

ASPHALT TECHNOLOGY NEWS

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NCAT HOLDS NATIONAL TRANSPORTATION SYMPOSIUM

The National Center for Asphalt Technology (NCAT) organized a two-day National Transportation Symposium at Auburn University on November 13 and 14, 2002. The symposium featured research results, from concept to performance, from the first two-year loading cycle at the 1.7-mile NCAT Test Track—one of the most advanced and comprehensive facilities of its kind in the world.



William Walker, president of Auburn University, welcomed the delegates attending the National Transportation Symposium.

The program, which began at 1 pm on November 13, was moderated by Mike Acott, president of the National Asphalt Pavement Association. William Walker, president of Auburn University, welcomed the attendees.

The symposium was partly funded by a grant which Paul Parks, provost emeritus of Auburn University, received from Oak Ridge Laboratories. Byron Lord of the Federal Highway Administration (FHWA) presented his agency's perspective on accelerated load testing. Mack Roberts, retired Director of the Alabama Department of Transportation (ALDOT), discussed the need for a test track. The ALDOT is the primary sponsor of the NCAT Test Track.

After these preliminary presentations, the attendees went to the track by buses at 2 pm. NCAT personnel were on hand at the track demonstrating various tests which were conducted during the two-year loading cycle.

Technical sessions were held in the morning of the following day and were moderated by John Spangler, Chairman of the NCAT Board of Directors. NCAT personnel: Ray Brown, Buzz Powell, Brian Prowell, Allen Cooley, and Don Watson, made presentations on different aspects of the test track. After their presentations, representatives of three sponsor states (Larry Lockett of Alabama DOT, Gale Page of Florida DOT, and John Haddock of Purdue University representing Indiana DOT) discussed the application of test track results to

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their respective states. The symposium was adjourned at noon after summary and closing remarks from Byron Lord of the FHWA.

The technical proceedings of the symposium in form of a report, "NCAT Test Track Design, Construction, and Performance" dated *(continued on page 2)*

—National Transportation Symposium

(continued from page 1)

November 2002, is available from NCAT and can be downloaded from the NCAT website at <<http://www.ncat.us>>. A very brief summary of this report follows.

Objective

The primary objective of the test track was to provide an accelerated loading facility that could be used to rapidly test a large number of test sections simultaneously. This allows validation of laboratory tests and pavement design procedures under traffic similar to that which is observed on roadways. Based on the requirements of several sponsors several mini experiments were evaluated in the first cycle of testing. Some of the evaluations included: performance of fine-graded versus coarse-graded mixes, effect of asphalt binder grade on performance, effect of aggregate type on performance, and performance of several mixture types including Superpave, SMA, and open graded



Ray Brown, NCAT director, presented the Test Track performance data.

friction courses. Other studies included the effect of grinding transverse joints on performance, effect of traffic on friction, permeability of various HMA mixtures, densification of HMA, and the effect of pavement smoothness on fuel consumption.

Sponsors

One of the advantages of a test track is that it allows several test sections to be constructed and trafficked at one time so that a direct comparison can be made between the sections. Because of the higher cost of constructing and testing several sections simultaneously, several sponsors were needed to help finance the operation of the facility. The sponsors of the first cycle at the track included: Alabama DOT, Florida DOT, Georgia DOT, Indiana DOT, Mississippi DOT, North Carolina DOT, Oklahoma DOT, South Carolina DOT, Tennessee DOT, and the Federal Highway Administration (FHWA).

Experimental Design

An oversight committee was formed at the beginning of this study in which sponsors were encouraged to work together as much as they could so that an overall test plan for the facility could be developed. Most sponsors chose to ship in their own local aggregates while using common asphalt binders that were used for most of the test sections.

