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TEXAS PAVEMENT PRESERVATION CENTER
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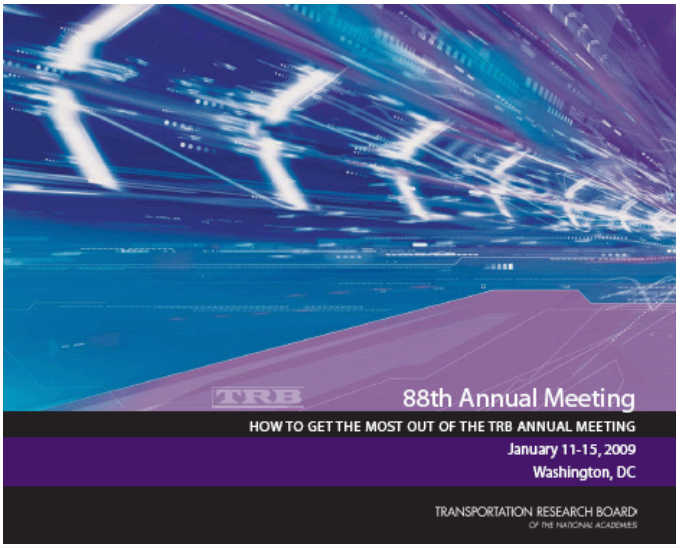
Our Mission

The mission of the TPPC, in joint collaboration with the Center for Transportation Research (CTR) of the University of Texas at Austin and the Texas Transportation Institute (TTI) of Texas A&M University, is to promote the use of pavement preservation strategies to provide the highest level of service to the traveling public at the lowest cost. The executive sponsor for the TPPC is the Texas Department of Transportation (TxDOT).

Contact Us

Director: Dr. Yetkin Yildirim, P.E.
E-mail: yetkin@mail.utexas.edu
Website: www.utexas.edu/research/tppc



Past and Upcoming Events

TRB 88th Annual Meeting

The Transportation Research Board is a division of the National Research Council, which serves as an independent adviser to the federal government and others on scientific and technical questions of national importance. The Transportation Research Board's 88th Annual Meeting assembled more than 10,000 transportation professionals from around the world in Washington, DC on January 11-15, 2009. The program consisted of over 3,000 presentations in 600 sessions. Summaries of selected seminar papers related to pavement preservation are included in this issue.

Scrub Seals

As part of our continuing mission to advance the field of pavement preservation, the Texas Pavement Preservation Center is including in this issue a brief overview of a temporary pavement treatment option used by TxDOT: scrub seals. Scrub seals, as a cost-effective alternative to seal coats, can provide a temporary fix for low volume roads.

TPPC Seal Coat Training Courses

Seal Coat training courses will continue to be offered by the TPPC. The course designed for inspectors, entitled "Seal Coat Inspection and Applications," focused on proper inspection methods and the equipment used during chip seal construction. The other, "Seal Coat Planning and Design," instructed engineers on planning, designing, and constructing chip seals.

For more information on the Seal Coat courses, please contact Dr. Yetkin Yildirim, P.E. at yetkin@mail.utexas.edu or (512) 232-3084.

TxDOT Experience with Scrub Seals by Dianah Ascencio, TxDOT

Consistent procedures and processes used to preserve and extend the life of the roadway are the backbone of routine maintenance. But as construction and material costs rise, and maintenance dollars dwindle, the challenge of routinely maintaining Texas' roadways has burgeoned; forcing TxDOT to seek out less expensive, alternative solutions to highway preservation—particularly the rural farm to markets.

While maintenance offices across the state *are* thinking outside the box and formulating new techniques, in many instances they are returning to the old playbook and relying on trusted, yet improved, methods.

"We are adapting and doing new things on low volume roads. But in some cases, we're going back to old methods," said Tracy Cumby, Lubbock District maintenance administrator.

The scrub or squeegee seal method uses new and modified rubber emulsifiers to combat roadway deterioration and extend a roadway's life expectancy as cost effectively as possible. In the scrub sealing method, asphalt emulsion is squeegeed over the entire road surface, filling the cracks. Then, this emulsion is covered by sand, small aggregate. A drag broom may be used to further smooth the fine aggregate, or else rolled excess aggregate can be swept off the following day.

