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Past and Upcoming Events

TxDOT Study on Prime Coats

Texas Pavement Preservation Center (TPPC) has conducted a study on most commonly used prime coats in Texas, their curing time and characteristics such as permeability and penetration.

TRB 90th 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. TRB's mission is to promote innovation and progress in transportation through research. The Transportation Research Board's 90th Annual Meeting attracted more than 10,900 transportation professionals from around the world to Washington, DC January 23-27, 2011. The TRB Annual Meeting program consisted of over 4,000 presentations in nearly 650 sessions. Summaries of selected seminar papers related to pavement preservation are included in this issue. For more information on these papers please contact CTR library at 512-232-3126.

TPPC Board of Directors

TxDOT: Michael W. Alford, P.E., Ray L. Belk, SPHR, Gary D. Charlton, P.E., Tracy Cumby, Toribio Garza, Jr., P.E., Randy R. King, Paul Montgomery, P.E., Tammy B. Sims, P.E., J. Jeffrey Seiders, Jr., P.E.,
Industry: Joe Graff, Halcrow, Bill O'Leary, Martin Asphalt, Kevin King, TXI, Barry Dunn, Viking Construction, Myles McKemie, Ergon

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).

TxDOT Study on Prime Coats

TPPC conducted a study on Prime Coats to evaluate the curing time and other characteristics when applied to a granular base. The most commonly used prime coats in Texas were selected for the experiment. Specimens were subjected to real conditions such that prime coat applied base was left exposed to weather. Curing time was calculated in three different weather conditions to understand how the weather affects curing time. In addition to determining curing times, other important engineering properties that determine the performance of prime coats such as, strength (both dry and wet strength), permeability and penetration were also studied. Based on the curing times, strength tests, permeability and penetration tests, a unique ranking list was developed using dry and wet strength, penetration and permeability as the key factors to determine the prime coat which would serve all the intended functions effectively and efficiently.

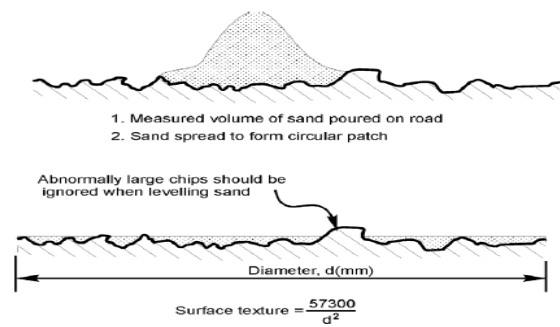
TRB 90th Annual Meeting Selected Pavement Preservation Papers

Comparative Analysis of Macrotexture Measurement Tests for Pavement Preservation Treatments by Bekir Aktaş, Douglas D. Gransberg, Caleb Riemer and Dominique Pittenger,

Determining macrotexture on pavement correctly and quickly is important for safety and economy in pavement preservation testing. This study investigated and compared two methods commonly used to determine macrotexture on pavement surfaces: the outflow meter ASTM STP 583 and the Transit New Zealand TNZ T/3 sand circle test. The research and analysis results have shown that there are functional limitations in each method's ability to accurately measure pavement macrotexture. The outflow meter provides users with results measured in seconds. It is portable, practical on wet surfaces, inexpensive, and fast, but the measured outflow time can be inaccurate for pavement preservation treatments with high macrotextures. The opposite is true for the sand circle method which should be avoided on surfaces with low macrotexture. This results in the following recommendations for appropriate use of each test method:

- If macrotexture < 0.79mm (0.03 in.), use the outflow meter only.
- If macrotexture > 0.79mm (0.03 in.) and < 1.26mm (0.05 in.), either test is appropriate
- If macrotexture > 1.26mm (0.05 in.), use the sand circle test only.

It is recommended that the macrotexture limitations for each test method should be contained in specifications for each test to ensure that the agencies that use these tests are made aware of each test's functional limitations.