One of the primary purposes of the first cycle of tests was to determine the ability of a number of laboratory tests to predict the permanent deformation of various HMA mixtures. There was no specific design established to do this since each sponsor was allowed to use any



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E. Ray Brown, Director
Prithvi (Ken) Kandhal, Associate Director Emeritus/Editor
James S. Killian III, Associate Editor, College of Engineering

mix that they desired. However, this approach did provide a wide range of mixture types and properties and hence provided the opportunity to establish any relationship that may exist between performance and laboratory tests.

There were some sponsors that were interested in comparing fine-graded versus coarse-graded mixes. These test sections offered the opportunity to determine the effect of aggregate grading on performance.

Several aggregates were used on the track including: limestone, granite, marine limestone, gravel, and slag. Reclaimed Asphalt Pavement (RAP) was also used in a few sections. These test sections provided some opportunity to evaluate the effect of aggregate type on performance.

There were several direct comparisons of mixtures containing PG 76-22 and PG 67-22 binders while all other mix properties were held constant. This allowed a direct comparison of the performance of mixes containing the two grades of asphalt binder.

In some test sections an additional 0.5 percent asphalt cement was added to mixtures to determine the effect of extra binder. This was done for the modified as well as for the unmodified binders.

Figure 1 shows the layout of the test track and Table 1 shows the details of 26 test sections on the two

tangents. Twenty additional test sections were constructed on the curves.

Test sections consist of 2 inches (50 mm) of binder course and 2 inches (50 mm) of wearing course. All test sections are underlaid with 24 inches (610 mm) of HMA base course and 4 inches (100 mm) of permeable asphalt base. Rutting was the primary distress expected in most test sections. Because of the thick structure, fatigue cracking was not expected to be a problem.

Construction of the binder course and wearing course in each test section was completed conforming to the desired specifications. This required extensive quality control testing during construction.

Traffic

Four trucks hauled triple trailer (tractor with 3 loaded trailers as shown in Figure 2) assemblies around the track at 45 mph for 17 hours a day (six days a week) in order to apply 10,000,000 ESALs of traffic to the track within two years. The trucks were driven a total of approximately 1.6 million miles to accomplish this.

Data Collection

Trucking operations were suspended each Monday to allow NCAT personnel safe access to the surface of the