According to Cumby, this process improves the characteristics of the highway surface. "It may not be the smoothest ride, but it buys a little time before you have to come back in with a seal coat. And, it prevents you from having to do a costly total rehab."

A tire rubber modified surface sealer, which contains 10 percent tire rubber emulsion, is being used on a project in the Lubbock District's Crosby County to pre-treat a 12-mile section of FM 207.

"We're using the material to seal cracks and prevent moisture from getting into the base and doing any more damage before we come back this summer and seal coat the roadway," said David Barrera, Crosby County Maintenance supervisor.

Products like the one being used on FM 207 provide benefits that go beyond preserving the roadway.
"It's easier and safer to use," Barrera said. "The product arrives from the plant and goes down at ambient temperature. It doesn't require any additional heat."

The material's relatively quick curing time, within an hour to an hour and a half in the West Texas wind and heat, allows traffic to be put back on the roadway fairly quickly. Though this method is not nearly as effective as

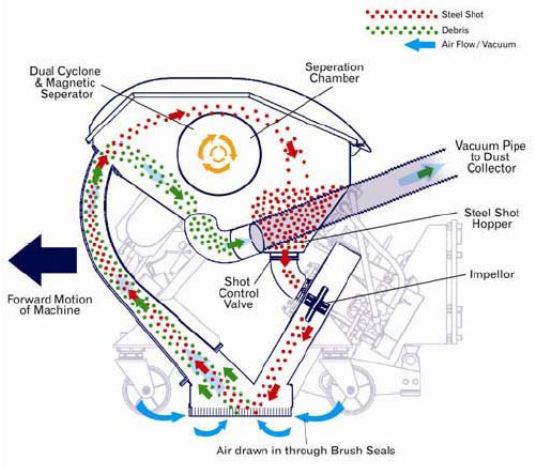
seal coating, it is a good alternative to the more costly processes, Cumby adds.

Preserving an aging transportation system continues to be increasingly difficult. Without the needed funds to totally rehabilitate roadways, maintenance sections are resorting to the less expensive scrub and fog seals, and seal coat alternatives. Perhaps not fixing the problem, but offering some relief and buying time. "Fewer maintenance dollars means we rethinking our operations," explained Cumby. "Bottom-line is we need to work smarter, watch waste and adopt good practices even if we had plenty of money."

TRB 86th Annual Meeting
Selected Pavement Preservation Papers

Life Cycle Cost Analysis of Surface Retexturing with Shotblasting as an Asphalt Pavement Preservation Tool by Douglas D. Gransberg

In, Gransberg's analysis, shotblasting is proposed as an economically viable and environmentally sustainable alternative to current surface retexturing practices. The shotblasting process involves a machine that propels abrasive particles onto the road surface to blast away contaminants, retexture a polished surface, and restore skid resistance. This technique is routinely used by major US airports to restore runway skid resistance, and the pavement life cycle cost analyses conducted in this study conclude that the same technique could be used effectively on public highways. Currently, pavement microtexture and macrotexture can only be restored by replacing the chip sealing and thin hot-mix asphalt overlays. The use of shotblasting technology proposes to retexture polished pavements, improving their micro- and macro- texture, without requiring the use of any asphaltic material or aggregate, and with minimal disruption for the traveling public. An agency that invests in this shotblasting technology would be able to improve both concrete and asphalt pavement skid resistance without the consumption of additional asphalt products, with minimal impact to the traveling public, and in weather too cold to permit traditional pavement retexturing practices.



Typical Shotblasting Apparatus Process
(TRB 09-0409 pg. 4)

Comparing Hot Asphalt Cement and Emulsion Chip Seal Binder Performance Using Macrotexture Measurements, Qualitative Ratings, and Economic Analysis by Douglas D. Gransberg

Roads with a poor pre-seal condition demonstrate an early loss of macrotexture and premature flushing after a re-seal. This study offers the first quantitative proof that, regardless of binder type, pre-seal conditions ultimately determine the post-seal performance of the pavement. These results suggest that the unpredictable results of chip seal application may have less to do with the skill of the worker and more to do with the variety of pre-existing pavement conditions. The study also demonstrated that, given equal existing pavement conditions, emulsion chip seals are more cost effective than hot asphalt cement chip seals, because emulsion chip seals are shown to lose their macrotexture at a slower rate.

