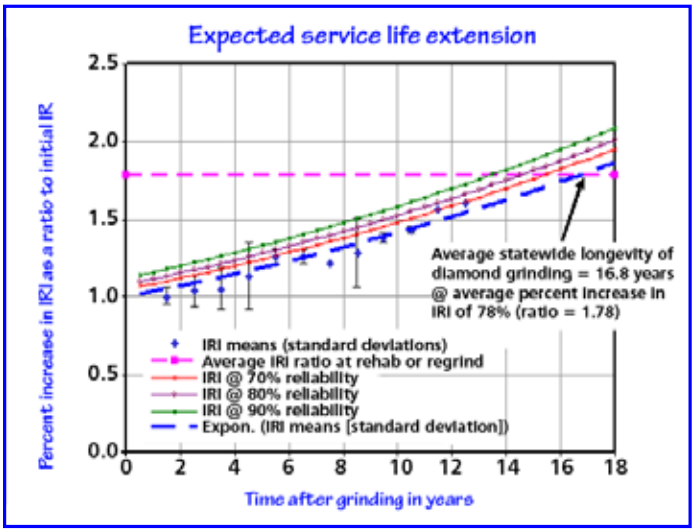

Figure 2. Expected service life extension of diamond ground concrete pavements in California.

Here, it is seen that the IRI improved (reduced) considerably along most of the affected lanes as a result of diamond grinding.

Data were also gathered from this and 25 other California projects on the performance of diamond grinding as a pavement preservation technique. These data were collected from the California Pavement Management System (PMS) database. Based on these historical data, Figure 2 shows the average expected longevity of diamond ground projects in California, along with the corresponding curves for the 70th, 80th and 90th percentile reliability levels.

In Figure 2, the expected percent increase in the International Roughness Index (IRI) is expressed as the average IRI for 26 California diamond ground projects divided into the average expected IRI for the same 26 projects at the end of their design lives. In other words, if the IRI just after grinding on any given project is, say, 100 in/mi, then (on average) it is expected to be 178 in/mi at the end of its design life when further maintenance or rehabilitation needs to be carried out. This second round of life extension could be another grinding project (up to three successive grinds have been performed on Route 10 in San Bernardino County) or any other form of maintenance or rehabilitation.

The upshot of Figure 2 is that, on average, a diamond ground PCC pavement should maintain its smoothness nearly 17 years in California, or some 14½ years if, for example, an 80th percentile reliability level is applied. Compared to the corresponding national average values of 14 and 11 years, respectively, these results are quite reasonable, since the climatic conditions in California are comparatively favorable for longer lasting PCC pavement performance.

Currently, the specification for pavement smoothness after grinding is based on a California Profilograph measurement using California Test Method #526, which is not particularly stringent. Even though it is certainly possible for contractors to achieve a very smooth surface as a result of grinding (combined with slab leveling for major settlements, if needed), this capability has not yet been utilized to its fullest.

Based on current experience, it is indeed possible to diamond grind candidate concrete pavements up to three times before major reconstruction is needed. This could extend the service life of a new concrete pavement to as much as twice its normal design life by adding only two or three grinding projects and continuing normal routine maintenance—none of which should disrupt the traffic flow during peak hours.

Can diamond grinding be used in all cases?

There are certain pavement distresses or conditions that should preclude the use of diamond grinding as a pavement preservation alternative on concrete pavements. These include:

- Lack of structural integrity (e.g., voids under joints from pumping, excessive slab cracking and progressive cracking over time).
- Poor load transfer at transverse joints as indicted by excessive faulting or load-deflection testing.
- Spalling or other damage due to ASR.
- Freeze-thaw damage, including D-cracking.
- Soft aggregates in the PCC slab, such as limestone, that are prone to polish (this may be partially overcome by widening the spacing of the grinding blades).

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None of these distresses would be remedied by diamond grinding, and the problem would likely continue to cause pavement failure a short time after grinding.

Other advantages of diamond grinding

There are two other direct benefits to diamond grinding that were not measured or recorded in the Caltrans PMS database. One of these benefits is to achieve an appreciable noise reduction in tire-pavement interface sound emissions, while the other is to improve the safety of the freeway by virtue of an immediate and long-lasting increase in the skid resistance of a diamond ground concrete surface.

Table 1. Typical noise levels of concrete pavement surfaces in Arizona.

Surface texture type	CPX noise level measured at tire (dBA)
Whisper Grind Test Section	95.5 (as-constructed)
ADOT uniform longitudinal tined (¾")	99.1
ADOT uniform transverse tined (¾")	102.5

It is commonly experienced that diamond ground pavements are much quieter after grinding than before grinding. To quantify this well-known phenomenon, the Arizona DOT (ADOT) ran a series of grinding and texturing tests along the SR-202 Freeway in the Phoenix area. The test areas, with the grinder using differing blade spacings and grinder configurations for several adjacent test areas, were called "whisper grind" sections, since the primary objective of ADOT's study was not smoothness but rather noise mitigation. A summary table from

Table 2. CPX test results for various diamond ground surfaces (dBA) in Arizona.

Date	6/6/03	6/6/03	6/6/03	9/8/03	9/8/03	9/8/03
Test Area	**Lane 1**	**Lane 2**	**Lane 3**	**Lane 1**	**Lane 2**	**Lane 3**
1	96.6	96.4	NA	NA	97.5	NA
2	NA	NA	98.1	NA	NA	98.0
3	98.5	95.6	NA	NA	97.0	NA
4	NA	NA	95.5	NA	NA	95.5

ADOT's Construction Report, "SR202 PCCP Whisper Grinding Test Sections" (Scofield, October 2003) is shown in Table 1.

