EXECUTIVE SUMMARY OF THE PRESENTATIONS AT THE 3rd ANNUAL CALIFORNIA PAVEMENT PRESERVATION CENTER

M. Stroup-Gardiner

June 9, 2008

Over 330 representatives from local, regional, state and federal agencies, industry and academia attended the 3rd Annual California Pavement Preservation Center conference held April 9th and 10th this year in Newport Beach, California. Participants shared their considerable expertise and wide-ranging experience in the areas of pavement preservation for both flexible and rigid pavements. Over 30 exhibitors were on hand to share their knowledge on specific pavement preservation treatments and techniques. One highlight of the conference was the first annual presentation of the Pavement Preservation Task Group awards. The Awards Ceremony and summaries of the presentations made at the conference are included in the following sections.

WELCOMING OF ATTENDEES AND OPENING REMARKS

Dr. Shatnawi filled in for Randall Iwasaki, Chief Deputy Director, Caltrans. Dr. Shatnawi provided the audience with the background for California's Pavement Preservation Program, which began in the 1990's. The philosophy of the California program is to keep good roads good while repairing distressed pavements with cost-effective strategies. The program provides a needs-based preservation plan, identifies preservation backlogs, illustrates alternative funding strategies, estimates cost-benefit ratio, and estimates dollars and lane miles that would be delayed in the State Highway Operations and Protection Program (SHOPP). Legislature mandated 5-year maintenance plan for California's 50,000 lane miles of freeways and highways which has provide for a significant increase in preservation funding .The funds allocated in 2004/2005 increased in 2007/2008 from $75 million to $206 million. Encumbered funds increased from $111 million in 2004/2005 to $253 in 2007/2008.

A main component of the program focuses on the need for partnering by agencies and industries. The Pavement Preservation Task Group (PPTG) is the partnering platform which engages state, local and city agencies and construction industry and material suppliers in subcommittee groups for 23 specific pavement preservation topics. Successful partnering has resulted in the Annual Pavement Preservation Conferences (3rd one this April, Newport Beach) and has developed such tools as the Maintenance Technical Advisory Guides (Flexible and Rigid Manuals), joint delivery and training programs, specification development, and a formal Innovation Process and Evaluation. The California Pavement Preservation Center (CP2C) was also a part of this effort, which was established in July 2006 as a credible unbiased 3rd party and a catalyst for bringing innovations and enhancing specifications and guidelines.

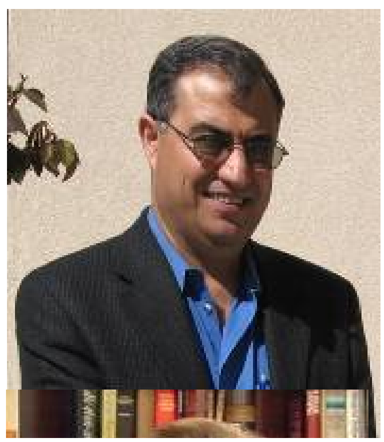
Dr. Shatnawi also welcomed the participants and provided a brief conference history. Dr. Shatnawi recognized the importance of the strong support and dedication of the individuals and companies including the Federal Highway Administration support by Mr. Jim Sorenson, Mr. Steve Mueller, and Mr. Jason Dietz; the conference organizing committee Co-chairs were Dr. Shatnawi, Ms. Laura Melendy of the University of California, Berkeley LTAP Center, and Dr. Gary Hicks of the CP2C; the Industry Committee members Larry Rouen, Caltrans; Hans Ho, Brandon Milar, Gary Hildebrand, Casey Holloway; Local Agency Committee members: Sui Tan, Bill Robertson, Margie Valdes, George Bradley, Nazario Sauceda, and Erik Updyke; Consultant committee members Margot Yapp, Haiping Zhou; and sponsors of the conference including the Asphalt Pavement Associations of California (APAC), American Concrete Pavement Association (ACPA), California Chip Seal Association (CCSA), Rubber Pavements Association, (RPA), Local Technical Assistance Program (LTAP), and the California Pavement Preservation Center (CP2C).

Mike Miles, Deputy Director, Caltrans Maintenance and Operations, presented information on Caltrans plans for a new division of Pavement Management. The plan, based on similar divisions in other comparable states, resulted in the formation of an organization which includes key elements such as design, rehabilitation, preservation and pavement management, which is expected to be established in July 2008. First deliverables were identified as a pavement management system capable of predicting performance, a mechanistic-empirical (ME) pavement design method.

Mike Miles

AWARDS CEREMONY

The nominating committee presented eight awards in three categories: Individual Award, Program Award, and Project Award Individual Awards were presented to three people whose contributions of time, effort and dedication has resulted in significant contributions through enthusiastic, visible and tireless promotion of pavement preservation. The first award was presented to Dr. Shakir Shatnawi. Dr. Shatnawi is the Co-Founder of the Pavement Preservation Task Group, whose work on the Maintenance Technical Advisory Group Manual was of such a high standard that the Federal Highway Administration elected to adopt the documents for national use. Without Dr. Shatnawi's vision, innovation and dedication, there would have not been a PTTG. Dr. Shatnawi also recognized the need for education, technical assistance and independent assessments of innovation projects, which led to the establishment of the California Pavement Preservation Center at CSU, Chico.



Dr. Shakir Shatnawi

The second Individual Award was presented to Mr. Gary Hildebrand. Mr. Hildebrand is also a Co-Founder of the Pavement Preservation Task Group. Mr.

Gary Hildebrand

Bill Robertson

Hildebrand has used his years of Caltrans experience to make the MTAG manuals and workshops the high quality products they are today. His tireless promotion and recruiting of exceptionally qualified volunteers from industry and agencies alike makes pavement preservation activities visible to the public.

The third Individual Award was presented to Mr. Bill Robertson , City of Los Angeles. Mr. Robertson displays an exceptional understanding of what it takes to implement pavement preservation. His community communication programs and methods serve to educate both the decision makers and the general public about the needs, options and benefits of pavement preservation programs. He has used innovative processes and materials to preserve, maintain, and rehabilitate more roads per dollar spent.