**Sand Circle Test for Texture Measurement
(TRB 11-0346 pg. 5)**



Outflow Meter Test Instrument (TRB 11-0346 pg. 6)

Innovation Process and Database for Pavement Preservation Treatments Used in California by DingXin Cheng, T. Joseph Holland, R. Gary Hicks and Larry Rouen

The California Department of Transportation (Caltrans) has developed a streamlined process and management system to support innovations by funding and documenting innovative projects, an effort made to promote the effective pavement preservation techniques in California. An innovation database has been developed to assist the implementation of innovation and new products in the area of pavement preservation and to encourage technology transfer through dissemination of information through websites. A number of new innovation projects, such as cold-in-place recycling, fog and rejuvenation seals, hot-in-place recycling, interlayers, polymer or rubber modified asphalt chip seals, open graded rubberized asphalt concrete with high binder contents (RAC-O-HB), and warm mixes have been stored into the database. The first version of Caltrans innovation online database has been created and published online. The Caltrans innovation procedure and database are valuable pavement preservation management tools. It has helped Caltrans identify and manage pavement preservation innovation projects. Other agencies can use it as a template to support their pavement preservation programs.



Finished RHMA-O warm mix overlay in Route 94, San Diego, CA (TRB 11-0445 pg. 14)



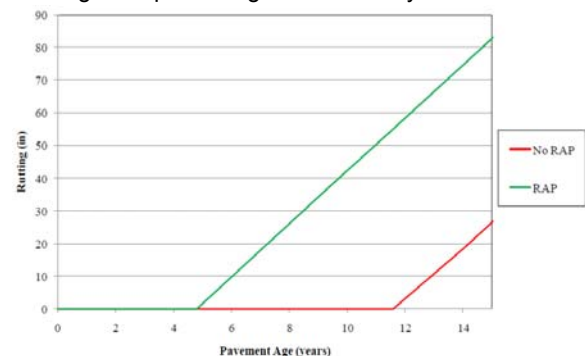
Modified Sweep Test Mixer (TRB 11-0562 pg. 10)

When to Safely Broom or Remove Traffic Control on Fresh Emulsified Asphalt Chip Seals by Scott Shuler

One of the most subjective decisions that must be made during chip seal construction is determining when the first brooming can be accomplished to remove excess chips or when to open a fresh chip seal to traffic. The author suggests that moisture content of the chip seal system is directly related to the strength of an asphalt emulsion residue. A new laboratory test that simulates the sweeping action of rotary brooms during chip seal construction was developed during this research. This test simulates the shear forces applied by brooms and uncontrolled traffic to fresh chip seals, and can be used to predict the time required before brooms or uncontrolled traffic can be allowed on the surface of the chip seal in terms of the moisture content of the chip seal. Also, three full-scale test pavements were constructed in differing climates and the results of moisture content testing in the field were compared with modified sweep test results in the laboratory. Results indicated that the three field tests were capable of resisting brooming and traffic damage when moisture content of the chip seal system ranged between 15 and 25 percent. This correlated well with results of laboratory testing using the modified sweep test on the materials from field tests as well as experimental laboratory materials. The test results also indicated that the moisture content at which 90 percent of the aggregate chips are retained during the sweep test is the “critical moisture content” corresponding to very high residue adhesive strength at which uncontrolled traffic could be allowed onto the chip seal field test sections. For equal residue strength, more moisture loss in the chip seal was required when dry aggregates were used than when saturated surface dry aggregates were used, confirming the belief that moist aggregates provide higher early strength than dry aggregates when building chip seals.

Reclaimed Asphalt Pavement: Save Today, Pay Later? by José P. Aguiar-Moya, Feng Hong and Jorge A. Prozzi

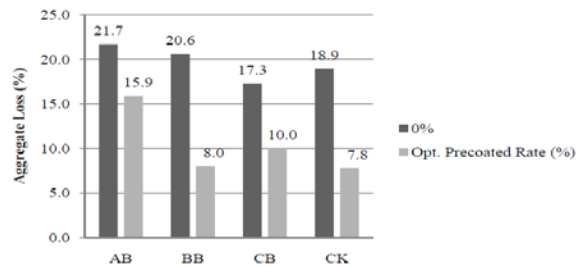
There are many advantages associated with the use of RAP, including economic benefits due to the reduction in virgin asphalt binder and new aggregates required, environmental benefits associated with the use of a recycled material, and short-term performance benefits due to increased rutting resistance. However, field observations have raised some concerns in terms of the long-term performance of mixtures containing RAP compared to those of virgin mixes. The long-term implication of using RAP and its effect on pavement cracking are yet to be better understood. The authors used data from FHWA’s LTPP SPS-5 experiment in Texas to quantify and compare the field performance of pavement sections containing RAP with those that do not contain RAP. The results have indicated that milling prior to overlaying increases the life expectancy of the pavement structure when no RAP is used in the mix. In the case where RAP is used, the effect of milling is reversed. The authors thus emphasize that pavement designers need to be cautious with the use of RAP and to take into consideration that pavement structures with RAP might deteriorate faster in the long run, mainly in cases where RAP is used in thin overlays. Also, increasing RAP percentages is not always the solution.