As can be seen in Table 1, compared to other common PCCP surface textures of transverse tined or longitudinal tined, diamond ground surfaces are considerably quieter. For new construction, Caltrans typically utilizes uniform longitudinal tining—which tested out in Arizona at around 99 dBA using the close proximity method (CPX) of noise measurement. As can be seen, considerable improvement is obtained, with CPX noise levels as low as 95.5 dBA (on a log scale) attainable through whisper grinding.

As mentioned, several different grinder configurations were included in the experimental design of the whisper grind test sections. Table 2 shows the results to-date of all CPX tests conducted on two different dates after grinding.

In terms of improved texturing and skid resistance, many documented studies have shown considerable improvement in the skid resistance of diamond ground concrete pavements. The degree of improvement naturally depends on the skid resistance of the facility before grinding, from new construction (in the case of California, with longitudinal tining) to older, polished surfaces that may have lost much of their macrotexture. The hardness of the aggregate in the PCC is also critical to longevity of diamond ground surfaces. Softer aggregates, such as limestone, are more prone to polishing, causing a loss of texture depth on diamond ground surfaces. Most aggregates in California are much harder and thus maintain their texture over longer time periods.

The same ADOT study for noise mitigation mentioned above also monitored the changes in skid resistance for the same whisper grind test sections. Table 3 depicts the before- and after-skid numbers, together with the percent improvements, due to diamond grinding with various blade spacings and grinder configurations. The percent improvement for any given test section due to grinding is shown in parentheses.

As indicated, the increase in friction values varied between 15% and 41%, with an overall average improvement of 27%. Since these pavement sections were relatively new, it can be expected that grinding will result in even better improvements in skid resistance due to diamond grinding.

It is also likely that diamond grinding will reduce user costs. Many road tests have unequivocally shown that fuel efficiency and vehicle repairs are significantly reduced when the smoothness of a pavement is improved. Accordingly, road user costs will be reduced as a result of diamond grinding, with the greatest benefit occurring on the heaviest traveled roadways. In California, most of our PCC pavements are heavily traveled freeways. From a user cost point of view, this further bolsters the

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Table 3. Friction values and percent changes due to diamond grinding in Arizona.

	Before grinding	Before grinding	Before grinding	After grinding	After grinding	After grinding
Test Area	**Lane 1**	**Lane 2**	**Lane 3**	**Lane 1**	**Lane 2**	**Lane 3**
1	0.52	0.55	NA	0.65 (25%)	0.63 (15%)	NA
2	NA	NA	0.56	NA	NA	0.66 (18%)
3	0.49	0.51	NA	0.69 (41%)	0.69 (35%)	NA
4	NA	NA	0.53	NA	NA	0.67 (26%)

case for more widespread use of diamond grinding as a CPR method, further improving the overall condition of the state's vast network of concrete pavements.

The diamond saw blade makes small longitudinal grooves in the pavement.

Summary

On average, diamond grinding of step faulted Portland Cement Concrete (PCC) pavements in California results in an average extended service life of 17 years. Furthermore, diamond grinding may be performed up to three consecutive times on the same pavement section without loss of structural integrity. These figures compare favorably with the nationwide average of 14 years, since the climatic conditions in California result in a greater average lifespan.

Other benefits of diamond grinding are also noted: Improved skid resistance resulting in greater safety and a lower tire-pavement interface noise level. User costs are also reduced, since fuel costs and maintenance of vehicles are inversely proportional to increasing smoothness levels.

Based on these findings, it is suggested agencies implement diamond grinding of PCC pavements on a more widespread basis. It is also feasible that diamond grinding of newer PCC pavements will increase the typical life cycle of these pavements, while also contributing to the same additional benefits of improved skid resistance and noise abatement.

Seventh International Conference on Managing Pavement Assets

by David Peshkin, P.E., Applied Pavement Technology, Inc.

David Peshkin

The Seventh International Conference on Managing Pavement Assets was held in Calgary, Alberta from June 23-28, 2008. The conference theme —- "Preserving What We Have… Investing in the Future… Finding the Balance" — was a reflection of the pressures on the pavement profession to develop both economical and sustainable infrastructure solutions. Almost 300 delegates from 26 countries participated in pre-conference workshops, toured the exhibit hall, met with vendors, and attended three days of presentations.

One general area of interest to the delegates and a specific area of interest in California and elsewhere is the integration of pavement preservation and pavement management. Before covering what some of the speakers had to say about integration, let's review what it is and why it's so important.

Background

The early practice of pavement management focused on decisions about pavement rehabilitation and reconstruction. While it seems that no two agencies approached pavement management in an identical manner, almost every facet of pavement management was designed to support decisions related to rehabilitation and reconstruction, including the following:

- What pavement conditions should be measured and how frequently they should be evaluated?
- What treatments are feasible under different conditions?
- What capital improvements will make the best use of available funding?

Because it was not directed by a special department, pavement management was undertaken by planners, construction, research, or others involved in capital programs. And it was most commonly a central office function that might or might not involve districts or regions.

Today many highway agencies and transportation departments recognize that managing pavements means not only considering the proper selection of rehabilitation and reconstruction projects, but including pavement preservation treatments—and especially preventive maintenance treatments. They are also moving away from a narrow focus on pavement management to a broad emphasis on asset management by considering trade-offs between investment options. For pavement preservation programs to be successful in the long run they must be integrated with pavement management. The following list summarizes and briefly explains some of the key characteristics of successful integration between pavement preservation activities and pavement management:

Pavements are evaluated to determine their suitability for preventive maintenance: since good candidates for preventive maintenance are pavements in good condition, this means evaluating and tracking the condition of pavements long before they start to fall apart. In some cases, it may mean collecting different types of condition information than in the past.