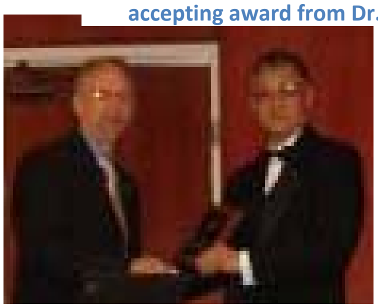
Three Program Awards were presented to agencies whose use of progressive pavement preservation techniques resulted in documented benefits of pavement preservation while at the same time provided the best maintenance to construction dollar ratio. The first Program Award was presented to Santa Barbara County for their use of a pavement preservation program developed in 2001. This program was funded using monies from Measure 'D', which implemented a half-cent county wide sales tax to be used to maintain roads. The cost savings from their pavement preservation program allowed them to spend future monies on Level 3 and 4 roadways while still maintaining an aggressive pavement preservation program. The Pavement Preservation Program was initiated in two phases. Phase I placed a number of miles of a Cape seal (Scrub seal followed by a Type II Microsurfacing). Phase II used rejuvenating fog seals for roadways not covered by the Cape seal.

The second Program Award was presented to Contra Costa County for their Pavement Preservation Program which, with 750 lane miles, has one of the best pavement condition indexes in the Bay Area. In 2007, over 1.2 million square yards of pavement surface were treated with one of four surface treatments: polymer modified emulsion chip seals, asphalt rubber chip seal, asphalt rubber Cape seals, and slurry seals. The majority of the work is done by in-house maintenance forces; the application of the asphalt rubber is contracted out. Work not done by county forces is sent to the Design Division for development of plans and specifications, then passed on to the Construction Division for advertising, award and oversight.

The City of Lakewood was the recipient of the third Program Award. The City demonstrated its political will in using funds to resurface approximately 80% of their street mileage with rubberized asphalt concrete. The City of Lakewood managed to reduce their annual maintenance budget of $180,000 to $75,000 with this program.

Pat Giles from Contra Costa County accepting award from Dr. Ho.

John McGray from Santa Barbara accepting award from Dr. Ho.



Mayor Steve Croft from the City of Lakewood accepting award from Dr. Ho.

City of Lakewood.

Bob McCrea accepting award for the Lake County project

The two Project Awards were presented for projects which have demonstrated significant advances in the development and use of new technologies which resulted in significant favorable public comments. The first Project Award was presented for the 2007 Lake County Cape Seal Project, Buckingham and Riviera West Subdivisions. The funding for this project was provided in part by the Zone of Benefit for the "Enhanced Road Maintenance". The total budget was $753,170; the final contract amount was $373,219. Partners for this project were Emulsion Technology, Western Emulsions, Inc., Graham Contractors, Inc., and Pacific Enzymes.

The second Project Award was presented to the City of Watsonville for their 2005 Chip Seal Innovation project. Twenty-seven roadways throughout the city were selected for a three part surface treatment. The majority the roadways had PCI values less than 50, with more than half below 40 PCI. A microsurfacing application was used as a low budget leveling course, followed by an asphalt rubber chip seal, and a Type II slurry seal for the final surface. The contractors for this project were International Surfacing Systems/Wester States Surfacing, Valley Slurry Seal and Chrisp Company.

Jeff Smith accepting Watsonville project award from Dr. Ho.

PROGRAM OVERVIEW PRESENTATIONS

"Sustainability Issues: Materials, Energy and the Environment"
Stephen R. Mueller, P.E., Pavement and Materials Engineer, Federal Highway Administration

There are approximately 4 million miles of roads in the country's roadway system. Federal roads comprise about 3% of the system, state roads about 20%, and local roads about 77%. Of these, 2/3's are paved and 1/3 unpaved. About 94% of the roadways have an asphalt surface.

The majority of the presentation focused on the components of pavement preservation that can assist with environmentally friendly (sustainable) components such as recycling and reuse of materials. Emulsions require less energy to produce and place; they can be used in a number of preservation tools including cold in-place recycling, thin lift overlays, fog and rejuvenating seals as well as chip, slurry, microsurfacing, and cape seals. Most of these preservation treatments can reduce the production of green house gases by using a reduced amount of energy. This is especially important for California, which has a good portion of the state in the US ozone non-attainment category. The presentation provides a range of facts and statistics for the environmental benefits for pavement preservation treatments.

PAVEMENT PRESERVATION PROGRAMS AND FUNDING PRESENTATIONS

"Getting Ahead in Pavement Preservation: Santa Barbara County's Perspective"
Scott McGoupin and Kevin Donnelly

The Santa Barbara county system consists of 1,667 lane miles of asphalt pavement 110 major bridge structures, 48 traffic signals, over 15,000 street trees, concrete hardscape improvements, and over 4,100 drainage facilities. Topics covered included a brief description of the evolution of the pavement preservation program in Santa Barbara county, challenges to implementing a pavement preservation program, and their Road Maintenance Annual Plan (RdMAP) and the success of their emulsion program (rejuvenating fog seals and cape seals).

The Santa Barbara program started from the pre-1989 philosophy of "worst first" and evolved to their post 1989 program supported by Measure 'D' which provided a dedicated stream of funding for transportation maintenance needs from a ½ cent sales tax. Key components for their present

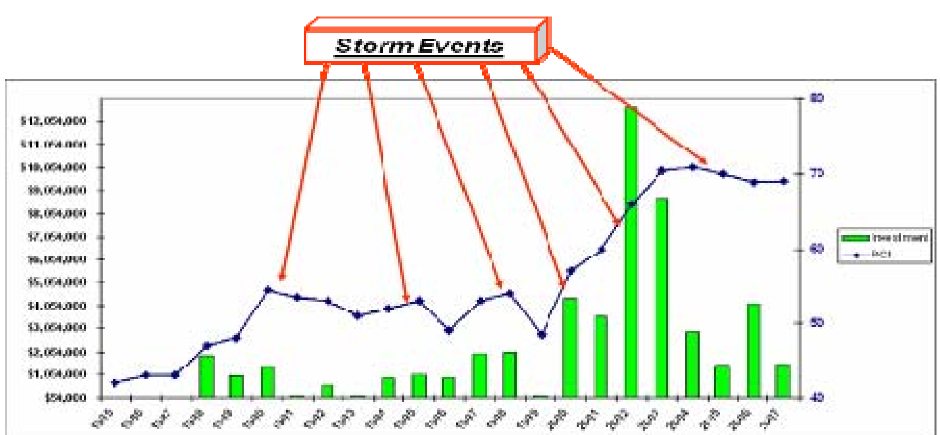


Figure 1. Santa Barbara improvement in network PCI after implementation of pavement preservation program.

day program includes a pavement management system which defines the network inventory, roadway assessment and work history (MicroPaver), an internal process dedicated to increasing communication, and a well defined pavement preservation treatment tool box. Before 1989, the average PCI was in the low 50's. Within 6 years, the PCI of the system PCI increased to the 70's (Figure 1).