Transverse Cracking Progression on a Pavement with a Thick Overlay (with Milling Prior to Overlaying) (TRB 11-1017 pg. 11)

Determining of Precoated Aggregate Performance on Chip Seals Using Vialit Test by Mustafa Karasahin, Bekir Aktas and Cahit Gurer

One of the methods that are commonly used for increasing performance of chip seals is precoating aggregate surfaces with bitumen on-site or in asphalt plants. Aggregates coated with bitumen help initial adhesion between binder and aggregate particles, particularly to overcome potential negative effects caused by dust and moisture, make surface markings clearer and reduce damages to vehicles on newly laid chip seals. In this paper, effect of precoated aggregates, which are used to increase performance of chip seal on aggregate-bitumen adhesion was investigated. Optimum precoated rates for four different aggregates, three different gradations of basalt and one gradation for limestone, were determined with Vialit Adhesion Test. Precoated aggregate with optimum rate ensured better adhesion than aggregates uncoated with bitumen. Results of experimental studies have shown that precoated aggregates contribute highly to performance of chip seal particularly in terms of aggregate-bitumen adhesion. However, authors suggest that precoated amount should be determined correctly and aggregates should be optimally coated with bitumen.



CB-Type-C Basalt; CK-Type-C Limestone; BB-Type-B Basalt; AB-Type-A Basalt;

Vialit Test Results of Pre-coated and Non-precoated Aggregates (TRB 11-1220 pg. 8)

Determination of the Performance of Chip Seal, Applied With HSKSC (Accelerated Chip Seal Simulation Device) on Unbound Base by Mustafa Karasahin, Cahit Gurer, Murat Vergi Taciroglu and Bekir Aktas

Chip seals applied on unbound granular bases are widely used in countries such as Turkey, Australia, New Zealand, and South Africa. Although several methods and techniques regarding measurement of the performance of chip seal on-site and under laboratory conditions have been developed in recent years, there is no evidence that a device, system or method in a laboratory setting could pre-measure the performance of chip seals. In this study, Accelerated Chip Simulation Device (HSKSC), which was developed and designed in Suleyman Demirel University (Turkey) was employed by the authors to assess the performance of chip seals applied on unbound granular bases under desired climate conditions. Two different chip seals (single-layer and double-layer) were designed with

this device and the chip seal samples were subjected to performance test under mild and hot climatic conditions respectively. It was concluded that as the number of cycles increases, considerable decrease appears particularly on macro texture and a limited decrease in micro texture. The experimental research has shown that this device simulated the behavior of chip seal on unbound granular base realistically.



HSKSC Test Equipments (TRB 11-1225 pg. 5)

Automated Pavement Crack Sealing System Development by Wayne D. R. Daley, Sergio Grullón, Wiley D. Holcombe, David M. Jared, Steven D. Robertson, Colin T. Usher and Jonathan F. Holmes

Crack sealing is an accepted practice in many state Departments of Transportation (DOTs) as this operation is believed to add significant life to roadways. The research performed by the Georgia Tech Research Institute in conjunction with the Georgia Department of Transportation has proved that a commercial-scale automated crack sealing system is viable. Solutions related to the high-speed firing of nozzles, automated crack detection, and navigation in a real-time system have been demonstrated on a limited-scale system. A prototype of the automated crack sealing system was built and mounted on a trailer. It consisted of a single stereo camera, an applicator system, and a means of providing a continuous supply of sealant to both a longitudinal and a transverse distribution system. The configuration of this prototype system was designed to meet the primary goals of detecting and filling a 1/16" wide crack at a speed of 5 mph.

The software for the crack detection and control system consisted of two major sub systems: a vision processing sub system and a real-time control sub system. The vision processing sub-system consisted of a camera and a Windows-based processing computer. The control sub system consisted of a real-time operation system (RTOS) computer interfaced to wheel encoders and dispensing

hardware. This design allowed the RTOS computer to control and query all of the hardware in real time in order to correlate crack detection with dispensing. The future for automated crack sealing operations is promising as this research has demonstrated that many of the technical barriers to commercialization have been addressed, thus opening the door for increased productivity and worker safety.