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Dr. Don McLeod delivered the Distinguished Lecture. (Photo: Dr. Lynn Cowe-Falls)

Preventive maintenance treatments are part of the matrix of feasible treatments: this requires an understanding of what treatments work under different conditions. A pavement may receive several preventive maintenance applications before it requires rehabilitation.

The location of treatments and the pavement conditions before and after placement are tracked as well for preservation treatments as they are for capital projects: while many agencies have used pavement preservation in the past, there is a widespread inability to track and document the performance of these treatments. When performance is not documented, it is difficult to differentiate what works from what doesn't, and to establish the cost effectiveness of various treatments.

Information is accessible (and used by) both the usual users of pavement management data, as well as maintenance and other organizational units: a typical large organization may operate as a series of independent units (sometimes referred to as the "stovepipe" effect), ultimately failing to take advantage of the varied knowledge, experience, and expertise distributed throughout the organization. The result is a duplication of effort, inefficiencies, and waste.

Selected papers

Several speakers addressed the issue of integration head on from a number of different points of view. Brief summaries of the issues are presented below. *Integrating Pavement Management into a Comprehensive Strategic Asset Management System for the State of Utah Department of Transportation*, J. L. Zavitski, R. Rose, and G. Kuhl. This paper takes integration one step further, addressing the integration of multiple management systems within an agency. The presenter pointed out that Utah DOT's priorities include placing safety ahead of capacity and taking care of what they have to make it work better. An integrated asset management system allows them to consider these priorities, as well as societal, economic, and environmental factors in allocating funding to various assets. Key elements of their integrated approach include establishing a core asset management team and individual asset managers, facilitating both the horizontal and vertical movement of data, and ensuring that the right information is available at the strategic, tactical, and operational levels.

> ... while many agencies have used pavement preservation in the past, there is a widespread inability to track and document the performance of these treatments.

Closing the Loop — Unifying the Management of Pavement Assets from Inception to Maintenance, M. G. Henderson, N. Dumas, G. Robertson, and D. Rose. The authors describe the Western Cape (South Africa) Provincial Administration's pursuit of integrated asset management, which includes the collection, integration, processing, and flow of data at the strategic, tactical, and operational levels of the organization. Data are available to support maintenance activities, rehabilitation projects, and even research initiatives such as accelerated and long-term pavement performance monitoring.

Best Practices in Pavement Preservation, K. A. Zimmerman and D. Peshkin. The authors contend that while pavement preservation practices are becoming more common within transportation agencies, there is little guidance available on what constitutes best practices. The following are identified, and supported with examples from both state and local agencies:

- Establishing a program.
- Treatment selection and timing.
- Funding. program integration.
- Staffing. marketing.
- Contracting.

Specifically regarding integration, Ms. Zimmerman identified the following critical integration issues:

- Condition survey approach with preservation indicators.
- Performance models for preventive maintenance treatments, including stopgap applications.
- Treatment selection and impact rules.
- Storing the date, location, and type of the last maintenance activity on every pavement in the network.
- Overcoming institutional barriers, such as stovepipe organizations.
- Use of performance data to influence decisions and opinions.

Improving GDOT's Annual Preventive Maintenance Using a Collaborative Decision Support System, Y. Tsai, Y. Wu, E. Pitts. The Georgia Department of Transportation (GDOT) has placed preventive maintenance treatments since the 1970s. In order to address the ongoing challenge of maintaining an 18,000-mile network, GDOT has turned to an information technology approach, in the form of a collaborative decision support system, to coordinate data collection efforts and decision-making processes among their Districts and the General Office. GDOT has begun using this system to develop its preventive maintenance program, including in-house minor

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Drs. Ron Hudson and Ralph Haas, two of the acknowledged founders of the pavement management movement, enjoy a light moment at the conference. (Photo: Katie Zimmerman).

preventive maintenance activities such as crack sealing.

What Makes a Pavement Management System Implementation Successful?, C. R. Bennett. This paper discusses factors associated with the successful implementation of a pavement management system. These include the agency processes, people, and technology that must be in place—and how they should interact—in order to have a successful program. The paper is based on a study of practices in 21 agencies covering 16 countries, and the complete results are reported in "Success Factors for Road Management Systems," a World Bank document that can be downloaded at: http://road-management.info/reports/user/6/05-10-11SuccessFactorsforRoadManagementSystems.pdf).

Although this does not focus on pavement preservation, clearly integration is an important part of a successful pavement management implementation. The report can also be used to benchmark an agency's current practices against recommended best practices.

Summary

The conference featured many other presentations on a broad range of topics related to pavement management and asset management. A number of papers addressed the challenges associated with developing effective performance measures. Interestingly enough, many of the representatives from Australia, New Zealand, and Canada have private-public partnerships (PPP) in place in which a private industry is responsible for the maintenance of highway facilities in accordance with performance measures established by the government agency. In these contracts, the private entity must decide what maintenance activities to perform and when to perform them. In exchange for providing this service, they get a fixed amount of money over the life of the contract, which typically is 10 to 20 years. The performance measures established by the government agency influence the decision as to what types of treatments to apply and when they should be applied. Some agencies have multiple performance measures for safety (such as potholes of a certain size must be repaired within 5 days of notification) and condition (such as a particular level of smoothness). Performance measures have to be established for all assets being maintained (e.g., lights, guardrails, striping, mowing) so the values used are directly related to the work conducted by the private agency. The private agencies use very sophisticated management systems to predict how asset conditions will change over time, since their profitability is based on how cost-effectively they can meet the owner's performance targets.