Challenges to implementing this program included achieving political by-in, improved public perception, and the establishment of long term dedicated funding streams. The key to Measure D was an intensive educational program for county decision makers, community outreach, video presentations on pavement preservation, annual workshops, and neighborhood meetings (Figure 2).

Table 1 shows all of the choices that Santa Barbara has identified for their pavement preservation tool box. They focus on the top five products, all emulsions, as the most effective and least costly.

Figure 2. Examples of educational materials development for decision makers and the public.

Table 1. Santa Barbara's Pavement Preservation Tool Box (ref)

Surface Treatment	PCI	Existing Surface	Treatment Life
Rejuvenating fog seal	70 – 100	Sound structural section	2
Slurry seal	60 – 80	Sound structural section	5
Micro Surfacing	60 – 80	Sound structural section	5 – 7
Scrub seal	40 – 70	Sound structural section	7 – 10
Scrub cape seal	25 – 70	Fairly sound structural section	7 -12
ARAM	25 – 70	Fairly sound structural section	10 – 15
Overlay	40 – 70	Fairly sound structural section	15 – 20+
SAMI – 3 layer system	20 – 50	Partially failed structural section	20+
Recycles	10 – 40	Partially failed structural section	20+
Reconstruction	0 – 10	Failed structural section	20+

"A Look Ahead at Supply Issues and the Forces Driving Them"
Mr. Bruce Cater, Regional Director, Quality Control, Lehigh Hanson West Region

Aggregates are produced in every county except San Francisco and are the cheapest commodity produced per unit volume while at the same time the highest overall value commodity mined in California. California experiences local and regional aggregate shortages. In the long term, some California regions have less than 10 years of permitted reserves. Aggregate resources can be stretched by harmonizing specifications, increasing the use of manufactured fines, allowing more use of recycled, and reclaimed aggregates. Moving to performance based specifications will help maximize marginal aggregate usage and allow quality control testing to focus on performance testing of the product rather than individual aggregate properties. The Hanson Heidelberg Cement Group estimates the aggregate requirements for just concrete aggregate will increase over current usage by 71,000,000 tons.

"How to Select a Pavement Management System"
Ms. Margo Yapp, Vice President, Nichols Consulting Engineers

To develop and initiate a pavement preservation program, it is imperative that upper management supports the efforts. The person or team implementing the program needs to be a credible advocate for funding, develop and present cost effective work plans, help make policy changes, stress the need to avoid (discard) the worst first policy and be aware of regulatory needs, constraints and requirements. A solid pavement management program will be able to answer questions about: 1) What do we have?, 2) What condition is it in?, 3) What do we need to do to fix it?, 4) When do we need to fix it?, 5) How much will it cost?, 6) Can we prepare a 'What-if' analyses?, 7) Does it have a GIS link?, and 8) Does it provide the information we need for GASB 34? A pavement management program should also provide a means of coordinating with utilities and other maintenance programs (e.g., tree trimming, re-striping). The agency information, presented in GIS format, provides a simple picture that is easily understood by policy makers and the public.

"Regional Benefits of Pavement Management"
Theresa Romell, Metropolitan Transportation Commission (MTC)

The San Francisco Metropolitan Region has a population of 7.1 million spread over nine counties, 109 jurisdictions with 41,000 lane miles of local roads and streets, 1,500 miles of highways, 23 transit agencies, and seven toll bridges with a replacement value in assets of between $40 and $50 billion dollars. The MTC's asset management program, StreetSavers, consists of three main components: software with training and user support, federal grant program, and policy and advocacy. The StreetSaver program was developed about 20 years ago; 108 of the 109 jurisdictions use the network level program. The information obtained from the management system provides users with condition summaries, needs and shortfall assessments, funding guidelines and criteria, and the Local Streets and Roads Committee.

"Funding Pavement Preservation: Sales Tax and Other Revenues: A Regional Perspective"
Nephele Barrett, Mendocino Council of Governments, Lake County/City Area Planning Council

Mendocino County has a population of about 90,000 people, 75 centerline miles of county roads, 100 centerline miles of city streets and 389 state highway centerline miles. Lake County is somewhat smaller with a population of about 64,000, 500 centerline county road miles, 95 city street centerline miles, and 138 state highway centerline miles. The original impetus for a pavement management program was provided by language in the ISTEA bill which required agencies receiving RSTP funds to have a pavement management program (PMP). While the requirement was eventually removed from ISTEA, the county agencies felt a PMP was still a good idea.

When the PMP was started, the average PCI in Mendocino County was 50, 51 in Lake County, and 38 in the City of Clearlake. The low PCI values indicated a need for pavement preservation funding. This started the exploration of implementing local sales taxes. Surveys and separate polling was conducted in each city, and the county. Cities had strong support for the sales tax; there was only mild support in the unincorporated areas. The county opted to pursue a countywide sales tax. The 2003 election measure failed, with only 51% yes vote. Reasons for the failed initiative were cited as anti-government sentiment, each agency wanted a "return to source" funding, and not enough support from local officials. The RTPA sought special legislation to permit cities to pursue sales tax measures independently. AB 902 went into effect in 2003 and amended the Revenue and Taxation Code to allow cities in Lake and Mendocino Counties to have a transportation sales tax measure of up to ½ of a cent. The RTPA funded GIS linkage to the PMP to provide the cities with a tool for demonstrating the existing condition and any improvements gained by the sales tax funding.