Picture of Prototype Crack Sealing Hardware with Detail of Applicators (TRB 11-1472 pg. 3)

Life-Cycle Cost-Based Pavement Preservation Treatment Design by Dominique Pittenger, Musharraf Zaman, Caleb Riemer and Douglas D. Gransberg

The use of economic analysis, specifically life cycle cost analysis (LCCA), to achieve the cost effectiveness and return on investment that supports pavement preservation and transportation decision-making is one way to promote sustainability in transportation. Although LCCA is a powerful project economic evaluation tool, there is no prevalent method used by state agencies to conduct economic analysis at the pavement preservation level. No significant research has been done to quantify the actual service lives of the pavement preservation treatments themselves nor has a model been furnished to analyze their LCC. The authors thus try to address this issue by proposing a methodology for using field test data to quantify the service lives of pavement preservation treatments for both asphalt and concrete pavements. Additionally, they introduce the concept of LCC model based on equivalent uniform annual cost, rather than net present value, specifically addressing the relatively short term nature of pavement preservation treatments and allowing the engineer to better relate treatment LCC output to annual maintenance budgets. The research also developed a methodology for developing pavement preservation treatment-specific deterioration models and demonstrated how these provide a superior result to those based on

empirical service lives. Finally, the research demonstrated how the new model could be utilized to assist a pavement manager in selecting the most economically efficient pavement preservation treatment for a given pavement management problem.

Correlation of Moisture Loss and Strength Gain in Chip Seals by Scott Shuler, Walter S. Jordan III, James M. Hemsley, Jr., Kevin McGlumphy and Isaac L. Howard

The research described in this paper presents laboratory test methods which measure adhesive strength gain as a function of moisture loss. Although the tests were somewhat different, results were similar and indicated strength in emulsion residues increases as the total moisture in the system is reduced. According to the authors, moisture loss of the emulsion was shown to be a better variable to determine traffic opening than cure time. The modification of ASTM D 7000 identified as Sweep-2 in this paper provides a method to determine the timing for chip seal brooming and opening to uncontrolled traffic. The test results determined the moisture loss of the chip seal which corresponds to adhesion needed to retain chips under traffic loads. The moisture content of the chip seal can be monitored during construction to determine when the desired moisture content is reached. The authors also concluded that each emulsion performs differently with each aggregate combination from the following test data:

Emulsion-Aggregate	Aggregate Loss (%)			
	Dry at 40% Cure	Dry at 80% Cure	SSD at 40% Cure	SSD at 80% Cure
E4-A1	61	15	63	8
E4-A2	70	16	57	12
E4-A3	55	8	52	3
E4-A4	82	10	80	15
E5-A1	25	20	18	9
E5-A2	72	30	63	27
E5-A3	68	43	42	46
E5-A4	77	37	64	50
E6-A1	75	17	82	25
E6-A2	76	18	81	20
E6-A3	78	21	75	18
E6-A4	77	16	80	17
E7-A1	55	3	41	4
E7-A2	66	18	63	2
E7-A3	70	4	52	1
E7-A4	48	30	45	6
E8-A1	32	4	43	5
E8-A2	50	0	63	2
E8-A3	68	1	65	2
E8-A4	60	5	57	4

Sweep-2 Test Results Highlighting Aggregate Characteristics (TRB 11-1832 pg. 12)

Unsealed Gravel Roads Management Systems Programming and Data Management by Khaled Ksaibati and George Huntington

Discussions at the 88th Annual Meeting of the Transportation Research Board in January 2009 identified a lack of an unsealed earth and gravel roads management methodology suitable for small, local agencies, particularly those with governmental structures like those of American counties in the rural west. This paper thus addresses issues related to the need for software and data

management structures and systems for managing unsealed roads, particularly for small, local agencies. Methods for managing data, generating maintenance schedules, and producing network-level outputs are described. Eight unsealed road maintenance tasks are proposed, namely, blading, reshaping, regravelling, dust control, stabilization, isolated repairs, major work and drainage. According to the authors, primary aspects of implementing a gravel roads management system from a programmer or data manager's point of view are described, namely, Assessment, Inventory, Database structure, Maintenance and cost tracking, Condition monitoring, Cyclic maintenance scheduling, Triggered maintenance scheduling and Network level outputs.

