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TPPC Board of Directors

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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).

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Past and Upcoming Events

As part of our continuing mission to advance the field of pavement preservation, the Texas Pavement Preservation Center is offering training courses on seal coats, the Texan term for chip seals. The courses serve two main groups: engineers and inspectors. The course designed for inspectors, entitled "Seal Coat Inspection and Applications," focuses on proper inspection methods and the equipment used during chip seal construction. The other, "Seal Coat Planning and Design," instructs engineers on planning, designing, and constructing chip seals. The purpose of both courses is to increase the awareness and understanding of pavement preservation by providing instruction on a common preservative maintenance treatment.

Both sections of the course are approximately 8 hours in length and offer attendees 0.8 Continuing Education Units. To receive a certificate of completion for the course, all attendees must score a passing grade on a series of quizzes over the material covered.

The first four rounds of Seal Coat courses were held in Fort Worth February 27 and 28, Austin March 18 and 19, Lubbock April 15 and 16, 2008 and San Angelo November 6 and 7. Additional courses are scheduled to begin in the spring of 2009.

The TPPC and TxDOT are also in the process of developing training courses on microsurfacing, another common pavement preservation treatment. This course will teach attendees the concepts behind the current best practices for microsurfacing in the industry.

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

Pavement Preservation (PP) Treatment Selection

As part of our continuing mission to improve pavement preservation practices and disseminate important PP concepts, the TPPC is currently conducting a literature review centering on the topic of pavement preservation treatment selection. In this issue, we provide a brief summary of the information included in this literature review. Topics covered include: the advantages and attributes of a well-organized pavement management system (PMS), PMS development, parameters that should guide treatment selection, methods of measuring pavement distress and roadway characteristics, and strategies for pavement assessment, data analysis and treatment selection.

Pavement Management Systems (PMS)

A pavement management system, or PMS, describes the approach that an agency takes to road maintenance. The American Association of State Highway and Transportation Officials (AASHTO) defines a PMS as “a set of tools or methods that assist decision-makers in finding optimum strategies for providing, evaluating, and maintaining pavements in a serviceable condition over a period of time.”

The effectiveness of a pavement maintenance organization is generally determined by the PMS in place. Therefore, PMS development should be a very careful and thought-out process. During the PMS development process, the agency must establish program guidelines, an organized approach to identifying the proper locations and times for PP treatment placement, a method of determining feasible treatments, a logical approach to final treatment selection, implementation procedures, and a system for program assessment. Careful planning and informed decision-making can provide the road agency with one of the most important tools for successful pavement management: an effective PMS.

Factors to Consider

Before a pavement preservation project or treatment can be selected, the agency must learn as much about the roadway in question as possible. The existing pavement must be studied, tested, and analyzed, and all relevant information related to the roadway must be considered:

Existing Pavement Condition

The age of the existing pavement and its material makeup, structural condition, and current distress must be evaluated or determined for an agency to make an informed treatment selection. Pavement condition is defined by the amount and type of distress exhibited, riding comfort, load-carrying capacity, safety, and appearance. The main types of distresses that should be measured are cracking (both type and extent), raveling, oxidation/weathering, bleeding, flushing, rutting, shoving, patching, loss of friction/polished aggregate, and roughness.

Identifying the cause, type, and extent of the pavement distress should be the agency’s first priority. Often, worries over cost and financial constraints obscure the project’s main goal, which is to achieve effective results. In order for the agency to decide if a pavement is a good candidate for preservation efforts and, if so, what treatments would be the most beneficial, any problems that the pavement has must be thoroughly understood.

One type of pavement distress that must be considered when selecting a treatment is cracking. Cracks must be investigated further; the type and extent of an exhibited crack must be identified. Agencies commonly qualify cracking by identifying the type, such as longitudinal cracking, fatigue or alligator cracking, transverse cracking, edge cracks, thermal cracks, shrinkage cracks, and sealed or unsealed cracks, and the extent, which takes crack width and severity into account.

Fatigue Cracking

The pavement’s surface condition must be assessed as well. Surface distresses that should be evaluated prior to treatment selection include raveling, oxidation or weathering, bleeding, flushing, rutting, shoving, patching, polished aggregate or loss of friction, roughness, and ride quality. Usually these distresses are further categorized by severity into low, moderate, and high levels. Clear definitions for each severity level of every condition must be developed to reduce variations between one pavement surveyor’s evaluation and another’s.