Another funding mechanism using a Refuse and Construction Vehicle Impact Fee was also explored. Their research showed that a number of cities had already used this mechanism for funding PMP. The items and categories included in formulating this type of fee are covered in the presentation.

"Local Revenue Bond Program"
Souri Amirani, City of Santa Ana, Public Works Agency

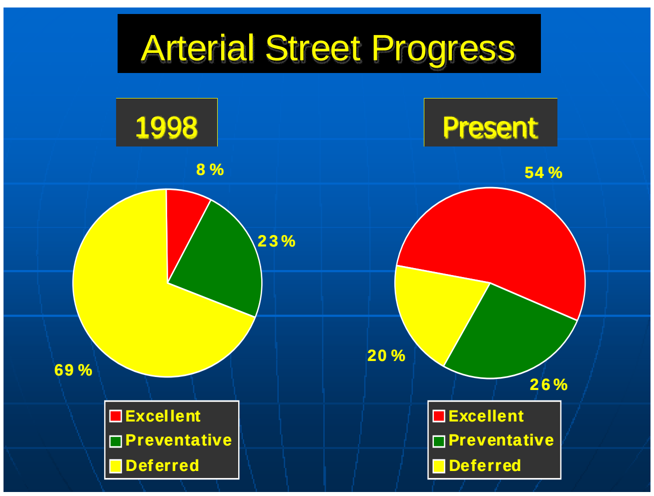


Figure 3

Santa Ana, "downtown Orange County" covers an area of 27 square miles, has more than 60 neighborhoods and a population of 353,428, 112 miles of arterial streets, 311 miles of local streets. Funding for the arterial streets comes from regional, state and federal grant sources; the pavement condition of these roads is good (Figure 3). The annual capital budget for street improvements is about $7.5 million from federal RSTP funds, gas taxes, Measure M turnback, and Proposition 42. However, there is no reliable funding source for local streets and over time, funding sources have been lost. The condition of the streets indicates the need substantial deferred maintenance. The local streets have an annual funding of $1 million from a Community Development Block Grant (DCBG) and Proposition 42.

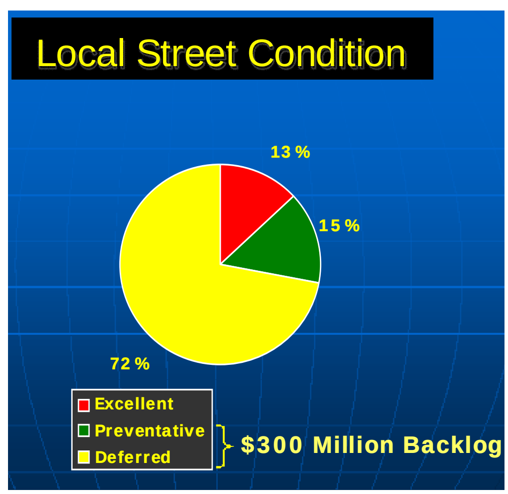


Figure 4

The backlog of deferred maintenance for local roads was $300 million (Figure 4). Santa Ana needed to come up with options to eliminate or greatly reduce this backlog. Options they investigated included a 10 year program; deemed not feasible as it would require $30 million a year for 10 years. The next option was an assessment district; there was no public support for this option. Their third option was a $60 million bond as a Certificate of Participation (COP) with $40 million in local funds (preferred option) and $100 million total. Since the total $300 million backlog could not be financed, the main focus of the program was street pavement only. The scope of the implemented program was: removal of industrial streets (12%), removal of concrete streets (12%), consider alternatives to reconstruction to reduce cost, minimize concrete repairs (critical only), and removal of areas improved within the last 7 years (13%). The success of the funding program required the teamwork of the Santa Ana Financing Authority, Financial Advisor, Bond Council, Underwriter, Issuer City of Santa Ana, City Manager and Assistant City Manager. Communication with all stakeholders was considered very important.

Once the funding was available, the objectives were to preserve the best streets first, repair streets requiring major rehabilitation last, research and investigate new pavement repair and rehabilitation materials, techniques and processes. Figure 5 shows the plan they developed for the next 5 years. The goal was to expend $60 million in bond money in 3 years, then complete $100 million in improvements in 5 years. The work was started in 2008.

Pavement Condition Index (PCI) for Street Rehabilitation Strategies

PCI Range	Rating	Initial Improvement per PMS	Final Improvement
84-89	Excellent	Slurry Seal	No Work at this time
73-83	Good	Thin Overlay	Thin Overlay
60-72	Fair	Structural Overlay	
Critical Level for Structural Maintenance			
41-59	Poor	Reconstruction (Partial)	CIR (Cold In-Place Recycling)
0-40	Failed	Reconstruction (Full)	Full Reconstruction

Figure 5

"Pothole Politics: The Road to Pavement Preservation"
William A. Robertson, Director, Department of Public Works, Bureau of Street Services

The City of Los Angeles covers 468.85 square miles and is the largest municipal street system in the United States with 6,500 centerline miles, 28,000 lane miles with 69,507 segments. The current PCI of the system is 62, with about 1,000 failed streets and a $2.3 billion backlog (target PCI of 80). The strategic game plan was presented as: identify the goal, create a pavement preservation plan, budget allocation, pavement management (MicroPaver), recycle-recycle-recycle, and tell the story. The pavement preservation plan identified rubberized slurry seal as providing the most "bang for the buck". MicroPaver was used to develop the budget allocation (Figure 6). The current budget allocation formula is based on: pavement condition (distress and ride quality), pavement area (factors in the varying sizes of lane miles), and bus/truck traffic (dictates pavement thickness).