Southbound Lane Sand Circles on Highway 19
(TRB 09-0411 pg. 5)

Chip seal maintenance: solutions for bleeding and flushed pavement surfaces by William D. Lawson and Sanjaya Senadheera

Lawson and Senadheera present a range of maintenance solutions that address the problems of bleeding and flushed pavements. The summary of available treatment methods presented in this paper should be a useful resource to pavement agencies. Bleeding and flushed pavements are caused by the presence of inadequate voids between the aggregate particles, which causes the asphalt binder to rise above the surface of the chip seal aggregate. Bleeding pavement is an immediate maintenance concern, and can be alleviated by the application of aggregate of various gradations, cooling the pavement surface by applying water with or without additives, and removing the bleeding asphalt and completely rebuilding the pavement seal. On the other hand, flushed pavement does not require such emergency measures, although it still constitutes a safety risk due to the loss of pavement skid resistance. In the case of flushing, pavement can

be retextured using a variety of methods, or a new textured surface can be installed over the flushed pavement.

Applying Small-Size Aggregate to Treat a Bleeding Chip Seal (TRB 09-0659 pg. 9)

Development and implementation of network-level selection of pavement maintenance and rehabilitation strategy: Virginia practice by Wu, Shekharan, Chowdhury, and Diefenderfer

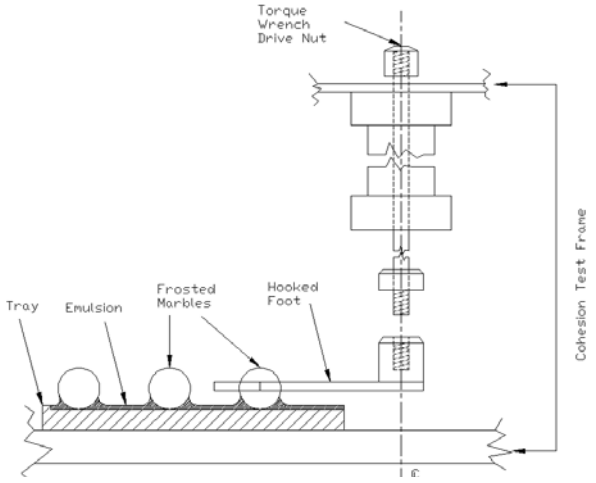
According to Wu, et. al, the planning methods of the Virginia Department of Transportation demonstrate the need for network-level pavement maintenance and rehabilitation planning. The decision matrices used by the agency have evolved over time to account for both network-level and project-level considerations in order to achieve a balance between the demands of local asset conditions, public opinion, and budgetary restrictions. The processes of network-level decision making developed from the use of composite condition index values to include distress-based decision matrices, as more distress data became available. As more data became available to the agency, including FWD data, traffic data, and surface age data, this data could be incorporated into maintenance considerations, resulting in more detailed treatment rules and a more accurate estimate of maintenance requirements. But rather than enlarging the already complex, existing distress-based decision matrices, this paper promotes the use of supplementary decision trees to enhance the flexibility and consistency of pavement maintenance planning methods.

Development of distress guidelines and condition rating to improve network management in the province of Ontario by Chamorro, Tighe, Ningyuan and Kazmierowski

New guidelines for the evaluation of pavement distresses at the network level for the Ministry of Transportation of Ontario are presented by Chamorro, et. al.: the MTO Pavement Distress Guidelines for Network Level Evaluations and the Distress Manifestation Index for Network Level (DMINL). These new guidelines were developed in consideration for their suitability to the automated/semi-automated pavement distress data collection technologies of the future. By analyzing distress data collected by automated technologies in a 2006 survey, this study formulates the guidelines that should govern the use of such collection technologies in the future to assure quality control.

Chip and scrub seal binder evaluation by frosted marble aggregate retention test by Isaac L. Howard, James Michael Hemsley Jr, Gaylon L. Baumgardner, and Walter S. Jordan, III

Howard, et. al. offer a detailed description of the *Frosted Marble Test (FMT);* a test that can be used to evaluate the curing of bituminous materials. The aggregate retention method of the FMT was developed for the Mississippi Department of Transportation, and this report includes the original Mississippi field data, original test methods, and the test results from the original protocol. Some problems with the FMT have been identified, and according to this research, certain protocols should be refined in order to make this test a major tool for bituminous material evaluation. According to this report, the FMT could be greatly improved if testing variability was addressed, a curing protocol was established, and a complimentary horizontal scale to assist data interpretation was introduced.



