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TxDOT
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Our Mission

The mission of 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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Issue Highlights

The 2007 Pavement Preservation Seminar

The 2007 Pavement Preservation Seminar was held Monday and Tuesday, October 8-9 at the Austin Convention Center in conjunction with the 24th Annual Association of General Contractors of Texas Trade and Equipment Show. The seminar was a great success, and the Texas Pavement Preservation Center would like to thank all those who participated in this effort to share knowledge and advance the field of pavement preservation. Special gratitude goes out to the sponsors of the event, namely the Asphalt Emulsion Manufacturers Association (AEMA), the Associated General Contractors of Texas (AGCTX), The Foundation for Pavement Preservation (FP2), the Texas Pavement Preservation Center (TPPC), and the University of Texas Center for Lifelong Engineering Education (CLEE). To further the educational benefits of the seminar, all of the presentations described in this issue are available in video form on our website at www.utexas.edu/research/tppc/conf.

Mark Your Calendar: TRB 87th Annual Meeting

The Transportation Research Board (TRB) held its 87th Annual Meeting January 13-17, 2008 in Washington, D.C. The TRB Annual Meeting program consisted of over 3,000 presentations in 600 sessions and attracted over 10,000 transportation professionals from around the world. All attendees received the TRB Annual Meeting Compendium of Papers DVD, which contains more than 1,800 technical papers. For more information, please visit the TRB website at www.trb.org/meeting.

Pavement Preservation Journal

The first issue of the Foundation for Pavement Preservation's Pavement Preservation Journal was published in August 2007. The quarterly publication includes case study papers describing experiences of industry personnel, contractors, and academic researchers and technical papers, consisting of new research developments. For more information, please visit the Foundation for Pavement Preservation's website at www.fp2.org.

The following reports on the presentations made at the 2007 Pavement Preservation Seminar. Some of the statements are opinions of the contributors and not necessarily those of the TPPC or TxDOT.

Chip Seals presented by Bill O'Leary

Bill O'Leary's presentation on chip sealing was full of practical information about this common surface treatment. O'Leary discussed many aspects of chip sealing, including the benefits of chip seals, road conditions that can and cannot be treated by chip seals, factors that affect the quality of the treatment, necessary pavement preparation prior to application, materials, application methods, and reasons chip seals often fail.

O'Leary indicated that chip seals are useful for many reasons. They extend pavement life, seal the road against air and water intrusion, improve skid resistance, delineate the main road and the shoulder, and can also be used as an interlayer to enhance the bond between an overlay and the existing pavement. However, chip seals cannot increase the strength of a pavement nor fix one that has failed. Therefore, chip seals should only be placed on roads with minimal structural distress. The condition of the existing roadway is a main factor affecting the quality of the treatment.

When placing a chip seal, important considerations include the condition of the current roadway, which materials to use, whether to place a fog seal over the chip seal, the knowledge and expertise of the inspectors and supervisors, and the rate of application. Such decisions should be made carefully, as treatment failure can occur for a variety of reasons: too little binder, too much aggregate, poor traffic control, weather, or too stiff binder. Bill O'Leary's presentation would certainly assist anyone trying to lay a successful chip seal surface treatment.

Chip Sealing over Fabric in Borrego Springs presented by Lita Davis

In the northeast corner of San Diego County lies Borrego Springs, CA. With a desert climate in the lower 500 feet of elevation, pavements here are particularly prone to cracking. In the evening, the temperature drops to about 30°F, but during the day the desert sun beats down on the roadways of Borrego Springs. This frequent change in temperature causes expansion and contraction, making oxidation and cracking extremely common. The labor required to seal all the cracks in a typical road segment was far too expensive, and in 1987, the local highway agency decided to test six different products on one roadway to see if the cracking problem could be alleviated. One of the products tested was a chip seal over fabric. The chip seal over fabric test segment has not required crack sealing since 1987.

The effectiveness of this treatment has contributed significantly to its relatively low annual cost. In a 30 year lifetime cost analysis based on 396,217 square meters or 465,460 square yards, chip seal over fabric treatments were found to cost less than both a crack seal with a conventional chip seal and a rubberized chip seal. The crack sealing with a conventional chip seal was found to cost $239,939 annually, the rubberized chip seal costs $166,886 per year, and the chip seal over fabric should cost only $107,137 a year. Although chip sealing over fabric is initially more expensive than the other two treatments, the long-term savings can make it well worth the initial cost.