Quantitative Evaluation of Fog Seals on Pavement Skid Resistance with Indoor Accelerated Loading Tests by Wang Duanyi, Chen Xiaoting, Lei Chaoxu and Larry Galehouse

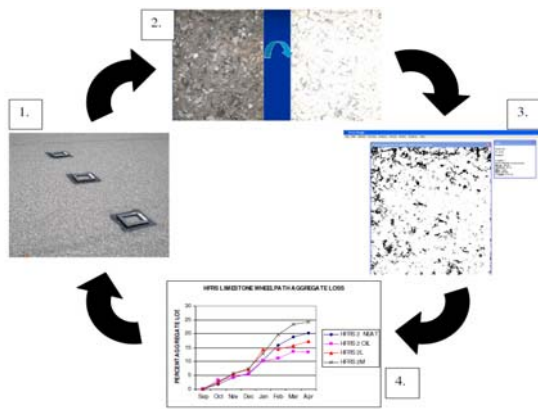
Fog seal, if done timely, is an effective and economical treatment. Meanwhile, it is widely known that the friction coefficient and texture depth of pavement are significantly reduced after application, which hampers the regular use of fog seal. The authors thus believe that by better understanding how fog seal affects skid resistance, new practices and technologies can be developed to solve the problem. A method was developed called tire-driving pavement function accelerated loading test system as the basic test platform. For the study, core samples from existing pavements were obtained to determine the parameters of the asphalt mixture such as air voids, gradation, etc. to design and fabricate specimens. Two fog seal applications were studied, namely, A-type fog seal application by spraying 0.6 kg/m² of asphalt rejuvenator followed by 0.5 kg/m² fine aggregate (maximum grain size is 1.18 mm) and A-type fog seal application by spraying 0.6 kg/m² emulsified asphalt and no fine aggregate, both treated after 10000 loading cycles. It was found that the texture depth and friction coefficient decline after fog seal treatments. Accelerated loading test results indicated that when the spread rate of asphalt material is 0.5 kg/m², the value of friction coefficient decreased the least. Accelerated loading test results also showed that the spreading of 1.18mm sized aggregate will provide the best effect. Also, aggregate spreading at a rate of 0.5 Kg/m² was able to achieve an optimum performance. The test results also suggested that the performance of diabase was much better than natural sand.



The Tire-Drive Pavement Function Accelerated Loading Test System (TRB 11-1997 pg. 3)

The Monroe Michigan Chip Seal Case Study: An Evaluation of Multiple Chip Seals' Cold Weather Field Performance by Joe Brandenburg, Herb Wissel and Jason C. Wielinski

The purpose of the Monroe Chip Seal Case Study was to evaluate chip seal performance for multiple test sections comprised with different asphalt emulsion – aggregate type combinations with emphasis on aggregate retention, especially during winter months. Different emulsions and aggregates were evaluated to determine if there was an optimum combination for performance in this climate over the course of one winter. The test sections were placed on a section of North Dixie Highway near the intersection of US Turnpike in Newport, MI near Monroe. Field performance of the chip seals was quantified by aggregate retention measured through image analysis. Firstly, three random stations were identified and photographed in each chip seal section. These pictures were then catalogued and prepared for imaging analysis. Secondly, each photograph was then converted to a black and white image. Thirdly, the bitmap image was imported into the Scion Image software program. This file was then converted into a binary file where all black or dark pixels were assigned a pixel value of 255 and all white or lighter pixels were assigned a value of 0. The program then assigned an average pixel value for the entire image. The average pixel value along with the number of pixels (or area) was then used to calculate the average area of aggregate coverage. Finally, the aggregate coverage for each chip seal was then averaged and converted into a percent of aggregate loss calculation. The research concluded that adding 1.0% OD (Oil Distillate) to an anionic high float emulsion improved performance (aggregate retention) over emulsions without oil. Anionic limestone chip seals outperformed anionic gravel chip seals. There was no appreciable difference between limestone and gravel cationic chip seals. Also, there was no significant difference between latex modified and SBS modified emulsions for gravel seals. Limestone seals with latex modified emulsion performed slightly better than SBS modified chip seals



Field Performance Testing Methodology
(TRB 11-2028 pg. 9)

Pavement Preservation – A solution for Sustainability
by Susanne Chan, Becca Lane and Tom Kazmierowski