Overall View of *FMT* Frame, Hooked Foot, and Tray (TRB 09-1662 pg. 9)

Georgia's evaluation of surface texture, interface characteristics, and smoothness profile of micromilled surface by Lai, Bruce, Jared, Wu, and Hines

In their evaluation of surface texture profiles, Lai, et. al. propose the use of micromilling in the application of open-graded friction courses or Porous European Mixes (PEM) for road rehabilitation. Conventional rehabilitative milling practices require the placement of a dense-graded Stone Matrix Asphalt (SMA) layer before any new friction courses can be applied. By analyzing the research findings of a micromilling operation in conjunction with a PEM overlay in Georgia, this study demonstrates that the use of micromilling eliminates the

need for SMA placement, and that Porous European Mixes (PEM) can be placed on top of micromilled surfaces without requiring a new surface mix layer. The estimated cost savings for this proposed method of micromilling is $58,000 per lane mile.

Micromilling Drum (top) and Conventional Milling Drum (bottom) (TRB 09-1857 pg. 4)

Automated Cracking Survey and Protocol Design by Kelvin C.P. Wang, Zhiqiong Hou, and Weiguo Gong

Wang, et. al. describe the latest developments in pavement cracking survey technologies, with regard to data acquisition and interpretation. New developments discussed in this study include the use of laser based imaging and real-time, fully-automated analysis. This analysis is based on the data generated by the Automated Distress Analyzer (ADA), a program currently used to automatically identify crack locations and geometries. But the resultant data is evaluated by a number of different cracking index protocols, including the Crack Indicatior (CI), the AASHTO interim Protocol, and the UK SCANNER method. This study demonstrates that ADA results can be effective at the network level when evaluated according to the CI and UK SCANNER methods. However, for the future implantation of automated pavement distress surveys, a simpler cracking protocol must be considered for development, one that can be utilized by a wide range of state pavement management engineers.

Digital Highway Data Vehicle (DHDV) with LRIS (TRB 09-2014 pg. 15)

Performance-based uniformity coefficient of chip seal aggregate by Ju Sang Lee and,Y. Richard Kim

A new chip seal performance index for aggregate gradation, developed by Lee and Kim, provides a new tool for the evaluation of aggregate. The performance indicator called the performance-based uniformity coefficient (PUC) is derived from the concepts of McLeod's failure criteria for chip seals and the coefficient used for soil, sand, and aggregate. According to McLeod, aggregate particles that are less than 50% embedded in the emulsion residue are likely to be dislodged. This study incorporates these failure criteria into the uniformity coefficient (UC), which is a measure of how uniformly particle sizes are distributed, to develop the performance-based uniformity coefficient. This new gradation-based performance indicator could be used as an aggregate selection tool and could clarify engineering communications within the chip seal industry.

Quieter HMA pavements in Washington State by Pierce, Munden, Mahoney, Muench, Waters and Uhlmeyer

Studded Tire Damage (wear) to HMA in Washington State (TRB 09-2205 pg. 4)

Pierce, et. al. discuss the implications of using open-graded friction courses to reduce road noise. Although open-graded friction courses (OGFC) have been shown to reduce tire-related pavement noise, the surface life of these pavements is relatively short. Compared to the 16 year average surface life of dense-graded HMA pavements, OGFC pavements measured by the Washington State Department of Transportation for this study have surface lives ranging from 4 to 10 years. This study defines the primary cause of such early deterioration as the surface wear caused by studded tires. In addition, this pavement wear ends up reducing the initial noise benefits of OGFC pavements significantly. OGFC pavements, although they initially provide noise reduction benefits, are more expensive and less durable than standard dense-grade mixes. Furthermore, as OGFC pavements degrade, due to the wear caused by studded tires, they lose the ability to

reduce road noise that made them an appealing alternative in the first place. This report concludes by defining OGFC pavements as, at this point, an unaffordable luxury.