Performance-Based Specifications on Chip Seal Projects presented by Lita Davis

Lita Davis began by outlining three points she hoped to help the audience understand: being "in spec" does not guarantee a good chip seal, the difference between method and performance-based specifications, and how the roles of both the agency and the contractor change with performance-based specifications. To this end, Davis discussed common problems that agencies and contractors have when they do not use performance-based specifications. Often, an agency will expect the contractor to make repairs if any problems develop in the treatment. However, contractors usually refuse because the agency was in control of nearly all aspects of the construction of the chip seal, not the contractor. Agencies must learn to either relinquish control or take full responsibility when a treatment is unsuccessful.

Many agencies currently use method specifications (also called prescriptive specifications) when drawing up a work contract. Method specifications entail that the

agency specifies the requirements for materials, dimensions, tolerances, work force, and construction methodology. Method specifications may or may not require a guarantee for the quality of the work from the contractor. Even if a guarantee is required, it will usually only cover faulty materials and/or faulty workmanship and not the performance of the end product.

A performance specification, which is an umbrella term that can describe either performance-based specifications or warranties, actually defines the performance characteristics of the finished product before construction begins. Performance is usually linked to materials, construction equipment and methodology, and any other factor that lies within the contractor's control.

Davis describes switching from method- to performance-based specifications as a "win-win" situation for the agency and contractor. In a construction situation, the wants of the agency include a good chip seal and the ability to hold the contractor responsible for the performance of the treatment. The contractor's goals are to have control over the materials ordered and the construction operations and to be responsible for the end product. Therefore, performance-based specs appeal to both parties.

Selection and Characterization of HMA Mixes for Thin Asphalt Overlays: A Theoretical Analysis presented by Lubinda F. Walubita, PhD

Dr. Lubinda Walubita's presentation on thin asphalt overlays shed light on many aspects of overlay mix and design, and described the treatment in general, including its main uses, advantages, and disadvantages. Thin HMA overlays are known to be excellent non-structural overlays that are commonly used for preventive maintenance, pavement preservation, and minor rehabilitation projects. They can be used to treat minor surface damage, such as raveling or bleeding, but only on structurally sound pavement. When used correctly, thin HMA overlays can enhance the appearance of a roadway, improve its functional characteristics, improve impermeability characteristics, and enhance pavement performance.

Using a thin HMA overlay is a cost-effective method of preserving and maintaining existing pavements, although overlays have disadvantages as well. According to Walubita, the main problem with thin HMA overlays lies in the limited scope of specifications and standards for the treatment. Most often, these specs and standards are agency-specific or proprietary in nature. Because of this, there are almost no widely accepted thin HMA overlay specifications for general applications or to use as reference guidelines. The present study was geared toward reviewing the general criteria for the selection and design of thin HMA overlay mixes and documenting the material characterization and mix design procedures in order to achieve satisfactory in-service performance.

The methodology used in this study began with an examination of the preferred materials used in thin HMA overlays. The most popular binders in the United States are PG 76-22 (SBS), which are polymer modified binders. Stiff binders are usually desired because they are less sensitive to temperature, rutting, and oxidative aging. Aggregates should be high quality gap-graded fine aggregates with good skid resistance characteristics, low soundness values, and durability. Other additives involved in thin HMA overlays are lime and silicon dioxide for extra skid resistance.

The proprietary mixes for thin HMA overlays commonly used today include Marshall, Superpave, Novachip, PAVEtex, and balanced mix-design. This presentation suggests a new balanced mix-design approach that has shown promising results but still requires field validation. Even with improved mix design, the satisfactory performance of a thin HMA overlay is not ensured. These treatments depend on good construction practices just as much as on the materials used. The condition of the existing road is also vital to the success of the treatment. A thin HMA overlay is sure to fail if placed on a pavement with serious structural distress or if placed improperly during construction, regardless of the quality of the materials and design employed.

Binder Selection presented by Darlene Goehl, P.E.

Binder selection is critical when planning a microsurfacing, thin overlay, or other surface treatment project. Darlene Goehl's presentation aimed to clarify

which binder should be selected for which type of project, based on her experiences in the Bryan District in Texas. For microsurfacing, Goehl recommends using a CSS-1P binder. HMA overlays can be of two varieties: spot level-up treatment and thin overlay. A spot level-up should be designed for workability and generally uses a PG 64-22 binder. For an overlay, the design should be based on the existing pavement. PG 64-22, PG 70-22, or PG 76-22 binders are typically used for overlays.