... many of the representatives from Australia, New Zealand, and Canada have private-public partnerships in place ...

There was also a lot of discussion about sustainability and the impact of climate change on roads, especially in the northern parts of North America. In fact, the Distinguished Lecture (Dr. Don McLeod) was on climate change considerations and the challenge of separating extreme variations in weather patterns from long-term climate changes. Some considerations for pavement folks to be thinking about include the following:

- Changes in appropriate asphalt binder grades due to changes in climate.
- Changes in design characteristics due to climate changes.
- Changes in spring load restrictions due to changes in freeze-thaw cycles.
- Melting permafrost layers in the north and their impact on pavement performance.

The speaker's advice was to recognize that climate change is occurring and to incorporate it into our pavement designs as a factor that causes some uncertainty in the final design. Pavement management practitioners will also have to think about how to incorporate these factors into existing performance models.

Next conference

The next International Conference on Managing Pavement Assets is scheduled to be held in Santiago, Chile, in November 2011. The initial conference announcement has been developed and planning is now underway.

Innovation projects and innovation data base update

By Mary Stroup Gardiner and Ding Cheng, CP2 Center, and Joe Holland, Caltrans

Background

Founded in July, 2006, the Center is actively involved with Caltrans and the Pavement Preservation Task Group (PPTG) on the implementation or evaluation of new and innovative products as one of its tasks. Other tasks include documenting the benefits of pavement preservation, training and staff development, improving pavement preservation performance, providing technical assistance, and promoting pavement preservation throughout the state. Caltrans has provided $5,000,000 per year to encourage the use of new technologies.

Table 1. Innovative products to be evaluated in the future

Products	2008	2009
HIR recycling	Project to be placed in D 2 and D8	Project to be placed in D2
CIR recycling	Projects to be placed in D3 and D11	Projects to be placed in D3 and D11
PMA chip seals	Project to be placed in D11	None identified at this time
Warm mixes	Project to be placed in D5 and possibly D1	None Identified at this time
Rubberized Emulsion Aggregate Slurry (REAS)	None in 2008	Project to be placed in D11

D = District

Table 2. Innovative products currently under evaluation

Product/process	Status
RAC-O-HB	Projects placed in statewide. They are currently under evaluation.
European quiet mix	One project placed in southern California. It is currently under evaluation.
Thin bonded wearing course	Routinely used since the late 90's. Caltrans is now experimenting with variations in the gradations and materials.
Microsurfacing	Evaluated a new specification. Now Routinely used in California.
AR chip seals	Have been routinely used. Currently evaluating changes in specs in D11 test site to minimize wheel track bleeding.
Interlayers	Test section placed in D2 to evaluate the following interlayers; • Modified binder asphalt • Poly/fiberglass fabric • AR chip seal • PME chip seal
Fog/rejuvenating seals	Three test projects will be placed statewide to evaluate the various products used in California for surface seals.

Current and upcoming innovation projects

Innovation, as defined by Caltrans, is any technology not currently used as standard practice by Caltrans. There are five innovative projects that have already been indentified for the 2008 and 2009 construction seasons (see Table 1).

Hot in-place (HIR) project will demonstrate the Japanese Hitone equipment and process. This technology is comprised of four components: preheating, milling, separating and paving. The RAP is separated into three different gradations, which are then recombined to produce a two-lift pavement. For the project in D2, the gradations will be a dense gradation topped with an open graded surface course, all completed in one pass of the recycling train.

Cold in-place (CIR) was most recently placed in the City of Chino (see following story). Other California projects will be identified in the upcoming months.

Polymer modified asphalt (PMA) chip seals will be placed in District 11 to evaluate both the 2007 PMA specification, graded as a PG 70-22, and the 2008 PMA revision, graded as a PG 76-22PM or a PG 76-22TR (tire rubber).

Warm mix demonstration project in Morro Bay generated excitement in the California Engineering community. As a result of this demonstration, both District 5 and District 1 engineers have elected to try the mix for their long-haul 2008 projects. The hot mix asphalt (HMA) will be mixed at the standard temperature but the warm mix additive is expected to provide workability even after mix cool down due to the long hauls, estimated to be from two to four hours.

Rubberized emulsion aggregate slurry (REAS) blends crumb rubber into asphalt emulsion at ambient temperatures, then used in a slurry to resur-

CIR in the City of Chino

Continued on next page

face roadways. It is estimated that this project can reuse 78 tires per lane mile while improving skid resistance and the pavement life expectancy. These benefits will be evaluated in the upcoming project.

Some of the products that are already under investigation are (Table 2):

- ***Microsurfacings*** – New specifications for microsurfacing have been tested and evaluated in field sections. These products are being used more and more now that some of the construction issues have been resolved.
- ***Fog and rejuvenating seals*** – Test sections have been and will be placed to assist in the development of new performance based specifications. The testing includes skid testing and tests for stiffness of the mix to insure safety to the users and that the agents are imparting some positive effects to the existing mixes.
- ***Interlayers*** – Caltrans placed test sections in District 2 to evaluate the use of different interlayers in combination with chip seals or thin asphalt concrete overlays.
- ***AR chip seals*** – Using test sections in District 11, Caltrans is evaluating asphalt rubber chip seals. The performance of the current designs in hot climates, with high traffic, has resulted in some bleeding. The design variations include changes in the aggregate gradation and the stiffness of the binder.