Estimated Service Life of the Treatment

Along with the existing pavement conditions, the estimated service life of potential treatments must be taken into account if thoughtful preservation decisions are to be made. Decisions must be based on the estimated effect of the treatment on the pavement’s performance life, not on the life and performance of the treatment itself.

Although performance life is dependent on a variety of factors, agencies must calculate the number of years a treatment can reasonably be expected to last. If there is no reason to believe that a treatment will extend the life or improve the performance of the pavement, it should be rejected.

Rut depth measurement

Traffic Conditions

Traffic conditions, such as volume, composition, and patterns of movement, are key parameters to consider when selecting appropriate treatments. The amount of traffic that a road is normally subjected to can greatly affect which treatment should be used. Some treatments are only suitable for low or moderate traffic levels, while others are excellent for heavy amounts of traffic. Traffic loading is one of the most important factors to consider after pavement distress, as it is the main source of pavement wear. Likewise, understanding the type of traffic that will be using the road is crucial to understanding the stress a pavement will undergo. For example, a road that sees a high volume of trucks will require a different treatment than a neighborhood street. Considering the road's classification then becomes essential to treatment selection. The way in which a road is used impacts the pavement surface significantly and makes some treatments more appropriate than others. For instance, a road can be identified as an interstate or non-interstate; as urban or rural.

Other key factors relating to traffic conditions include stop points and turning points. These specific areas of the pavement can be subject to increased stress, which may require a different type of treatment than other areas. The amount of roadway curvature can be an important circumstance also. The durability of the selected treatment must be appropriate for the traffic volume, the type of traffic, and how the traffic normally moves on the roadway.

Traffic volume can affect treatment selection for an additional reason: different types of treatments take different amounts of time to apply and cure. The amount of traffic disruption that will occur for each feasible treatment, based on traffic volume and curing time, must be weighed. Agencies must ensure that the application and curing times of potential treatments are appropriate for the roadway's traffic levels.

Noise Requirements and Aesthetic Preferences

Further considerations when selecting a PP treatment include roadway location, noise requirements, and aesthetic preferences. The amount of traffic, the posted speed limit, and the location of the roadway can seriously increase or reduce the need for treatments with low noise levels. Some treatments are designed for a quiet ride, while others are notoriously loud. Including noise levels in treatment selection decisions can increase customer satisfaction.

Customer satisfaction is also related to aesthetic aspects of the roadway, such as dust levels during construction or the general appearance of the pavement. Customers obviously prefer an attractive road, especially in certain locales, such as a highly visible street in the town square.

Climate Conditions

Climatic conditions should also guide pavement preservation treatment selection. The type of weather a pavement will have to withstand will influence which treatments can and cannot be used. Obviously, treatments used in a desert, valley, coastal, or mountain region would all vary. Other environmental conditions, such as the amount of acid rainfall, can impact treatment selection, as well. Additionally, areas that see significant amounts of snowfall can have pavement problems associated with the level of snow plow use.

Along with average weather conditions, the best time of year and weather conditions for the placement of a specific treatment must be considered. Every treatment has limitations as to when they can be applied most effectively. Some general limitations are related to optimal placement times and weather conditions. For instance, some treatments are best applied at night due to heavy traffic volume or other factors. A need for nighttime application can affect what time of year the treatment must be applied, as temperatures drop at night. Applications requiring warm temperatures must therefore be placed during a season that rarely experiences chilly nights. Other than seasonal constraints, timing is highly important, as roadways continue to deteriorate until a treatment is placed. Agencies must ensure that they are able to perform treatments while the pavement distress is still light enough to be relieved by pavement preservation techniques. Furthermore, treatments must not be applied too early in a pavement's life; otherwise, they will not be cost-effective. Precise timing of treatments is essential to good pavement performance.

Financial and Construction Data

Timing is often directly related to the financial aspects of the decision process. A key component of treatment selection is the cost of the treatment. Obviously, each project depends heavily on the availability of funding. If the best treatment exceeds the agency's budget, it cannot be used, regardless of how well it fits with the other factors involved. Perhaps even more crucial than the initial cost of the treatment is the treatment's cost-effectiveness.