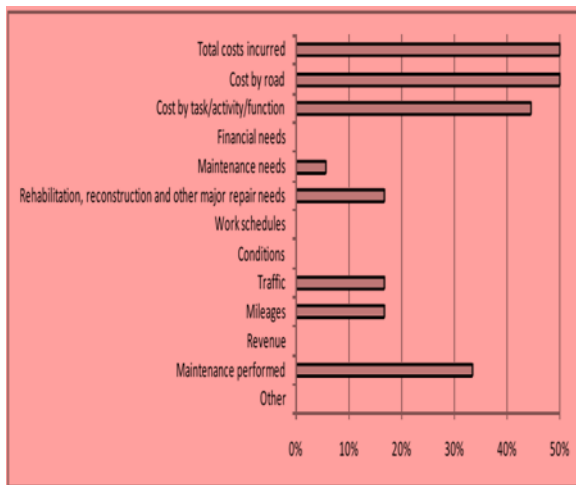
This paper throws light on the pavement preservation strategies of the Ministry of Transportation Ontario (MTO) in recent years in their effort to maximize cost savings in repair operations and maintain pavement condition. These preservation treatments include: crack sealing, slurry seal, micro-surfacing, chip seal, ultra-thin bonded friction course, fiber modified chip seal, hot mix patching and hot in-place recycling (HIR). This paper presents the benefits of pavement preservation by considering the service life of each treatment and calculating the associated energy consumption and GHG emissions per service year. Economic assessment and aggregate conservation assessment on the preservation treatment are also performed. The results indicate that pavement preservation strategies provide a significant reduction in cost, aggregate consumption, energy use and GHG emissions when compared to traditional rehabilitation and reconstruction treatments. The authors conclude that in order promote pavement sustainability, it is necessary to quantify the benefits of the treatment by utilizing life cycle cost analysis (LCCA) to evaluate the most cost effective treatment and utilize methodologies such as PaLATE to evaluate the environmental impacts. Currently, MTO is developing an Ontario based Green Pavement Rating System to quantify and encourage pavement sustainability. The main difference between MTO’s Green Pavement Rating System and other systems is it focuses specifically on the pavement component rather than the entire road. Using a simple, points based rating system, MTO Green Pavement Rating System is designed to assess the “greenness” of pavement designs or constructed pavements, both flexible and rigid structures. Assigning a rating to the pavement design will enable the ministry to incorporate more sustainable technologies in pavements and encourage industry to do the same. In the proposed rating system, pavements will be assessed within four categories:

Category	Goal	Points
Pavement Design Technologies	To optimize sustainable designs. These include long life pavements, permeable pavements, noise mitigating pavements, and pavements that minimize the heat island effect.	8
Materials & Resources	To optimize the usage/reusage of recycled materials and to minimize material transportation distances.	13
Energy & Atmosphere	To minimize energy consumption and GHG emissions.	10
Innovation & Design Process	To recognize innovation and exemplary efforts made to foster sustainable pavement designs.	4
Maximum Total:		35

Four Categories in MTO Green Pavement Rating System (TRB 11-2067 pg. 9)

Unsealed Gravel Roads Management: State-of-the-Practice in American Counties by Khaled Ksaibati and George Huntington

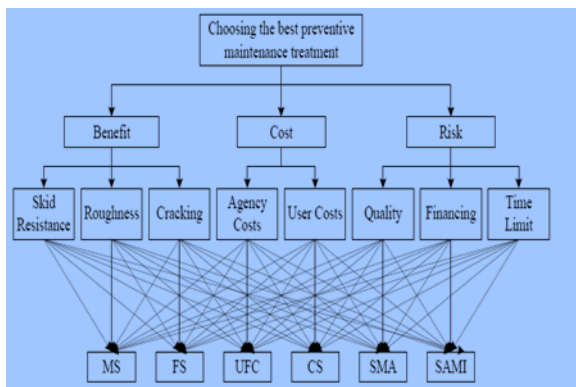
This paper discussed the current state of unsealed earth and gravel roads management, with a particular emphasis on the rural counties of the American west. As part of an effort to develop an unsealed roads management methodology, the Wyoming Technology Transfer Center has compiled considerable information about unsealed roads management practices both in the USA and abroad. The current state of roadway management by smaller agencies has been described by the help of the results of two recent surveys: one conducted at the National Association of County Engineers’ (NACE) Spring Conference held in Fort Worth, Texas in April 2010 and the other conducted by the North Dakota Local Technical Assistance Program (ND-LTAP) in four states, Montana, Wyoming, North Dakota and South Dakota, during the 404 summer of 2009, with the assistance of each state’s LTAP center. The authors observed that Maintenance scheduling was done without any consideration for user costs, based either on complaints or by simply maintaining each road in its turn, then repeating. Also, a frequently noted problem with unsealed roads management was over-maintenance. Reducing or eliminating this problem could result in substantial savings and improved network-wide service. The authors also suggest that if management systems, particularly cost and maintenance tracking methods, were improved, county road and bridge departments would be able to manage their unsealed roads more efficiently and present better arguments to decision makers when requesting funds and other support. As practiced by counties in the American west, there is plenty of room for improvement in achieving these goals in spite of the constraints imposed by severe limits on time and money.