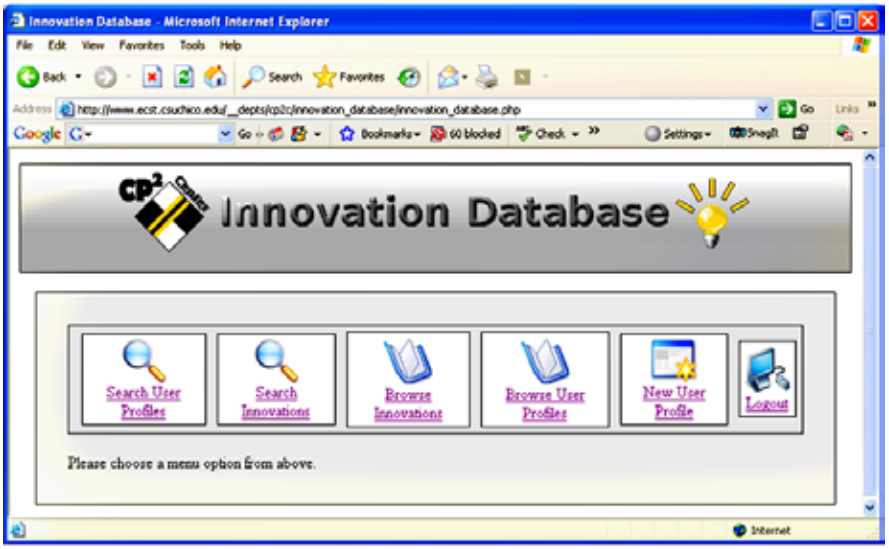

Figure 1. The Innovation Database entry portal.

The findings from the current and proposed test programs will be used to assist Caltrans and the PPTG in the development of improved specifications for tools not normally used in the state. Caltrans, the PPTG and the Center are trying to identify as many of the applicable tools as possible for use in pavement preservation.

Morro Bay warm mix demonstration project participants discuss the workability of the warm mix obtained from behind the paver.

Innovation Data Base

The objectives of developing an innovation database are to help streamline the process for implementing innovation and new products in the areas of pavement preservation and to encourage technical transfer through dissemination of information through a website.

Version One of the innovation database (Figure 1) has been developed by the innovation subgroup and the CP2 Center. The website for accessing the database is: http://www.ecst.csuchico.edu/cp2c/innovation_database. Caltrans' new innovation projects, such as RAC-O-HB, Interlayer, Fog and Rejuvenation Seal, Chip Seal, Warm Mix, CIR, European quiet pavement are being stored in the database.

The database is securely installed at the College of Engineering of CSU, Chico. It is currently maintained by CP2 Center staff. Users can obtain usernames and passwords from the Center to log in to the database. The database is capable of receiving innovation proposals, storing comments from reviewers, and approving innovations by a PPTG Chair.

There are five different groups of users for the database. The following are the basic roles for each group:

- ***General Public*** – This group was created to help disseminate innovation. They can log in using "guest" for both username and password. After login, they can browse and view innovations, and search innovations by keywords. But they can not comment, edit, or submit proposals.
- ***Champions or Innovators*** - This user group can submit new proposals and view others' innovations. They can also submit a file with their proposals. The format of the file can be a picture, Word, or PDF. For security reasons, they can edit their own innovations but they

Continued on next page

can not edit proposals submitted by other champions or innovators.

- ***Innovation Committee or Reviewers*** – This user group can review and comment on the innovations submitted. They can also see the comments created by themselves or others. But they cannot edit any innovation submitted.
- ***CP2 Center Staff*** – This user group can add or edit new users to the database in addition to having all the functions of innovation committee members.
- PPTG Chair – this user group can approve innovation status to pre-proposal, proposal, and final report besides the functions of innovation committee members.

In summary, the innovation database is created to help streamline the Caltrans' innovation procedure and disseminating innovation information.

Cold in-place recycled asphalt - street rehabilitation in Chino, California

by Nelsen Nelson, City of Chino

Chino's street rehabilitation project is also a recycling program. Our streets were rehabilitated in June and July, 2008, with in-place recycled asphalt from the same road. Using the process known as cold in place recycling (CIR), the existing roadway surface was milled off, mixed with an emulsion and re-laid in-place ready to compact and restored to a like-new condition. A two-inch cap of hot asphalt concrete mix will be placed on top of the final CIR product later this summer using asphalt rubber hot mix. Therefore, the entire project will contain recycled materials.

Before construction, above, and after construction.

The city resurfaced a total of three sections of roadway utilizing CIR, acknowledging strong support from the community. All American Asphalt was the prime contractor and Pavement Recycling Systems, Inc. was the subcontractor. The work was completed on the busy streets with minimal disruption to the traveling public.

Chino was looking for a better method to rehabilitate their roads and alleviate cracking, shoving and oxidation of the pavement surface. Like most cities, Chino's rehabilitation program primarily consisted of removing two to four inches of asphalt concrete by cold-milling and then repaving the road with new asphalt. This meant the material milled off the existing road was hauled away and new hot mix asphalt concrete was then trucked back onto the project site for placement on the road. The CIR process gave the city approximately five inches of new mix which would have cost about the same as three inches of new mixes. We feel the structural gain will be significant.

Although the mill and repave process worked well in most cases, there were several streets within the city that did not retain the aesthetics and smoothness expected at approximately seven years after resurfacing. These streets were displaying reflective cracking through the new overlay and separation at pavement joints. When reviewing the streets considered for this year's rehabilitation project, the city's engineers noted that the street surfaces were displaying cracking, shoving and oxidation, but the base material was still adequate and in good condition.