The City of Los Angeles Operations has 20 years of experience with recycling. City owned plants started recycling 5 to 10% and are now recycling 15 to 20%. Two municipal asphalt plants produce 600,000 tons of recycled asphalt and a third

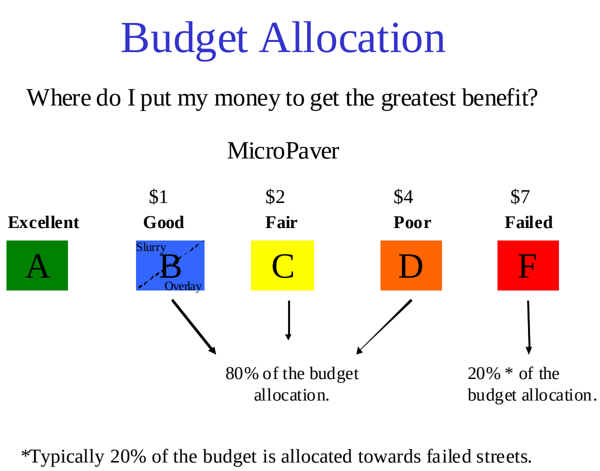


Figure 6

plant (vendor) produces 50% recycled asphalt.

Mr. Robertson created "Professor Pothole" as a way to "tell it like it is". The public outreach program involved 89 certified neighborhood councils, provided outreach to elected officials and their staff, embraced the media, and worked with local colleges and universities.

The results of these efforts were an increase in crack sealed, slurry seal, and resurfacing work from 310 miles in 2002 to 675 miles in 2008. The presentation contains more details and contact information.

FLEXIBLE PAVEMENT TREATMENT PRESENTATIONS

"Treatment Selection for Flexible Pavements"
R. Gary Hicks, Technical Director, California Pavement Preservation Center

Strategy selection is a guide to assist maintenance personnel in making better and more informed decisions in selecting and applying maintenance treatments. The audience was reminded that pavement preservation is ***not*** a means of providing capacity improvements or a process for new or reconstructed pavements. Both the rigid and flexible treatment selection matrices cover major treatment types currently used by Caltrans. Each matrix includes factors such as pavement age and condition, climate, traffic levels, available funding, agency policy, size of project, and construction time-of-day. A short list of feasible treatments is evaluated to determine the most cost effective strategy, as is done for the rigid treatment selection.

"Fog and Rejuvenating Seals"
Mr. Jim Brownridge, Marketing Manager for Tricor Refining, Bakersfield California
Mr. John Fox, Caltrans District Maintenance Engineer, Bishop, California

The presenters are also the Co-chairs of the PPTG sub-committee on Fog and Rejuvenating Seals in Pavement Preservation. They presented the results of the Caltrans report which emphasized a number of key concepts for their placement. First, the rate of application of either a fog or rejuvenating seal will depend upon the type of material being applied. The audience was encouraged to test the rate prior to application using a simple field test such as the ring test, which places a known small quantity of emulsion on a known surface area then evaluating the absorption of the emulsion after 15 minutes. Suggested application rates were 0.05 to 0.10 gal/sq. yd. for the diluted emulsion for fog seals, 0.06 to 0.10 gal/sq. yd. (diluted material), and 0.25 to 0.40 gal/sq. yd. for rejuvenating scrub seals. Other key points include using a well calibrated distributor truck to provide consistent, uniform application as well as allowing sufficient time for the absorption, curing and breaking of the products.

Table 2 lists the rejuvenating products identified by Caltrans for testing; the performance-based specifications are outlined in NSSP 37-600. The fog seal products are specified in NSSP 37-050.

Table 2. Fog and rejuvenating seal coat products identified by Caltrans for testing.

Caltrans Designation	Product	Summary Description	Criteria to Use
A	Reclamite	Emulsified recycling agent using heavy oils	Use for minor oxidation and cracking. Requires sanding.
B	CRF™	Emulsified recycling agent using a softer asphalt	Use for minor oxidation and cracking. Requires sanding.
C	Topein C	Mixture of tall oil pitch, asphaltene resin, and petroleum asphalt emulsified with water	Use for minor oxidation and cracking. Requires sanding.
D	PASS™ QB	Mixture of recycling agent, polymer and emulsified asphalt	Use for minor oxidation and cracking. Requires sanding.
E	PASS™ CR (Scrub Seal)	Mixture of recycling agent, polymer and emulsified asphalt	Use for moderate to major oxidation and cracking.
F	StyraFlex	Mixture of recycling agent, polymer and emulsified asphalt (different chemistry than PASS)	Use for minor oxidation and cracking. Requires sanding.
G	StyraFlex (Scrub Seal)	Mixture of recycling agent, polymer and emulsified asphalt (different chemistry than PASS)	Use for moderate to major oxidation and cracking.

The presenters highlighted the need for performance specifications immediately after product application to 1) identify when the skid values were sufficient to open roadway to traffic, and 2) indicate when sanding is needed prior to opening. Various methods for determining friction information were explored by Caltrans and other researchers on State Route 58 PM 121 to 123 in California District 9, east of Mojave. Devices that were evaluated included the Caltrans portable friction tester, ASTM D –xxx, the British Pendulum Number, and a portable dynamic friction tester. The report on these results will be available summer of 2008.

Laboratory testing is currently being conducted to evaluate the ability of the rejuvenator seals to soften (rejuvenate) the upper few millimeters of the pavement. Testing includes evaluating thin slices of cores, taken before and after applications, using both the dynamic shear rheometer and the bending beam rheometer.

"Recycling Solutions for Pavements"
Don M. Matthews, P.E., Division Manager, Pavement Recycling Systems, Inc.

Pavement preservation asphalt recycling can be accomplished using Cold in-place Recycling (CIR), Cold Central Plant Recycling (CCPR), Hot In-place Recycling (HIR), or Hot Recycling (HR – not covered in presentation). Recycling can be done on a wide range of facilities such as city streets, interstate highways, and airports. Pavements are considered good candidates for mill and fill, and where cracking distresses are not due to base problems and are considered good candidates for recycling. The benefits of recycling include cost savings and environmentally friendly operations. More improvements are obtained when the operations are done in-place. The key to successful recycling and reclamation are defined as analyzing the existing structure and conditions, understanding the causes of the distresses, assessing the road profile for needed adjustments, consideration of any drainage or base problems, the selection of the best materials and methods for each projects, and using a sound engineering approach.

"Thin Lift Asphalt Overlays, How to Get What You Are Paying For"
Skip Brown, Delta Construction Co., Inc.