Effect of crack sealant material and reservoir geometry on surface roughness of bituminous overlays by W. James Wilde and Eddie N. Johnson

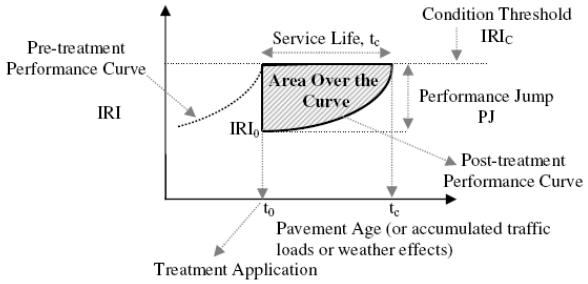
Wilde and Johnson describe a field test in Jackson County, Minnesota designed to evaluate the effects of crack sealant material and crack reservoir geometry on the formation of bumps in the application of single-lift overlays. The effects of crack sealant material type, the shape of routed cracks, and the pavement surface temperature were all considered as possible variables that could affect the formation of bumps. The results of this investigation demonstrate that hot-poured crumb rubber and hot-poured elastic sealants provided the best resistance to bump formation, also that cooler pavement surface temperatures resulted in less bump formation. Higher pavement temperatures at the time of overlay were shown to enhance the "slipping" or "sticking" of the sealant material.

Application of an Improved Crack Prediction Methodology in Florida's Highway Network by Sahand Nasseri, Manjriker Gunaratne, Jidong Yang, and Abdenour Nazef

Statistical analysis can be used to investigate the two primary factors contributing to pavement deterioration: traffic loading and low structural integrity. The results of such an analysis by Nasseri et. al. demonstrate that the impacts of these two factors are statistically very different: cracks caused by low structural integrity deteriorate faster than cracks caused by traffic loading. This study suggests that crack deterioration is not dictated by traffic loading alone, and highway agencies must account for this fact in their decision making process. Bottom-up cracks, often caused by inferior sub-surface conditions at the time of overlay, intensify faster than top-bottom cracks, caused by traffic loading, causing these pavements to degrade faster. Therefore, pavement preservation agencies should not solely focus their decision-making on highly trafficked areas, as less trafficked areas with sub-surface stresses may be in more need of maintenance. By accounting for these two very different causes of cracking, relevant transition probability matrices (TPM) can present pavement engineers with a more realistic approach for predicting future pavement conditions.

Comparing the Methods for Evaluating Pavement Interventions – A Discussion and Case Study by Muhammad Bilal Khurshid, Muhammad Irfan, and Samuel Labi

Khurshid, et. al. review evaluation criteria that have been used in past pavement preservation research, synthesizing evaluation techniques from both benefit and cost perspectives. Evaluative criteria, such as cost-effectiveness, treatment effectiveness, user-cost, and agency-cost, are comparatively analyzed using data from the Long Term Pavement Performance Program, a national pavement study. In this way, it is shown that evaluation results can vary widely depending on which criteria are prioritized. To achieve unbiased results, a matrix analysis, including various treatment/strategy alternatives, evaluation methods and performance criterion/measures, will be necessary to account for the various criteria. With this tool, pavement preservation decision makers can accurately select the best pavement investment option.



Graphical Representation of AOC, TSL and PJ (TRB 09-2661 pg. 3)

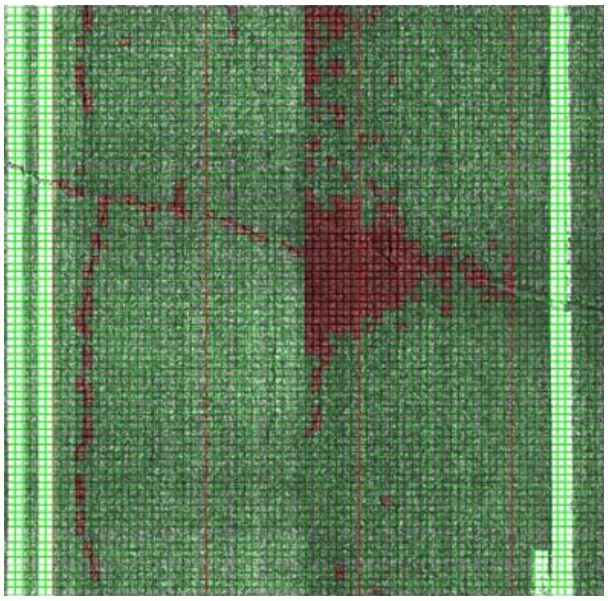
The Economics of Flexible Pavement Preservation by Mary Stroup-Gardiner, and Shakir Shatnawi