CIR was selected by the City as a cost effective solution that would also help minimize reflective cracking through the new overlay and provide a longer life cycle. One additional benefit expected was that the section of road under construction could remain open to the public during much of the process. These streets are heavily traveled (about 17,000 ADT) so reconstructing the road would be challenging.

One of the first tasks of the City was to develop specifications for CIR which meant modifying the Caltrans specifications into a format consistent with the *Standard Specifications for Public Works Construction* or "Greenbook". Chino prepares their Special Provisions to supplement and amend the Greenbook into a format that also parallels the Greenbook. The Special Provisions required the contractor to provide Quality Control while the City hired a geotechnical firm to provide Quality Assurance.

The CIR process worked even better than the engineers expected so they are considering if the two-inch asphalt concrete overlay is even necessary for future projects. They may modify their Special Provisions to incorporate a chip seal over the CIR material which would make this process even more economical.

For more information on this project, please contact Nelsen Nelson by email at: nnelson@cityofchino.org.

CIM AND CP2 CENTER TEAM UP

By Tanya Komas Director, CIM Program

Tanya Komas

The faculty and staff from the CP2 Center and the Concrete Industry Management (CIM) Program are teaming up to expand the technical expertise and program resources of both programs. The CIM faculty will provide the CP2 Center with teaching and research expertise in mortar, concrete, and recycling areas. At the same time, the senior CP2 Center staff, also adjunct professors in the CSU Civil Engineering Department, will provide aggregate and heavy highway construction expertise for the CIM program teaching and research initiatives. Both programs are currently developing state-of-the-art laboratory facilities and will be able to augment the capabilities of both programs by combining resources for aggregate processing and testing, upper end chemistry testing (for mortars, asphalts, admixtures, polymers), and field equipment such as coring rigs and non-destructive testing.

CIM Program Background

If the word change didn't exist already, today's concrete industry would have to invent it. This industry has committed to establishing and supporting programs to recruit and train technical/managerial candidates at the college level for the future. The concrete industry needs an educated workforce second to none. Concrete is the foundation of a $931 billion construction industry that is a primary driver of the US economy. Any skills shortage in concrete industry management/technology will stifle the construction industry's own growth in the future. Therefore, the concrete industry, which itself employs over 300,000 professionals, is seeking to keep abreast not only with the ordinary technical/managerial replacement rate of the industry as it stands today, and not only with the anticipated normal growth within the industry if nothing else about it alters, but also with the anticipated rapid expansion of the industry as concrete continues to become, for a variety of reasons, the material of choice in modern building practice for its strength, versatility, styling, longevity, and environmental advantages.

The College of Engineering, Computer Science, and Construction Management (ECC) at California State University, Chico (CSU, Chico) is one of five schools in the United States to offer a four-year Bachelor of Science degree in Concrete Industry Management (CIM). The other schools are Middle Tennessee State University (MTSU), Arizona State University, New Jersey Institute of Technology (NJIT), and Texas State University. These five schools have pledged to work together with the CIM National Steering Committee (NSC) to advance the program that will train and graduate professionals who all have a common skill set together with specialty knowledge particular to each institution. For example, the CSU, Chico CIM program has a special focus in concrete investigation and repair, lead by the program's Director, Dr. Tanya Wattenburg Komas, as well as in sustainability. As a special level of commitment to the Chico Program, CSU, Chico CIM Patrons are currently offering partial tuition scholarships to all declared CIM students who maintain a 2.5 GPA, are making progress toward the CIM degree, and remain in good standing at the University.

The multidisciplinary CIM program prepares men and women for a wide variety of professional careers in the concrete industry, which has an ever-growing demand for technical/managerial graduates. Concrete Industry Management (listed under the acronym CIMT in the course series) is founded on a strong lower-division base of general education, math, science, and business courses. The upper division technical classes and laboratory work allow students to develop the necessary technical knowledge in concrete materials and processes. At the same time, courses in logistics and information systems, finance, marketing, law, safety, quality, and project management prepare students to become effective leaders in the concrete industry. Students who complete the CIM program curriculum will also have fulfilled all the course requirements for a Minor in Business Administration. Additionally, all students in the CIM program gain valuable professional experience and knowledge when they serve as interns in local or national concrete-related companies. Most internships in this field are full-time, summer, and/or semester-long.

Continued on next page

CSU Chico wins recycling project

Dr. Stroup-Gardiner (CP2 Center) and Dr. Komas (CIM) were recently selected as the consultants to develop Synthesis Topic 40-01: Recycled Materials and Byproducts in Highway Applications. This synthesis will evaluate recycled materials and industrial byproducts used in transportation applications and assemble information and experience from domestic and foreign transportation agencies into a coherent body of knowledge. This information will serve as a guide to states revising the provisions of their materials specifications for when and how to use recycled materials in the most environmentally, economically, and technically sound ways possible.

Students earn good salaries, as well as required upper-division course credit, for completing an internship.

As a CSU, Chico CIM graduate, students will:

- Learn how concrete materials and products are produced, used, and tested.
- Gain a thorough understanding of contemporary concrete blending, mixing, transport, placement, and finishing processes.
- Learn the fundamental behavior of materials and gain experience testing material properties.
- Learn project, quality, and safety management methods and the impact of their application on the financial and economic aspects of concrete materials, products, and services.
- Be able to promote products and services related to the industry.
- Use contemporary computer applications, information systems, and software packages.
- Be able to effectively communicate their ideas in oral, written, and graphical form.
- Gain the ability to manage people and systems.
- Gain experience working in teams.
- Develop an appreciation for the legal and ethical implications of their work and will be aware of the impact of their actions on individuals, society, and the environment.