Responses to 'What dirt and gravel roads reports do you generate?' (TRB 11-2095 pg. 10)

Application of Analytic Hierarchy Process and Analytic Network Process in Preventive Pavement Maintenance Decision-making by Feng Zeng, Xiaonin Zhang and Jiangmiao Yu

In this paper, the authors presented a decision-making model for preventive maintenance by use of analytic hierarchy process and analytic network process. A practical example was selected to demonstrate the effectiveness of the two methods in the preventive decision-making, which is under general principles of comprehensive consideration of cost, benefit and risk possibility, followed by detailed considerations of pavement performance indexes, such as skid resistance capacity, roughness, cracking, owner costs, user costs, quality risk, financial risk and work period risk. Also, comparisons were made of the said indexes to identify optimal scheme for six preventive maintenance schemes, combined with sensitivity analysis. The results showed that the analytic hierarchy process was a practical tool suitable for preventive maintenance decision-making.

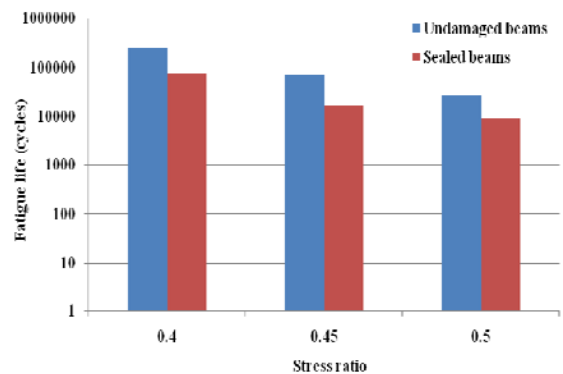


*micro-surfacing (MS), fiber-reinforced seal (FS), ultra-friction course (UFC), composite seal (CS), SMA-10 and SMA-10 plus SAMI

A 4-layer decision-making framework of AHP (TRB 11-2398 pg. 8)

Assessment of Crack-Sealing Materials and Techniques for Epoxy Asphalt Pavement on Steel Bridges by Leilei Chen, Sang Luo and Zhendong Qian

This paper throws light on an assessment of a newly developed crack sealant for steel deck epoxy asphalt concrete pavement. The effects of different sealing techniques have also been evaluated. The workability, bulk performance, interfacial performance and cooperative performance of the developed sealant were assessed through viscosity test, tensile test, pull-out test, tensile bond behavior test and shear bond behavior test. The tests have shown that the developed sealant could satisfy the requirements and criteria of the steel deck pavement crack sealant well. Also, both of the bending fractures occurred at the epoxy asphalt mixture sections, and the bending strength of the sealed beams did not vary a lot from that of undamaged ones at 15 °C . The fatigue results of undamaged beams and sealed beams under different control modes showed that the fatigue lives of sealed beams are significantly smaller than that of undamaged beams. The fatigue equations of undamaged beams and sealed beams at 15 °C were regressed, and they have provided ways for the life prediction of the epoxy asphalt steel deck pavements before cracking and after sealing. The pull-off test, cooperative performance test and the fatigue test results have indicated that the fracture section was at the interfacial between the sealant and the epoxy asphalt mixture. Authors thus conclude that efforts should still be made to improve the interfacial behavior of the sealant and the epoxy asphalt mixtures.