Factors affecting pavement quality include material properties, transportation issues, environmental concerns; project site conditions and compaction were presented from the contractor's view point. Contractors note that compaction efforts need to increase because of a number of aggregate properties: percent crushed faces, nominal maximum size, angularity, quantity of natural sand and high dust content. Environmental factors related to cooling, which are related to the time a contractor has to achieve compaction, are magnified due to the thin lift include air and pavement surface temperature, mix temperatures, wind velocity. Site conditions require the contractor to consider the lift thickness to maximum aggregate size ratio, lift thickness uniformity (or lack of) due to variations in existing pavement (Figure 7), base conditions, and mix segregation to obtain adequate compaction. Mr. Brown included guidelines for balancing HMA production and transport with placement and rolling given with information on optimum speeds for rollers (Figure 8). Higher speeds make it difficult to get density. Roller operators need to be consistent in both speed and rolling patterns.

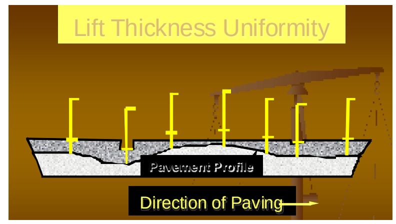


Figure 7. How uniformity in the existing pavement influences local lift thickness (Brown April 2008).

Typical Range of Roller Speeds (miles per hour)

Type of Roller	Breakdown	Intermediate	Finish
Static Steel Wheel	2 to 3.5	2.5 to 4	3 to 5
Pneumatic	2 to 3.5	2.5 to 4	4 to 7
Vibratory	2 to 3.5	2.5 to 3.5	3 to 5[1]

Figure 8. General guidelines for speed of rollers on thin lift overlays.

"Warm Mix Asphalt"
Larry L. Michael, Asphalt Consultant, Hagerstown, MD

The benefits attributed to using warm mix asphalt products include reduced emissions, fumes, fuel consumption, and viscosity. Warm asphalt products also improve workability, extend the paving window and provide the ability to pave at a lower temperature. Some product suppliers indicate that the percent RAP in the mix can be increased and that improved quality will be obtained. At this time, there are four main methods for producing warm mix asphalt concrete: introduction of moisture through a foaming process (Advera, Aspha-min, double barrel green, and low energy asphalt), a two stage hard-soft binder process (WAM-Foam), viscosity reduction/flow enhancer (Sasobit), and an emulsion with chemical package (Evotherm, Axko-Rediset). Warm mixes can be designed by any asphalt concrete mix design method, and use any of the PG grading system binder. A number of projects are presented in the full presentation.

Industry concerns that need to be considered when using warm mixes include problems with moist fines in the bag house, plant modifications needed for the different warm mix asphalt products, the availability of binder storage tanks, changes in mix behavior during production and laydown, costs, and agency acceptance.

"Interlayers"
Scott Dmytrow, Telfer Oil
Skip Brown, Delta Construction
Lita Davis, County of San Diego

This presentation is a portion of the MTAG flexible pavement manual training tools. While the written chapter on Interlayers is in the formal review process, the presentation used for the conference provides a good overview of the use and installation of interlayers. Interlayers are defined as materials or a combination of materials, which can be placed within a pavement during new construction, rehabilitation or preservation in conjunction with an overlay or surface treatment. Types of interlayers are fabrics (polypropylene, paving mats (polyester/fiberglass products), grids (non-composite and composite), chip or cape seals (ARCS, PMA, Scrub seals) and peel and stick membranes. Interlayers are used to extend the pavement life by doing one or more of the following: reduce reflective cracks, reduce pavement permeability, creating a moisture barrier, providing stress and strain relief. Ride quality can be either improved slightly or maintained at the current level. Preparation and/or repair work that needs to be completed prior to the placement of an interlayer system includes repair of potholes and cracks greater than ¼ in wide, and subgrade failures. The existing pavement needs to be cleaned and rutting needs to be corrected through milling or a leveling course. The presentation contains photographs of construction activities as well as a brief trouble shooting section. A few examples of cost estimates for 30 year life cycle are included. The life cycle costs will vary depending upon the type of interlayer or the combination of treatments that comprise the interlayer system.

"Rubberized Asphalt Concrete: Case Studies"
Erik Updyke, P.E., Senior Civil Engineer, Construction Division
Imelda Diaze, Civil Engineer, Geotechnical and Materials Engineering Division
Los Angeles County Department of Public Works

Several rubberized asphalt concrete products are included in the Caltrans Section 39: Rubberized Hot Mix aAsphalt Gap graded (RHMA-G), Rubberized Hot Mix Asphalt Open graded (RHMA-O), and Rubberized Hot Mix Asphalt Open graded with High Binder content (RHMA-O-HB). Rubberized Asphalt Concrete (RBAC) includes Asphalt Rubber Hot Mix (ARHM; wet process), Tire Modified Asphalt Concrete (TMAC) (terminal blend process), and Crumb Rubber Modified Asphalt Concrete (CRUMAC; dry process). More detailed information for these products is included in the presentation.

A number of case studies using these products are discussed. The lessons learned from the collection of case studies are listed as a need to: understand the difference between a thin lift overlay and a structural overlay, determine the appropriate material(s) and thickness, consider the effects of trench cuts during strategy selection, and consider a reflective cracking retarding interlayer during strategy selection. Performance expectations should be reasonable for the strategy selected. The selected strategy needs to be implemented in a timely manner and good records need to be kept. Agencies are urged to capture and integrate historical data into their pavement management systems for use in future strategy selection. FWD results may not be consistent with PCI values. The information for tolerable deflections in the Caltrans Highway Design Manual Table 635.1A is not useful for analysis of RBAC.

"Crack Sealing as Preventative Maintenance for Asphalt Concrete Pavements"

Crack sealing asphalt concrete pavements can extend the life of the pavement from 1 to 5 years. The presentation contains examples for the cost savings achieved at both the minimum and maximum increase in pavement life. Extending the life by only 1 year results in a savings of $900/lane mile per year and $4,400 per lane mile year if the life is extended 5 years. Crack sealing slows deterioration down by limiting the intrusion of water into the lower pavement layers.