Cost-effectiveness is defined as the relationship between the long-term cost of a pavement maintenance treatment over a given evaluation period and the improvement in serviceability of the pavement. Therefore, agencies should consider not just the initial cost, but whether a treatment will be worth its cost in the long run. Pavement preservation is designed to provide the most cost-effective methods of dealing with pavement deterioration, so the lifetime cost of a treatment is naturally a matter of concern to roadway agencies.

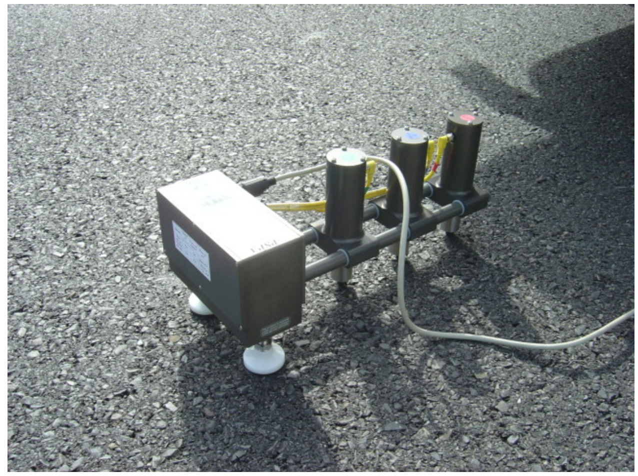
Even if sufficient funding is available, an otherwise acceptable treatment may have to be rejected due to construction constraints. Therefore, agencies must weigh the availability of proper materials and qualified contractors into their decisions. Some treatments require special materials or application skills, which may force agencies to choose an alternate treatment.

These are just a few of the factors that must be considered when selecting an appropriate pavement preservation treatment. To make informed decisions, the age of the existing pavement and long-term road plans must be considered. Road agencies must also consider the availability of skilled construction crews and materials when considering how to apply the right treatment to the right road at the right time. Treatment selection must be based on multiple, and often interdependent, factors. It is therefore crucial that the agency identify and prioritize the parameters that will be used to come to a final treatment decision.

Data Measurement and Collection

For agencies to make proper treatment selection decisions, all of the parameters of those decisions must be accurately measured and evaluated. Researchers are constantly attempting to develop new, simpler, and more accurate methods of measuring these factors. In addition to evaluation of individual factors, many agencies also attempt to synthesize the pavement distress data into a general picture of pavement condition. The following will be a brief overview of the methods mentioned in the existing literature.

One of the most common techniques for pavement data collection is the utilization of a condition survey. A condition survey occurs when a maintenance team attempts to collect data on all the individual distresses a road is experiencing to form an impression of the condition of the pavement as a whole. There are a myriad of ways to conduct a condition survey, including manual, automated, high-speed lane pass, low-speed shoulder pass, and photographic.


Portable Seismic Pavement Analyzer Equipment

Usual methods of crack evaluation include visual inspection, coring, employing a falling weight deflectometer (FWD), using ground-penetrating radar (GPR), and using ultrasonic equipment. "Evaluation of Top-Down Cracks in Asphalt Pavements by Using a Self-Calibrating Ultrasonic Technique" by Khazanovich, et al. describes a study by the Colorado DOT that tested the accuracy of visual observation for determining crack depth and found that visual measurements cannot be counted on to provide correct results.

Coring is not entirely accurate either, and because coring is destructive, the common practice is to core only a sample of the cracks in a pavement segment, leaving many cracks unmeasured. FWD's are often too sensitive to irrelevant parameters to detect shallow cracks, and GPR's give results that require expertise to read, which limits their usage to experts. Khazanovich, et al. recommend using ultrasonic equipment with a dry point contact (DPC) transducer, based on the results of an MnROAD research study.


Temperature measurements for Falling Weight Deflectometer

As Baladi, et al. explain in "Pavement Condition Index—Remaining Service Life," roughness is usually measured using a response-type measuring system or a profilometer. Typically, roughness will be expressed in mm/km, in/mile, counts/unit length, and so on. Road roughness indicates ride quality and the tangible benefits that road users gain from preservation efforts. Therefore, roughness measurements are often used to evaluate the general condition of a road. The International Roughness Index (IRI) developed in 1982 provides a common quantitative basis for the comparison and calibration of roughness measurement results and is used extensively by road agencies.