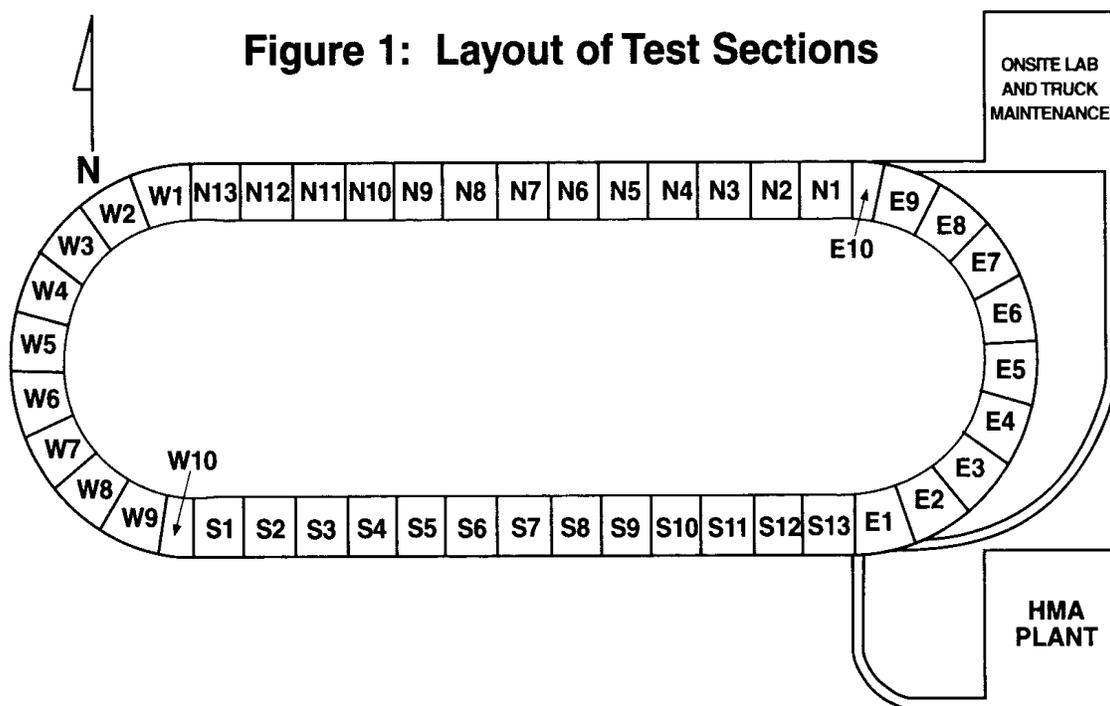


Figure 1: Layout of Test Sections



Figure 2. Traffic Application via Triple Trailer Trains.

Table 1: Details of NCAT Test Track Tangent Sections

Section	Mix Type	Aggregate Type	Binder Type*
N1	9.5 mm dense-graded ARZ	limestone/slag	SBS Modified PG 76-22
N2	9.5 mm dense-graded ARZ	limestone/slag	SBS Modified PG 76-22+
N3	9.5 mm dense-graded ARZ	limestone/slag	PG 67-22+
N4	9.5 mm dense-graded ARZ	limestone/slag	PG 67-22
N5	12.5 mm dense-graded BRZ	limestone/slag	PG 67-22+
N6	12.5 mm dense-graded BRZ	limestone/slag	PG 67-22
N7	12.5 mm dense-graded BRZ	limestone/slag	SBR Modified PG 76-22+
N8	12.5 mm dense-graded BRZ	limestone/slag	SBR Modified PG 76-22
N9	12.5 mm dense-graded BRZ	limestone/slag	SBS Modified PG 76-22
N10	12.5 mm dense-graded BRZ	limestone/slag	SBS Modified PG 76-22+
N11	12.5 mm dense-graded	granite	SBS Modified PG 76-22
N12	Stone matrix asphalt	granite	SBS Modified PG 76-22
N13	Stone matrix asphalt	gravel	SBS Modified PG 76-22
S1	12.5 mm dense-graded	granite (high LA)	SBS Modified PG 76-22
S2	9.5 mm dense-graded	chert gravel	SBS Modified PG 76-22
S3	9.5 mm dense-graded	limestone/gravel	SBS Modified PG 76-22
S4	12.5 mm dense-graded	quartz gravel	SBS Modified PG 76-22
S5	12.5 mm dense-graded	limestone	SBS Modified PG 76-22
S6	12.5 mm dense-graded ARZ	limestone/RAP	PG 67-22
S7	12.5 mm dense-graded BRZ	limestone/RAP	PG 67-22
S8	12.5 mm dense-graded	granite	SBS Modified PG 76-22
S9	12.5 mm dense-graded BRZ	granite	PG 67-22
S10	12.5 mm dense-graded ARZ	granite	PG 67-22
S11	9.5 mm dense-graded	granite	PG 67-22
S12	12.5 mm dense-graded (Hveem design)	limestone	PG 70-28
S13	12.5 mm dense-graded ARZ	granite	PG 70-28

* Plus sign designates approx. 0.5% higher asphalt content than the optimum.

ARZ = above restricted zone gradation.

BRZ = below restricted zone gradation.



Delegates at the Symposium boarding buses for inspecting the Test Track.

track to conduct pavement management studies. Field performance was documented weekly in the form of transverse and longitudinal profiles, surface texture measurements, and nondestructive density testing. Deflection testing and skid testing were conducted monthly, and cores were cut every quarter to generate correlations for nondestructive testing and to facilitate densification analyses.

Findings

At the time this report was written approximately 9.4 million ESALs had been applied to the track. The remaining traffic was planned to be applied in November and December 2002. Since the weather is cooler during these two months no measurable additional rutting was anticipated.