Currently, the type of sealant is defined by whether the crack is working (greater than 1/8 inch movement) or non-working (less than 1/8 inch movement). Transverse cracks are typically working cracks, develop between 2 to 7 years for new pavements, and generally have a spacing of more than 6 meters. Longitudinal cracks, and block cracks are generally considered to be non-working cracks. The alligator, edge and slippage cracks are considered non-working cracks but are not good candidates for sealing.

The selection of the appropriate sealing product is dependent on the temperature in the region. Sealants should not crack at the highest regional temperature but still be flexible enough and sufficiently adhesive at the lowest regional temperatures. Working cracks require more flexibility at cold temperatures while filling non-working cracks generally require better properties at the warm temperatures. Routed cracks create a clean well-formed reservoir for the sealant and allow a sufficient amount of sealer to be placed for the expected movement. The three configurations include the band-aid, flush fill, and wide shallow rout reservoir. The proper construction process for joint sealing is included in the presentation.

"An Introduction to Slurry Seal and Microsurfacing Systems"
Steve Olsen

Slurry seals, developed in the 1930's in Germany, consisted of a coating of fine crushed aggregate, emulsified asphalt and water which was applied to the roadway. In the 1960's and early 1970's slurry seal contractors attempted to apply the product in thicker applications that could be applied in narrow courses in the wheel paths (rut filling). This evolved into the use of high quality aggregates and advanced emulsions, which became the microsurfacing product.

Microsurfacing differences, when compared to slurry seals, include higher polymer contents in the emulsions, higher residual asphalt content, faster breaking, and higher quality of aggregates, all of which require a higher quality control system.

Good candidate pavements vary depending on the product. Slurry seals are a good choice for newer pavements either high or low traffic volume, parking areas, airports, bike paths, pavement delineation, a tool in the preventative maintenance program, and combined with a chip seal to produce a Cape seal. Microsurfacing work well for surface treatments for high traffic volume collectors, arterials and highways, rut filling applications, double applications for minimizing surface irregularities, night work, areas with fast traffic times, concrete bridge decks, and airports. The service life of both treatments are a function of the condition of the existing pavements: treatments will last about 7 t 10 years when applied to pavements with PCI's of 80, 5 to 7 years on PCI's of 60, and 2 to 5 years for PCIs of 40. Factors that may affect service life include rock and emulsion characteristics, volume of traffic, studded tire wear, snow and ice removal efforts, and contractor workmanship.

Additional information in the presentation includes guidelines on material properties; mix design, equipment and application photographs

"Chip Seals"
J. Shawn Rizzutto, P.E., Senior Construction Engineer, Caltrans

Chip seals are used to protect and waterproof the underlying pavement, seal small cracks, improve surface friction and extend the life of the pavement. Chip seals can address pavement distresses such as polished aggregates, thermal cracking, low skid resistance and raveling. Roadways that are good candidates for chip sealing need to be structurally sound, in no need of repair, clean and dry. Chip seals need to be applied at a temperature that allows the product to cure completely.

Good construction practices include selecting the proper binder application rate, spray bars set at the proper height, nozzles set at consistent angles, uniform aggregate application, aggregates applied within 1 to 2 minutes of binder application, and the chip spreader moving slowly so the rollers can keep up without speeding. Aggregates need to be clean and not too wet. A fog seal (flush coat) is used to help with retaining aggregate and providing a black surface for good delineation of striping. Trouble shooting information is included in the presentation.

RIGID PAVEMENT TREATMENT PRESENTATIONS

"Strategy Selection for Rigid Pavements"
Mr. John Roberts, Executive Director, International Grooving and Grinding Association

Mr. Roberts stressed the first level of response for deteriorating concrete pavements should be preservation because it is the least costly, least disruptive, provides increased safety, is environmentally friendly and directly addresses improved ride quality. Concrete preservation tools include full and partial depth repairs, slab stabilization, dowel bar retrofitting, "cross-stitching" longitudinal cracks and joints, diamond grinding, and joint and crack seals. The best success of any preservation tool is to use it for the most appropriate pavement condition. It is likely that for any given condition, a number of treatments may improve and preserve the condition. A feasible treatment should address the current or anticipated distress (es) within site-specific constraints for construction window, traffic flow conditions, overhead clearances, right-of-way, and funding. Just because a treatment is feasible, does not mean it is the most economical.

“Increased Performance and Customer Satisfaction through Diamond Grinding: What Have We Learned in the Past 50(00) Years?”
John Roberts, Executive Director, International Diamond Grinding Association


Figure 10

Mr. Roberts provided insight into the need for smoother pavements to reduce the dynamic forces of vehicle – pavement interactions. Diamond grinding, defined as the removal of a thin layer (3 to 6 mm) of hardened PCC pavement surface using closely spaced diamond saw blades mounted on a rotating drum (Figure 10). This process was actually invented in California and used the first time in 1965 on a 19-year old section of I-10 to eliminate faulting. Diamond grinding is usually accomplished with multiple passes of a grinding machine. This preservation treatment has a typical life of 17 years; a pavement can be treated with this method 3 times without affecting the structural design of the pavement and can provide an average of 60 to 70% improvement in the smoothness of the unground profile. The cost of diamond grinding can substantially less than an HMA overlay, can be completed quickly during off-peak hours and without encroaching on other lanes. Other benefits include the elimination of problems with overhead clearances and blending of patches and repaired section irregularities for a more uniform appearance in the pavement surface. This method is useful for addressing faulting at joints and cracks, built-in construction roughness, polished concrete surfaces, wheel path rutting (e.g., chain wear), permanent upward slab warping, inadequate transverse slope, and unacceptable noise level. Diamond grinding should be considered part of any comprehensive pavement preservation program.

“Preserving Concrete Pavements with Dowel Bar Retrofit”
Linda Pierce, State Pavement Engineer for Washington State Department of Transportation

Ms. Pierce focused on three areas: project selection criteria, construction practices, and performance of dowel bar retrofit (DBR) in Washington State. Good candidate pavements for DBR should have load transfer efficiency between 50 and 70%, faults between 1/8 and ¾ inch, and/or transverse cracking (Figure 11). Pavements with extensive amounts of full or partial depth repair, or the presence of ASR, ACR and D-cracking (all material property problems) are ***not*** appropriate choices for DBR. Included in the presentation are a number of excellent construction sequencing and equipment for DBR are included in the presentation.