Ground Penetrating Radar Equipment

Once individual pavement distresses are evaluated, many agencies choose to combine the distresses into one or several parameters. The terms "distress index" and "condition index" are often used. An example of a condition index is the pavement condition index, or PCI. PCI, as described in Hajek and Phang's "Prioritization and Optimization of Pavement Preservation Treatments," is based on a 0 to 100 scale and utilizes measurements of ride quality and the severity of 15 different pavement surface distresses. There are dozens of other condition indices commonly used, as these indices simplify the pavement distress data and put it in quantitative terms. Much of the literature warns that condition indices can introduce problems, however, such as those caused by a lack of consideration for the rate of deterioration of the pavement that is inherent in many of these indices.

According to Balmer, et al. in "Pavement Friction Measurements and Vehicle Control Reparations for Nontangent Road Sections," a common way of measuring friction is with a small trailer-like device that can be towed with a pickup truck called a Mu-meter. Balmer et al.'s research found that Mu-meters are not effective at evaluating friction on a curve; however, the authors suggest using a two-wheeled trailer that has been specially instrumented to measure both the dynamic vertical test-wheel load and the longitudinal drag wheel force instead.

The remaining service life, or RSL, is often used when selecting a PP treatment. In "Expert Project Recommendation Procedure for Arizona Department of Transportation's Pavement Management System," Flintsch and Zaniewski define RSL as an estimate of the number of years left before an existing pavement will need a preservation treatment, or the minimum number of years when either cracking or roughness reaches the threshold value. Calculation of the RSL is achieved using a performance prediction equation and a trigger point for each condition indicator. The literature describes RSL as a very important tool for determining the proper time to place a PP treatment.

The cost-effectiveness of the available treatments is often of critical concern to agencies. According to Hicks, et al. in "Selecting a Preventive Maintenance Treatment for Flexible Pavements," the first step in determining cost-effectiveness is identifying the expected life of the treatment in years and finding local cost data. Then, the equivalent annual cost (EAC) can be found from dividing the unit cost by the number of years the treatment is expected to last. EAC is a very simple method of determining cost-effectiveness, and many others exist that include other figures into the cost estimate. For instance, Tarte, in the 2006 International Asphalt Conference presentation "Investment Decisions for Road Pavement Projects and Networks," insists that the user costs, which include vehicle running costs, cost of time spent during travel, costs incurred due to accidents, and cost of other personal factors, like driver comfort and convenience, be included in all calculations of cost-effectiveness.

Traffic volume is most commonly measured using the Annual Average Daily Traffic (AADT) and Average Daily Traffic (ADT) counts. Garber and Hoel describe AADT as an average of 24-hour counts taken continuously throughout the year and ADT as an average of 24-hour counts taken on multiple days, but not totaling a year, in their book, *Traffic and Highway Engineering*. Both AADT and ADT require traffic to be counted, which can be done automatically or manually. Manual traffic counting must be done by a person with a counting device, such as a manual electronic counter. Automatic counting usually uses surface detectors, like pneumatic tubes or subsurface detectors, which are usually either electric or magnetic contact devices.

Traffic composition is most often measured by the Annual Average Daily Truck Traffic (AADTT). As Huang's *Pavement Analysis and Design* explains, AADTT can be represented as a percentage of the ADT or as a regular value. If no information on AADTT exists, it can be estimated based on the class of the roadway in question.

Along with current road conditions, Jahren, et al. recommend collecting historical pavement data in "Quantitative Guidelines for Use of Thin Maintenance Surfaces." This data can be found by examining records stored in the agency's database with information on a pavement's historical background, relevant design features, past problems, etc. The resident maintenance engineer should be consulted, as well, to ensure that any seasonal or past problems affecting a pavement segment are taken into consideration, as these issues may not be readily apparent when evaluating the pavement condition.

Data Analysis and Treatment Selection

Deciding which factors to consider in treatment selection and collecting data on these factors are only the first steps in choosing a proper pavement preservation treatment. All the data gathered about a pavement must then be translated into an appropriate treatment option, which may be the most difficult step of the selection process. At this point, agencies usually have a number of considerations to factor into their decision, and seeing the best treatment just from looking at the collected data can be nearly impossible. Therefore, a system to organize the information, identify the key problems, and suggest workable solutions is usually adopted.