Data made available by the Maintenance Technical Advisory Guide (MTAG), developed by the California Department of Transportation, is used to estimate the cost of pavement maintenance treatments. Particularly, the data was used to measure the impact of project size, restricted construction work times, existing road conditions, and delays in placing treatments on the final cost of pavement preservation. By developing economic comparisons of various pavement preservation treatments, this paper intends to give pavement management systems better information with which to make treatment decisions. For example, significant dollar-per-square-yard cost savings are achieved by organizing preservation work so that the contractor has several weeks of work in one geographical area. These economies of scale apply to AR chip seal, slurry seal, and crack sealing work, but not to PME chips seals or spray seals. Additionally, significant project-cost increases are incurred when projects are placed under tight construction time restrictions.

Development of New Automated Crack Measurement Algorithm to Analyze Laser Images of Pavement Surface by Jungyong "Joe" Kim and Hosin "David" Lee

Kim and Lee present a new automated crack measurement algorithm which allows for the accurate analysis of laser-collected road images. Traditionally, Laser Road Imaging Systems (LRIS) have proven to be difficult to analyze accurately due to the high contrast in the images, which generates a significant amount of background noise. This paper proposes the use of a

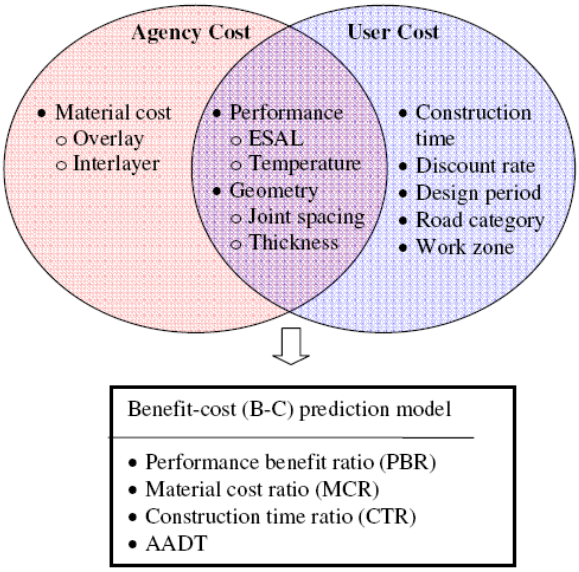
new algorithm, based on the Retinex algorithm, for the accurate analysis of laser images gathered by LRIS. A regression analysis was performed to determine the optimal thresholding equation for the Retinex algorithm, then a set of 40 images were used to validate the new algorithm, comparing its results to those of existing thresholding methods. The new crack measurement algorithm demonstrates smaller precision error and greater accuracy than the existing global and local thresholding methods. This will provide an important tool to pavement preservation agencies collect road distress data through the use of laser-based Automated Image Collection Systems.



Global Regression Thresholding Method
(TRB 09-3672 pg. 6)

Development of a Benefit-Cost Prediction Model for Hot-Mix Asphalt Overlays in Illinois to Evaluate the Cost Effectiveness of Interlayer Systems on Controlling Reflective Cracking by J. Baek, I.L. Al-Qadi, and W.G. Buttlar

Baek, et. al., develop a benefit-cost ratio prediction model to assist in the selection of an interlayer system for hot-mix asphalt overlays. Performance of interlayer systems is dependent on traffic and environmental conditions, and material costs and construction requirements differ for each interlayer system. This variety of factors can make it difficult to determine the most efficient interlayer system for a specific location. By conducting a life-cycle cost analysis (LCCA) of three different interlayer systems in Illinois, this study computed a benefit-cost ratio for each system, incorporating the criteria of performance benefit, material cost, and construction time. These benefit-cost ratios were validated by crack survey results, and in comparative analysis, it is demonstrated that an interlayer stress-absorbing composite is most efficient in cold regions, whereas a sand-mix interlayer system is most efficient in warm regions.



Main Variables of a B-C Prediction Model
(TRB 09-3777 pg. 2)