Figure 11. Example of a completed DBR project in Washington.

Construction experience shows pavements are typically opened to traffic from 2 to 7 hours after construction is complete with a compressive strength of from 1,600 to 3,000 psi. The expected performance and examples of construction problems influence on performance are included in the presentation. Figure 3 shows a completed DBR project.

“Slab Replacement Using Precast Panels Featuring: Super-Slab™ System”
Mr. David Thomas, Parsons Brinckerhoff, Inc.

The audience was introduced to “the Super-Slab™ System, which is a jointed reinforced concrete pavement (JRCP) slab-on-grade proprietary system which consists of precision grading, precision precast slabs, interlocking dowels and tie bars, and bedding grout distribution system for slab support (Figure 412). The high performance concrete used in the slab construction is cured under controlled conditions, dowel and tie bars are embedded and the slabs are joined using matching inverted dovetail slots (Figure 13). The bottom location of the slots helps protect the grout from de-icing chemicals and helps with the mechanical resistance to dowel pop-out. A thin layer (1/2”) of fine bedding is graded and compacted in two passes, which minimizes the volume of bedding grout needed for slab support. This process can provide continuous replacement at a rate of about 3,000 sq ft per eight hour shift. Five hour work windows are also possible with this method. The initial cost estimates show Super Slab™ cost will be competitive with rapid-set concrete. However, the cost will be very dependent on the size of the project and the length of the work window.

Figure 2. Placement of Super Slabs™ on prepared base.


Figure 3. View of the slots in the bottom of the slabs.

Good candidate projects for this type of treatment include heavily trafficked facilities (e.g., toll plazas), ramps, pavements under bridges and bridge approach slabs, airport runways and taxiways, pedestrian cross walks, joint replacements and instrumented slabs. Brief information on recently placed projects is included in the presentation along with a good collection of project photographs.

“Partial and Full Depth Slab Repairs”
Kirsten Stahl, P.E., District Materials Engineer, District 7, Los Angeles

The benefits that can be obtained with either partial or full depth PCC slab repairs include restored structural integrity, improved ride quality, extended service life, restoration of a well-defined uniform joint sealant reservoir, and a reduced dynamic traffic load impact. Partial depth repairs are used to address the repair of spalling and joint sealants. Typical replacement materials considered by Caltrans include polyester resins, cementitious and bituminous materials. Full depth repairs are used to repair cracked panels, deep spalls, and blow-ups. Usually only cementitious materials are used in full depth slab repairs. The presentation contains detailed information on the step by step process used for both types of slab repairs.

“Subsealing Concrete with Expanding Polymers”

Applications for this product include the stabilization, under-sealing, and lifting of concrete pavements (Figure 14). It can also be used to restore base support which is lost due to weak bases and sub-base soils. The expanding polyurethane resins can provide positive encasement sealing of leaks in culverts, catch basins, and storm water pipe systems beneath the roadways. A number of examples of uses for this product are contained in the full presentation.

Figure 4. Example of results obtained with expanding polymers.

"Joint Resealing and Crack Sealing"
M. Stroup-Gardiner

This presentation represents a condensed version of the MTAG training information. Sealing is defined as the placement of an approved sealant material in an existing joint or crack to reduce moisture infiltration and prevent intrusion of incompressibles. Resealing or sealing should be considered when the original sealant is no longer functional, the pavement is not severely deteriorated, or performed with other concrete pavement rehabilitation activities.

Material used for sealing joints and cracks can be divided into two general categories: thermoplastics and thermosetting. Thermoplastics are typically asphalt-based products; these products get soft or hard as the temperature gets hotter or cooler. Thermosetting products form a product that becomes permanently hard once placed. Desirable sealant properties include durability to resist traffic moisture, sunshine and climate variation. Extensibility is desirable so the material will deform without rupturing. Sealant needs to be resilient so that it can recover from deformation and resist stone intrusion. The product also needs to be adhesive so that it will adhere to the joint and crack walls. Materials also need to be cohesive so that it can resist internal stresses. Sealant material performance varies widely with material type, the quality of installation, joint movement, and reservoir shape.

Additional information on reservoir preparation, material selection, and construction sequencing are included in the presentation.

"Importance of Surface Characteristics"
Larry Scofield, ACPA

Surface characteristics of pavements are important for vehicle control (friction), ride comfort (smoothness), mobility, economics, durability and noise comfort (noise). There are a number of types of concrete texturing that are used: diamond grinding, longitudinal tining, longitudinal grooving, astro turf (drag), random transverse tining, and a new texture referred to as the next generation concrete surface (NGCS). Texture is considered a continuum. That is, all ranges of texture are important including microtexture, macrotexture, megatexture and roughness.

The presentation presents a concise history of smoothness measurement devices. Differences in ride quality measurements, California Profilograph Profile Index and the International Roughness Index (IRI) are compared. A brief explanation of both measurements is included along with a discussion of the repeatability of the measurements.

A discussion of texture as it relates to friction is also included. The International Friction Index (IFI) is introduced. This measurement of friction uses both the friction value and texture value to develop the friction index. The IFI is based on a friction model that incorporates both the slip speed at the tire-pavement interface and the macrotexture of the pavement.

Texture is also important for noise. Noise is a function of level (volume) and frequency. Doubling traffic adds 3 dBA to the noise level. Noise is controlled at the source (tire-pavement interface), through distance from the noise, and through obstructions (sound walls). The on board sound intensity (OBSI) method of noise measurement uses a two probe system mounted on a vehicle near a standardized tire (Figure 15).

Figure 15. OBSI System.

"High Early Strength Concrete"

Special provisions require a cement sample be submitted 45 days prior to pour, the mix design within 10 days prior to trial slab, the just-in-time-training (JITT) 7 days prior to pour and completion of the JITT within 5 days prior to pour. A pre-op conference is required within 5 days of pour. Two days prior to pour, the perimeter saw cuts are made, panels are removed using a non-impact method, the base needs to be inspected and evaluated, the 6 mm foam joint filler and a bond breaker are installed. The presentation contains a number of photographs and a video clip for the work involved in using high strength concrete slab replacement. Information is also included for quality control program (QCP) requirements.