In an attempt to minimize the complexity of this process, agencies often adopt methodologies that preclude the need to make challenging project decisions. They often depend on regularly scheduled maintenance, or "worst first" reconstruction projects. But these practices do not qualify as pavement preservation systems. Regularly scheduled maintenance activities may preserve pavements, but they can be costly and inefficient. Obviously some pavements will need treatments more or less frequently than others, and maintenance schedules are not designed to address unforeseen problems. Atypical environmental conditions, poor construction practices, or sudden changes in traffic volume cannot be accounted for when treatments are placed according to a set schedule.

Fixing the worst roads first is antithetical to pavement preservation, which requires treating roads in good condition to halt deterioration. If a PMS focuses only on poor roads, the system is not a pavement preservation program by definition; "worst first" practices are the mark of pavement reconstruction programs. What pavement preservation offers is the chance to extend the life of existing roads; a much more challenging, but also more cost-effective alternative. Instead of letting roads degrade until they are in need of repair, a pavement management system provides an agency with the means to keep their roads in working condition longer.

The best preservation programs follow cause-based strategies. A cause-based strategy focuses on fixing or eliminating the cause of pavement problems. Instead of treating the symptoms of a pavement in serious distress, this strategy seeks to root out the source of current or future distress. A cause-triggered strategy obviously requires more data collection and more analysis to achieve than a schedule-based or "worst-first" strategy. Cause-based systems allow agencies to end the sources of distress, thereby effectively preserving the pavement in question.

Forming an effective framework is fundamental to a program's success, as appropriate treatment selection for each project is absolutely imperative. A database is a tool that can be used to organize all pavement-related information and clearly defined decision criteria. Having such a framework will help agencies to identify a range of possible treatments. But in order to choose the best, most cost-effective treatment, the agency must also develop analysis procedures. Analysis procedures should compare each possible treatment, using cost-effectiveness and any other important criterion that could affect the success of the selection in a decision matrix. Agencies must also have clearly detailed implementation procedures. There are many decisions to be made, such as the selection of a contractor, whether or not to use a warranty, and which inspection procedures to use during construction. Quality control and quality assurance procedures must be chosen as well. Every step of a pavement preservation program should be organized and systematic. A standard procedure for each aspect of treatment selection will ensure high quality throughout.

Finally, agencies should attempt to analyze the effectiveness of their selection systems. Program assessment can be achieved through the inclusion of a feedback mechanism, which will allow agencies to quickly identify and correct any problems. Road agencies must be able to understand if the PMS in place is meeting its specified goals; otherwise, the current strategy must either be modified or replaced.

An effective pavement management system should not be considered infallible, however, as every system has its limitations. A PMS will rarely produce a choice that is clearly superior, but it will allow for the implications of certain decisions to be understood. Furthermore, the results of a PMS do not retain their validity after a certain period of time. The results will no longer be accurate if they are not acted upon swiftly. Therefore, a PMS should be viewed as a decision support tool, and not as the final word on pavement decisions. Some sources even recommend using an alternative to a PMS, such as a Level-of-Service (LOS) program. An LOS assesses a variety of different assets and measures several types of parameters, whereas a PMS focuses mainly on the condition of pavement assets. Agencies must decide on their own which type of system works best for them and then remain alert to any problems or limitations involved with their system.

Summary

Although proper pavement maintenance treatments are oftentimes challenging to select, a well-developed pavement management system can alleviate many of the difficulties involved. A good PMS must have clearly defined goals, identify which factors are important considerations for a project, determine the relative importance of each of these factors, describe how to obtain the necessary data, and then provide the proper tools and methods for the ultimate selection of a treatment. Agencies may be tempted to avoid the complicated process of developing a PMS, but the success of their pavement preservation programs depends upon their doing so. Pavement preservation requires an accuracy of selection and timing that cannot be achieved through arbitrary decisions. Preservation programs must rely on objective methods and systematic approaches to treatment selection, not on past experience, anecdotal information, or even expert opinion. An effective PMS produces precise treatment selections and makes for a successful pavement preservation program overall.