The primary purpose of this report is to document the observations during the first cycle of the track. A more rigorous statistical analysis of the data and a more complete presentation of the data will be done in the final reports under preparation.

There were a total of 46 test sections constructed using various aggregates, grades of asphalt binder, and various mixture types. Some mixtures were designed with marginal aggregates and some mixtures were designed with 0.5 percent additional asphalt binder. Several mixture types were used including fine and coarse graded Superpave, stone matrix asphalt, open-graded friction courses, as well as some variations of these mixtures. After over 9 million ESALs had been applied, the most

amazing thing about this entire study was that very little rutting had occurred in any of the test sections. The track was designed to be sufficiently strong so that fatigue cracking would not occur resulting in rutting as the expected form of distress. The average rutting at the track was approximately 0.12 inches after approximately 9 million ESALs. Rutting is typically not considered to be a problem until the magnitude reaches approximately 0.5 inches so the rutting observed at the track was minimal. The two test sections with the most rutting (approximately 0.25 inches) were sections that did not use a modified asphalt and in which an additional 0.5 percent asphalt binder was added.

Besides the preceding general comments concerning rutting, a number of other observations have been made based on testing and performance evaluation. Some of these observations are as follows:

- Use of moisture and temperature gauges was very successful. Over 80 percent of the gauges provided accurate results after 9 million ESALs.
- Automatic belt sampling and mix sampling devices used during construction provided rapid, safe, representative samples.
- Over a two-year period, the highest average 7-day maximum temperature was 61.4°C (142.6°F) at 20mm below the surface. This compares well with the expected temperature calculated using the Superpave procedures.
- The amount of rutting in the test sections was negligible. The measurable rutting that was seen occurred in three stages. The first stage was the initial



Symposium delegates inspecting the test sections closely.

seating and compaction of the mix. The second and third stages occurred during the two summers. Rutting essentially stopped when the 7-day average maximum air temperature was below 28°C. Rutting in the second summer (2002) was measurably less than that for the first summer (2001) even though the temperature was higher in 2002.

- The highest surface temperature typically occurred at approximately 2:30 pm and the highest temperature at 10 inches below the surface typically occurred at approximately 10 pm showing a significant delay in heat transfer to the underlying layers.
- Under traffic, the mixes using PG-67 asphalt binder densified more than the mixes using PG-76 asphalt binder. The binder layer for the mix with PG-67 densified more than the surface mix with PG-76. This may indicate that a little more binder can be used in the higher PG grade mixes to improve durability.
- The amount of rutting calculated based on densification actually exceeded the actual measured rutting. This supports the fact that most of the test sections had very stable mixtures and the small amount of rutting that was measured was probably related primarily to densification.
- The track roughness as quantified by the International Roughness Index increased slightly during two years of traffic. The IRI began in the mid 60s inches/mile



NCAT engineers (L to R): Don Watson, Allen Cooley Jr., Brian Prowell, Ray Brown, and Buzz Powell discussed different aspects of the Test Track.

- and ended in the mid 70s inches/mile after two years.
- The subgrade moisture quickly increased from about 10 percent during construction to about 25 percent after being covered. The moisture stayed relatively constant at about 25 percent in all of the sections for the two-year period.
- The amount of rutting was about 60 percent less in the sections with PG-76 than in sections with PG-67.
- The performance of the coarse-graded and fine-graded mixes was approximately equal from a rutting point of view.
- Adding an additional 0.5 percent asphalt binder increased the rutting in the PG-67 mixes by approximately 50 percent but had negligible effect on PG-76 mixes. Hence, it may be possible to design mixes, with higher PG grades, at slightly higher asphalt contents to improve durability.
- The dynamic modulus test did not appear to be related to rutting. The confined repeated load test and the wheel tracking test did show some trend.
- In general, all mixes performed well for two years. The mixes that had the higher rutting levels were mixes that had been designed to be susceptible to rutting. Even these mixes, that were designed to rut, had no significant rutting.
- Traffic will continue on many of the sections for another two years so that additional information can be obtained to identify mixes that provide better performance and to determine laboratory tests that correctly quantify the performance.