CIM faculty and students at work

Tanya Wattenburg Komas, the CIM Program Coordinator/Director and instructor of a class in concrete repair and preservation, set up a research opportunity with colleagues at Texas A&M University to investigate the historic concrete bunkers at Pointe du Hoc, Normandy, France.. The team from A&M had been working for several years with the American Battle Monuments Commission (ABMC) on a project to survey the site and evaluate the cliffs of the historic D-Day landing site on which the concrete structures rest. The Chico State team was invited to participate in the project to assess the condition of

Inside the observation post, Courtney Sheehan tests relative concrete strength with a Schmidt (rebound) hammer while Chad Golden uses a cover meter to determine location, size, and cover of embedded reinforcing.

Chad Golden (left) and Andrew Billingsley use Olson Engineering's concrete thickness gauge to determine the thickness of the slab at the exterior of the observation post. The Monument to the Rangers sits on top of the structure.

the concrete structures and provide needed information about the depths of the foundations. The Chico team will produce a preliminary "existing conditions" report that will combine the previous laboratory testing results and the recent fieldwork results. Data collected during the concrete investigations will be used during the cliff stabilization phase of the project.

"The trip was an amazing experience for us all," said Komas. "The students completed an incredible amount of work with proficiency and professionalism, several days of which were accompanied by gale-force winds and heavy rain. That they were able to participate in a work of this magnitude is exciting for them and for me."

According to Komas, their involvement in the project was a result of her previous connections with Texas A&M University, the concrete repair industry, and the commitment of the academic community and the larger concrete industry in the unique CIM partnership. Through implementation of the proven CIM academic program, together with specialized courses at California State University, Chico, they were able to combine their strengths while training the students to be contributing members of future research and industry teams, she said. The skills and knowledge the students gained on this

Continued on next page

Chad Golden (on top of the casement) holds a transmitter that is sending ultrasonic pulses through the approximately 80 inches of concrete to where Robert Hostettler (inside) is holding the receiver. Andrew Billingsley (seen through the barbed wire) is running the test data via a field ruggedized computer on the velocity of the sound waves to determine soundness of the concrete.

trip will serve them well in their future careers in any area of the concrete industry that they might choose.

Career Outlook for Graduates

Career opportunities for graduates of the CIM program are excellent. Examples of entry-level positions available immediately include:

- Production manager of these sorts of plants: ready-mixed concrete, pre-cast/pre-stressed concrete, concrete pipe, or concrete block.
- Concrete specialist in engineering, architectural, or construction firms.
- Marketing and technical agent of concrete equipment and services.
- Seller and marketer of production, construction, and finishing equipment.
- Product distribution manager.

For further information, please contact

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Upcoming pavement preservation events

ISAET 2008, International Symposium on Asphalt Emulsion Technology, September 24-26, 2008, Crystal City, Va., www.aema.org.

ARRA Semi Annual meeting, October 13-15, 2008, Atlanta, Ga., www.arra.org.

Caltrans MTAG training, October 21-23, 2008, Los Angeles, Calif., www.cp2info.org/taskgroup.

AEMA Asphalt Emulsion Workshops, November 11-12-2008 (users) and 13-14, 2008 (producers), Indianapolis, Ind., www.aema.org.

International Conference on Warm Mixes, November 11-13, 2008, Nashville, Tenn., www.hotmix.org.

California Pavement Preservation Task Group (PPTG) all members meeting, December 9, 2008, Los Angeles County, Calif., www.cp2info.org/taskgroup.

California Chip Seal Association (CCSA), January 21-22, 2009, Ontario, Calif., http://www.chipseal.org.

AEMA-ARRA-ISSA Annual Meeting, Feb 18-21, 2009, Palm Springs, Calif., www.slurry.org.

California Pavement Preservation conference, April 8-9, 2009, Oakland, Calif., www.cp2info.org.

National Conference on Preservation, Repair, and Rehabilitation of Concrete Pavements, April 22-24, 2009 St. Louis, Mo., www.fhwa.dot.gov/pavement/concrete/2009CPTP.cfm.

Asphalt Rubber 2009 (AR2009), November 2-4, 2009, Nanjing, China, www.AR2009.net.

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

Certificate and rotational programs

Following is a brief description of two programs that Caltrans upper management is supporting. Caltrans employees and others are encouraged to contact the Center regarding these programs.

Pavement preservation certificate program

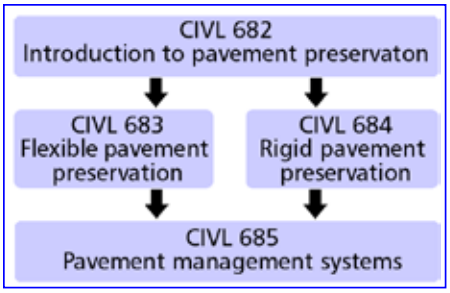

Figure 1

The first on-line Pavement Preservation Certificate class was offered Spring of 2008 as a one-credit class. Comments received from both the students and instructor of this class indicated the extent and work requirement for the class was more in line with a traditional three-credit class. The CP2 Center is currently working with the Civil Engineering Department and Regional Continuing Education (RCE) to convert the original 12 one-credit on-line class format to a new, more traditional 4 three-credit class format (Figure 1). A special class for credit adjustment for students in the original one-credit class will be worked out this semester so that everyone gets the same credit for work. Two of the four three credit on-line classes which comprise the Pavement Preservation Certificate program will be offered this fall. These adjustments to the Certificate Program should be more directly useful and easier to complete for students.

Fall 2008 pavement preservation classes

The first class in the four class program will be Introduction to Pavement Preservation (CIVL 682). This class will provide the student with an understanding of the history and agency implementation of current preservation programs.