Some criteria that should be considered when selecting a binder include the purpose of the seal being placed, the condition of the existing pavement, the time of year, the weather, and traffic levels. Typical surface treatment binders are asphalt, emulsions, and cutback. Each different type has different temperatures and seasons in which it can be placed. Further, asphalt concrete requires the aggregate to be precoated to minimize dust accumulation and improve the adhesion of the aggregate to the seal coat binder. When using an emulsion or cutback, however, the aggregate should not be coated, as the precoating inhibits the binder's chemical break, absorption, and adhesion to the rock.

When selecting a binder involves seasonal decisions, it is important to note that both cool and hot weather binders are available. Hot weather binders should be placed when the temperature is 70°F and rising, whereas cool weather binders may be applied when the air is between 40° and 70°F. If traffic interruption is a concern, some binders should be considered over others. Asphalt cement (AC) stiffens and binds the aggregate more quickly than is possible with an asphalt emulsion, and therefore will allow traffic to travel over it sooner. Rain and humidity can become problematic when an asphalt emulsion is used, as humidity can slow the curing time and rain necessitates keeping traffic off the road until it dries. Many other factors can affect the setting or breaking rate of an emulsion, such as the porosity and moisture content of the aggregate, the temperature, mechanical forces, cleanliness of the aggregate, and the type and amount of emulsifying agent used.

The last criterion to consider when selecting a binder is cost. Goehl included a chart in her presentation that depicted a cost comparison between asphalt cement with precoated aggregate and emulsion with uncoated aggregate for several different levels of average daily traffic. The costs for this chart were based on the average bid prices in the Bryan District. Goehl found asphalt cement to be the more economical of the two for each traffic level studied.

Chip Seal Asphalt Binders presented by Bill O'Leary

Asphalt binders are traditionally used in three different ways: hot, which creates asphalt cement, cut-back, which is a binder diluted with solvent, and emulsified asphalt. Many different chip seal binder liquids exist today, some created with latex, others with recycled tire rubber. One consideration remains as important to the industry as ever: the price of asphalt continues to dictate which projects agencies can complete.

Asphalt price is affected by a variety of factors, such as the availability and price of crude oil, coker feedstock, and residual fuel, the market and road building budget, the weather or season, and the competition. Usually, a quick and easy way to find the price of asphalt is to multiply the crude oil price per barrel by 5.6. The solution is usually close to the price of asphalt per ton. However, this year, because the market and demand for asphalt is down, asphalt prices are almost a dollar less per ton than they should be considering the cost of crude oil. If crude oil prices continue to rise, asphalt prices are certain to catch up in the near future.

History and Future of Pavement Preservation
presented by James Sorenson, P.E.

According to James Sorenson, out of the five most developed countries in the world, the U.S. has the least amount of money going into pavement preservation. Even though funding has not reached an appropriate level, people are starting to realize that pavement preservation works more efficiently than a reactive or periodic approach. Some programs, like the TxDOT seal program, still utilize a systematic approach, though many in the industry have fully adopted the "right treatment, right road, right time" creed. Those in the business must make intelligent choices; sometimes a fog seal is enough, other times a cape seal or something long-lasting is the right fit. Choices need to be made based on the best course of action.

Pavement preservation is vital to maintaining the road system. Everyone who thinks of pavement preservation

should bear in mind the upkeep required on a house. If a house needs a coat of paint but is neglected, soon the siding may become damaged and need to be replaced. Like a house, pavement needs constant minor and relatively inexpensive upkeep to prevent more costly repairs later on.

The really appealing aspect of pavement preservation is the rate of return that can be had in comparison to new construction and rehabilitation projects. The rate of return for new construction is usually about 1.6 or 1.8 to 1 and 1.2 or 1.4 to 1 for rehabilitation projects. Pavement preservation activities, however, have a return rate somewhere in between 6 and 10 to 1. The return involved makes pavement preservation the right choice when agency budgets are constricted. Sorenson believes agencies should require a certain percentage of all roads to be covered with some type of treatment and improved in some way each year.