Fatigue test results of different beams (TRB 11-2419 pg. 11)

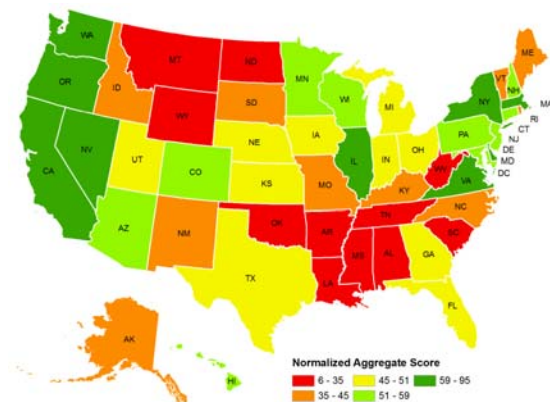
Quantifying the Economic Domain of Transportation Sustainability by Carol Atkinson-Palombo, Chris McCahill, Ryan O'Hara, Norman W. Garrick and Jason Zheng

To fully understand and integrate the ideas of sustainability with transportation, the authors of this paper see the need for proper metrics and performance measures. This paper demonstrates how the theoretical concepts of transportation sustainability can be transformed into a

practical metric for assessing the performance of the United States' transportation system in terms of sustainability. The analysis is carried out for surface transportation at the state-wide level. The final results describe the relationship between urbanity, mode share, and the economic aspects of transportation sustainability. Using existing sustainability literature, a composite index framework was used to create a metric that can quantify and measure a broad spectrum of characteristics related to transportation sustainability. The authors have thus concluded that the best performing states in terms of the economic aspects of transportation sustainability are more urban and have lower automobile mode shares.

Domain	#	Element	i	Indicator	
Environmental	1	Minimize consumption of renewable & non-renewable resources for transportation	1	Energy Consumption	
			2	Infrastructure Materials Consumption	
			3	Vehicle Materials Consumption	
	2	Transportation and placemaking system is designed to maximize land use efficiency	4	Land Use	
			5	Ecological Systems	
	3	Minimize transportation and place-making system's impact on ecological systems	6	Greenhouse Gas Emissions	
			7	Pollution	
	4	Limit transportation related wastes & pollution	8	Waste Production	
9			Health		
Social	5	Transportation meets access needs in a way that is consistent with human health & safety	10	Traffic Safety	
			11	Government Interoperability	
	6	Planning and management of transportation incorporates different levels of government & community input	12	Community Involvement	
			13	Social Interaction	
	7	Transportation and placemaking system promotes social interaction & social equity	14	Social Equity	
			15	Accessibility	
	Economic	9	Transportation is affordable for individuals	16	Affordability
		10	Transportation provides efficient movement of people & goods for economic activity	17	Mobility
11		Transportation is financed in an equitable manner	18	Finance Equity	
12		Transportation is resilient to economic fluctuations	19	Resilience	

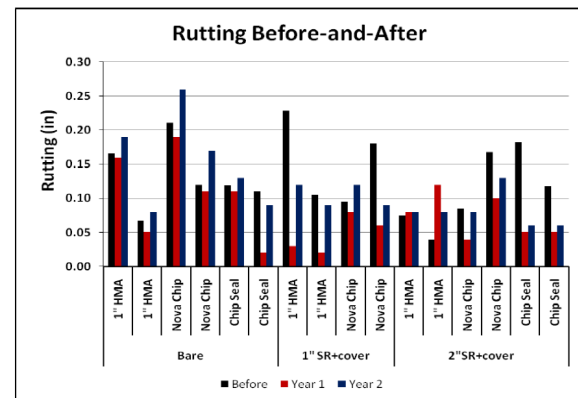
Composite Index for Transportation Sustainability (TRB 11-2875 pg. 5)



Normalized Aggregate Scores for the Economic Domain of Transportation Sustainability at State-Wide Level (TRB 11-2875 pg. 13)

Effectiveness of Thin Surface Treatment in Kansas by Md. Shaidur Rahman, Mustaque Hossain, Paul Nelson and Richard Miller

This paper discussed the effectiveness of several thin surface or preventive maintenance treatments on sixteen highway test sections in Kansas. The treatments studied included thin Hot-4 Mix Asphalt (HMA) overlay, ultra-thin bonded asphalt surface (Nova Chip), and chip seal. Effectiveness of the thin surface treatments for mitigating typical distresses was then evaluated by conducting before-and-after (BAA) comparisons using the Pavement Management Information System (PMIS) database maintained by the Kansas Department of Transportation (KDOT). It was observed that transverse and fatigue cracking significantly decreased and rutting conditions were improved after the thin surface treatments were applied. Roughness conditions improved on the 16 highway test sections treated with 1" HMA and Nova Chip, while the effects of chip seals on reducing roughness were not as obvious. Each of the cover treatments provided benefits for the first two years, which are cost effective. The authors suggest that the comparison would favor the least initial cost option because of the limited difference in performance between alternatives.



Effectiveness of thin surface treatments based on rutting (TRB 11-2953 pg. 9)