Introduction to Pavement Preservation

Module (Week)	Description
1	Introduction and overview
2	Pavement preservation concepts
3	Influence of pavement condition on project selection
4	Evaluating pavement for preservation options
5	Pavement preservation treatments (general)
6	Pavement preservation treatments (continued)
7	Maintenance treatments
8	Rehabilitation options
9	Feasibility assessment overview
10	Identifying feasible treatments and strategies
11	Selection process
12	Optimization of treatments overview
13	Economic issues
14	Warranties
15	Summary of pavement preservation activities

The second two three unit classes, Pavement Preservation Overview and Flexible Pavements, will be offered during the fall semester 2008. Classes begin August 25, 2008 and will run through December 2008. Students enrolled in the Web based classes will be required to work each week on assigned topics so as to allow instruction and study to run concurrently.

Students and the instructor, Dr. Mary Stroup-Gardiner, communicate on the week's topic.

Flexible Pavement Preservation

Module (Week)	Description
1	Introduction – pm & r overview
2	History of flexible pavement design
3	Identification of the type, extent and severity of flexible pavement distresses
4	Identification of the type, extent and severity of flexible pavement distresses (continued)
5	Test methods for assessing functional and structural pavement condition
6	Project 1: conduct and report pavement condition survey (datapave data)
7	Preservation treatments – fog and rejuvenating seals
8	Preservation treatments – chip seals
9	Preservation treatments – slurry and microsurfacing
10	Preservation treatments – thin surfaces
11	Pavement preservation - recycling
12	Pavement preservation – composite systems
13	Preservation strategy selection methodology
14	Project 2: report development of preservation selection strategies
15	Final assessment exam: critical review of a fictional agency's flexible pavement preservation recommendations for roadways to be treated the following summer

To enroll in either or both courses the student must fill out the enrollment form which is available on line at: http://rce.csuchico.edu/forms/AddDrop2007.pdf.

A check for the fee for each class $525 must accompany the application and be returned to the center address below by Thursday, Sept. 4, 2008.

Center rotating engineer program

The California Pavement Preservation Center Rotating Engineer Program can range from three months to a one-year appointment that will provide benefits to the national pavement preservation efforts, Caltrans, and the candidate. The Rotating Engineer will focus on pavement preservation topics which include, but are not limited to, environmental assessments of preservation technologies, forecasting treatment life expectancy, development of non-standard specifications, technology transfer and training, and construction of innovative projects. The Rotating Engineer in turn, will gain expertise and an understanding of Caltrans perspectives in these areas. In addition, the selected Rotating Engineer will have an opportunity to live and work in northern California, which promises to enhance the incumbent's working and personal experience. If you are interested in an exciting and challenging professional development experience, please contact us at the CP2 Center, 25 Main Street, Suite 202, CSU, Chico, Chico, CA 95929-0603.

MTAG Training planned for October 21-23, 2008

By Larry Rouen, Caltrans

The Division of Pavement Management, with assistance from the Pavement Preservation Task Group (PPTG), Caltrans District 7 and the California Pavement Preservation (CP2) Center, has scheduled training of the Maintenance Technical Advisory Guide (MTAG). The sections to be discussed are shown in the table below.

Maintenance technical advisory guide

Flexible chapters	Rigid chapters
Introduction	Introduction
Materials	Surface characteristics
Treatment selection	Treatment selection
Crack sealing	Joint resealing and crack sealing
Patching & edge repair	Diamond grinding and grooving
Fog and rejuvenating seals	Dowel bar retrofit
Chip seals	Isolated partial depth concrete repair
Slurry seals/microsurfacing	Full depth concrete repair
Thin maintenance overlays	
Bonded wearing course	
Interlayers	
In-place recycling	

This training is for Maintenance Engineers, Managers and Superintendents, Resident Engineers, Field Engineers, Designers, and anyone else eager for knowledge of pavement preservation.

This will be a very intensive 3 day seminar that will cover all chapters in sufficient detail to provide the attendees with a working knowledge of the pavement preservation background and techniques. The training instructors will be experts from Caltrans, industry and the CP2. The seminar will be held in Los Angeles at the District 7 District Office, October 21 through 23. The Flexible Pavement training will be the first two days, October 21 and 22 and the Rigid Pavement training will be the last day, October 23.

You may attend one or both sessions. Make sure to register for each one. There is no cost for the seminar itself, but seating is limited. The classes will begin at 8 a.m. and finish at 5 p.m. Please schedule your travel arrangements appropriately.

Caltrans staff should register through the LMS. The course number for the Flexible Pavement Preservation class is 100933. The course number of the Rigid Pavement Preservation class is 100932. Others may register through the CP2 Center website: www.cp2info.org/center.

First International Conference on Pavement Preservation (ICPP)

The First International Conference on Pavement Preservation will be held in April, 2010, in Newport Beach, California, with the aim of bringing together researchers and experts working in the field to exchange ideas and discuss critical issues and concerns. The conference will be co-organized by Caltrans, FHWA, and the Foundation for Pavement Preservation. A website for the conference will be established at the following location: www.pavementpreservation.org/icpp

The main theme of the conference will be pavement preservation and sustainability. The conference will address an array of issues that are relevant to the pavement preservation community. Authors will be invited to submit abstracts that will be reviewed by a technical committee based on quality and relevance. The authors of the abstracts selected will be invited to submit full papers to be included in the conference proceedings. If you are interested in participating in the conference planning, please contact the conference chair, Shakir Shatnawi: shakir_shatnawi@dot.ca.gov.

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