One obstacle for the advancement of pavement preservation has been a lack of experience. In 1997, a regulation was passed that required construction workforces to be properly trained and qualified. Since then, 43 states and five geographic regions have composed organizations to create PP-related training courses. There are, however, only a few centers based on pavement preservation, including the Texas Pavement Preservation Center. To supplement this are sources online from which people involved in the industry can receive certification. The National Center for Pavement Preservation has several online training courses, for example, at www.pavementpreservation.org.

Aggregate Issues presented by Caroline Hererra, P.E. and Pat Wootton

Caroline Hererra's presentation focused on aggregate as it pertains to seal coats. Hererra finds seal coats to be a great preservation strategy, as they improve surface friction, provide a moisture barrier, extend a pavement's lifespan by seven to ten years, and are relatively inexpensive. In a seal coat, the aggregate is almost totally exposed, which means that it must bear the brunt of both adverse weather conditions and traffic loading. Furthermore, this aggregate is usually only one rock thick. Thus, aggregate in seal coats must be very high in quality and carefully designed.

Good surface friction is vital to the safety of our roadways. The only way to ensure proper skid resistance is through an effective aggregate design that takes both micro and macro texture into consideration. Macro texture depends on the voids between the aggregate stones and the way the stones fit together. Macro texture is responsible for keeping water off the surface of the road. Micro texture is the texture of the individual stones themselves. An obstacle to achieving good micro texture is the relatively low durability of stones with high amounts of micro texture; smooth, dense stones are generally more durable.

Herrera's presentation then moved to the classification of aggregate by quality. In 1999, the WWARP classified aggregate frictional properties into three different categories: SAC A, B, or C. The boundaries for each category were based on existing skid data. This method was somewhat problematic, however, as prior to 1999, skid testing was not required. Therefore, there was little data to work with. From 1999 to 2006, skid data has been collected on 50% of the interstate every other year. This real-life performance data is then used to judge the effectiveness of the classification system.

Currently, agencies are looking for new ways to measure and test aggregate properties. Some of the latest developments include the aggregate imaging system, aggregate crushing value (ACV), and aggregate impact value (AIV). Tests like the Micro-Deval can also measure the friction, toughness, durability, and abrasion resistance of aggregate. Through empirical testing, agencies can know with certainty the quality of the aggregate they are receiving and the performance that can be expected from every classification of aggregate.

Next, Pat Wootton of Vulcan Construction Materials took the lectern to discuss aggregate issues from a producer's point of view. In response to an attendee's question, Wootton explained the relationship that his company has to recycled concrete and base material. He said that in Houston, these materials are being used extensively. Although his company would rather sell virgin aggregate, recycled material creates a profit, too. Therefore, the company sells a lot of both kinds of aggregate.

Wootton was then asked if his company is doing anything to keep aggregate costs low. He answered in the affirmative: the company is putting load capacity monitors on belts and installing automatic shut-offs to ensure proper flow during materials production. Hopefully, this will decrease costs in the future.

Finally, Wootton explained the material testing that takes place at aggregate production companies. Currently, work is being done to develop sturdier, less sensitive testing devices that can be used in quarries to study stone texture and other properties. At this point, TxDOT does not require producers to use any particular type of test, but that may change in the future. TxDOT has, however, put out a soils and base testing certification program, which may improve testing practices.

Microsurfacing and Slurry Seals presented by Paul Montgomery, P.E., Barry Dunn, and Pierre Peltier

The panel on microsurfacing and slurry seals began with Paul Montgomery's discussion of the general uses and guidelines for microsurfacing treatments. Microsurfacing can effectively fill ruts up to 1 inch, improve skid values, cover flushed or bleeding pavement, improve wet-weather characteristics, and reduce noise. It cannot add structure to a road, fill deep ruts, stop reflective cracking, or repair a bad ride. Microsurfacing should only be used on roads with good structural characteristics. To test for this, a Falling Weight Deflectometer can be used; the result should be less than 30 mils or microsurfacing should not be considered. Furthermore, the existing highway should have a good seal prior to application.

Microsurfacing should only be applied when the temperature is 50°F and rising. The surface should be clean and free of excessive scratches, marks, and tears but should still have some macro texture for friction. Microsurfacing costs about twice as much as a seal coat and about half as much as a thin overlay. An average treatment will last five years, but if sealed again, could further extend pavement life by six or seven years. Overall, microsurfacing is very effective when used for the proper application on a road with a sound base structure.

Barry Dunn then took the stage to talk about microsurfacing and slurry seal treatments as preventive maintenance treatments. He believes that agencies often base treatment selection solely on the cost and performance life of a specific product or material, which oversimplifies the problem. One main consideration should always be the condition of the existing pavement. A study found that treatments applied to pavements in good condition have good results, and vise versa. At some point, roadway deterioration accelerates: the condition moves from good to poor and then quickly becomes worse. Tests indicate that visible pavement distress lags behind the condition of the binder in the mix. Once damage becomes visible, the optimal time to perform preventive maintenance has probably already passed.

Microsurfacing and slurry seals are truly preventive maintenance treatments. Therefore, these treatments should be placed before any distress is visible. Early application will seal the mix, maximize binder life, and extend pavement service life. Microsurfacing and slurry seals are especially effective at preventing weathering and oxidation.

Pierre Peltier then took the microphone to discuss quality control of microsurfacing treatments. According to Peltier, the development of clear specifications can greatly improve the quality of a microsurfacing treatment. Agencies have certain expectations going into such a project, like good skid resistance, filled-in voids, and the ability to allow traffic on the road within one hour after treatment. Therefore, it is vital to the success of the project that the agency develop specifications thoroughly enough for the contractor to know what is expected.

Mix design is another major factor affecting quality. The types of materials used should be those specified and selected for the project, and materials testing should be performed on a regular basis, also according to specification. Next, the field inspector and crew must be capable and knowledgeable in their respective areas. Good communication between everyone working on the same project is crucial. The existing pavement condition is also highly important. Finally, a properly prepared surface can increase the quality of a job significantly.

Surface treatments fail due to material incompatibility, improper preparation, improper control of materials during application, poor traffic control, improper road selection, and poor timing. Quality control means avoiding these things and motivating workers to produce the best product possible.

After the presentations, a question and answer session between the audience and the panel began. One audience member asked if micosurfacing is an effective treatment for oxidized and polished pavement. In response, the panel said that it depends upon the existing surface. The surface should be swept clean, and then sometimes a tack coat or fog seal should be laid before a microsurfacing is placed in order to give a really dry pavement some asphalt before the treatment.

For heavily cracked roadways, one solution suggested by the panel was pouring sand into the cracks, then sealing them, and finally sealing the whole pavement with a microsufacing treatment. In many northern states, wide cracks develop due to climatic conditions. These states use special slurry seal/microsurfacing

boxes to fill the large cracks or dips in the road. Although large cracks will still return after treatment, they will be more manageable. Another point made about cracking is that while cold mix can be laid on a fresh crack seal job right away, a month's worth of traffic should be permitted before a hot seal goes down over the crack sealing. Thermal cracking will cause cracks to reflect, so a chip seal should be placed first, due to its flexible nature. Then, a microsurfacing treatment can be placed over the chip seal. An audience member was curious as to whether or not scrub seals are effective against thermal cracking. Barry Dunn replied that he would be afraid that skid resistance would be compromised by that treatment.

Seal Coats presented by Darwin Lankford, P.E. and Bill O'Leary

Darwin Lankford hails from the rural Childress District in Texas. In his district, the road agency places seal coats on an average of 300 miles of roadway a year, in order to maintain the yearly cycle of sealing. Every September, the agency buys materials for seal coats for the following summer. This district primarily uses AC 15-5TR and tests every load of asphalt to ensure quality.

Still, even though the agency has a well-planned sealing strategy, seal coats usually fail on about 28% of low volume roads and 37% of high volume roads. Penetration accounts for about 75% of all treatment failures. Chip loss wastes tax money, damages windshields, and forces agencies to spend valuable maintenance money stabilizing shelling roads. To help avoid treatment failure, agencies must be firm about testing their materials regularly, visiting with their suppliers, and sending their suppliers the materials test results.

Bill O'Leary then took over to discuss chip seals and binders for seal coats and expand upon Lankford's thoughts on quality control. First, O'Leary explained the logic behind typical binder nomenclature. The name of a binder holds much information, such as whether an emulsion is cationic, anionic, or nonionic and the speed at which the emulsion sets.

O'Leary then informed the audience about a proposal written by the state to enact an assurance quality control program for asphalt binders. The proposal pushes for the grading of suppliers on a scale of 1 to 4. If passed, every asphalt supplier will be required to have a certified testing lab or access to an independent lab in order to receive a high grading score. To receive a high score, a supplier would have to produce no failed materials and have consistent test results. Because the score will affect the company financially, it will be very important to suppliers to meet these qualifications, which could improve material quality dramatically. O'Leary thinks this proposal is a move in the right direction and applauds the state for its vision.

After these two presentations, the floor was open for questions. One audience member was curious if the contractors in Lankford's district still receive payment when there is such a high rate of treatment failure there. Lankford explained that they do, and that the failure is probably due to a flaw in the agency's specifications.

Lankford was then asked if chip seals are planned for the roads in his district or if they are placed based on visual data. He replied that sealing is done primarily due to the results of visual inspection. Every year, a member of maintenance personnel drives all the roads that will potentially receive a seal coat to make sure that the treatment will be appropriate. The district has a schedule for seal coats but also tries to inspect the roads as much as possible.

An attendee asked Lankford if his district has found any treatments that succeed in preventing chip loss. His response was that they have not found anything that is really effective, though they mainly use fog seals at this point. Then an audience member suggested that Lankford's district try to retain the rock in their seal coats by requiring their contractors to fog seal or repair any roads that have chip loss. Another member of the audience stepped forward to say that his contractors have improved significantly over the past few years because he has begun personally inspecting their work. From attending seminars like this year's Pavement Preservation Seminar, he knows what to look for in his contractors' work. Education and the dissemination of knowledge about best practices are the most effective means of improving pavement preservation practices.

Life Cycle Cost Comparison of Strip Sealing and the Ultra-High Pressure Watercutting Technique for Restoring Skid Resistance on Low-Volume Roads written by Douglas D. Gransberg, P.E., CCE and Bryan Pidwerbesky, PhD, presented by Bill O'Leary

The traditional treatment for roads with excessive asphalt in New Zealand involves igniting the pavement and burning off the excess binder. A new method has been developed, however, that may prove to be far more effective. The ultra-high pressure watercutter

works like a rinse and vacuum tool. The water leaves the device with 30,000 psi.

Though the water hits the pavement with enormous pressure, the machine uses a relatively low volume of water. The water removes excess asphalt and leaves the rock; the machine then vacuums up the water and the asphalt. After the process is finished, the watercutter is filled with about 95% asphalt and 5% water, which means that an insignificant amount of aggregate is pulled up.

Another interesting advantage of this machine is that it is best used in the winter. The cutter works most efficiently on cool, wet pavement. As these are the exact opposite conditions required by most treatments, the cutter can be used when the majority of other maintenance operations have halted.

Gransberg and Pidwerbesky's paper presents a very sound analysis of cost comparisons. The cutter is financially competitive with strip sealing for restoring surface texture even without including the environmental benefits associated with this method in the cost analyses. The watercutter is a more sustainable treatment than laying down new pavement, as it uses no new materials at all.

The new cutter is not being used in the United States at this point, though an American equipment manufacturer has expressed great interest in making this machine. O'Leary predicts that the cutter will be in the States very soon, probably within the next six months. He thinks watercutter retexturizing seems like a very good method, as it actually solves pavement problems rather than just covering them up.

The audience was curious as to whether or not the asphalt removed with the cutter could be recycled and reused. O'Leary said that it could be, though this is not the current practice in New Zealand. Reusing these materials could make the watercutter even more cost-effective and environmentally friendly.

Several audience members were concerned about the purchase price. O'Leary responded that the latest estimate is a couple hundred thousand dollars.

Finally, a member of the audience described seeing a demonstration of a similar tool. This tool had a very small cutting head and was used to remove striping from the pavement. He said it removed the striping very well, and that the pressure and pattern, as well as the amount of time a section of pavement is focused on, could be adjusted to control the amount of binder removed. He and all who saw the demonstration with him were very impressed. O'Leary agreed that there are similar machines to the watercutter from New Zealand being used in the United States, but the main difference is the amount of water used. The tools in the U.S. tend to use a substantial volume of water, whereas the New Zealand watercutter requires a very small amount of water to achieve similar results.

2007 Pavement Preservation Seminar Participants: (from left) Dr. Yetkin Yildirim, Darwin Lankford, Bill O'Leary, Paul Montgomery, and Barry Dunn