Some speakers and moderators of the Symposium (L to R): Byron Lord, John Spangler, Larry Lockett, and Ray Brown.

PUTTING RESEARCH INTO PRACTICE

The following papers were presented at the annual meeting of the Transportation Research Board held in Washington, DC in January. We are reporting observations and conclusions from them which may be of value to field engineers. These comments are obtained mostly from research projects with a limited scope; before application to practice we recommend that you read the entire paper to determine its limitations. Titles of the papers are given, with names of authors in parentheses, followed by a brief summary.

1. EFFECTIVENESS OF LIME IN HOT MIX ASPHALT PAVEMENTS (Sebaaly, Hitti, and Weitzel)

The Nevada Department of Transportation (NDOT) has been using lime in HMA mixtures since the mid 1980s. The objective of this research was to quantify the improvements in pavement performance that have been realized through the addition of lime to HMA mixtures.

Two evaluations were conducted: laboratory and field. In the laboratory evaluation, lime-treated and untreated pavement sections were sampled and their properties were evaluated using laboratory tests. In the field evaluation, pavement performance data from the pavement management system (PMS) were used to compare the field performance of lime-treated and untreated sections. The overall program evaluated samples from eight field projects and analyzed PMS data for eight in-service projects.

Based on the analysis of the laboratory data and field performance of untreated and lime-treated pavements, the following conclusions were drawn:

- The properties of untreated and lime-treated mixtures from field projects in the southern and northwestern parts of Nevada, using the two most common aggregate sources, indicated that lime treatment of Nevada's aggregates significantly improves the moisture sensitivity of HMA mixtures. The study showed that lime-treated HMA mixtures become significantly more resistant to multiple freeze-thaw than the untreated mixtures. Lime-treated HMA mixtures showed excellent properties in the wheel path and in the between wheel path locations which indicates that lime treatment helps HMA mixtures in

resisting the combined action of environmental and traffic stresses. The untreated mixtures experienced very severe damage when subjected to multiple freeze-thaw cycling which explains their poor performance in the northwestern part of the state (Reno area) since such conditioning simulates the environmental conditions of this part of the state. All of the lime-treated mixtures survived the damage induced by multiple freeze-thaw cycling which would indicate good long term pavement performance.

- The long term pavement performance data of the eight in-service pavements clearly showed the superior performance of the lime-treated HMA mixtures. The PSI was used as the performance indicator for the untreated and lime-treated HMA pavements. The effectiveness of lime treatment was evaluated by comparing the performance of projects constructed on the same route which provided similar environmental and traffic conditions for both untreated and lime-treated mixtures. The long term pavement performance data indicated that under similar environmental and traffic conditions, the lime-treated mixtures provided better performing pavements with less requirements for maintenance and rehabilitation activities. In summary, NDOT was able to maintain a better average PSI on pavement sections built with lime-treated mixtures with less maintenance activities than for untreated HMA mixtures.
- The analysis of the impact of lime on pavement life indicated that lime treatment extends the performance life of HMA pavements by an average of three years. This represents an average increase of 38 percent in the expected pavement life. The percent increase in pavement life of 38 percent compares very favorably with the percent increase in the cost of HMA mixtures of 12 percent (\$4/ton) due to lime treatment. Therefore, NDOT's policy requiring lime treatment of HMA mixtures has been very effective based on both the performance and life cycle cost of flexible pavements in the state of Nevada.



IN MEMORIAM

John Spangler, who was chairman of the NCAT Board of Directors, passed away January 24, 2003, in Scottsdale, Arizona, after a long illness. Mr. Spangler was Chairman of the Board for Milestone Contractors LP. He also served as chairman of the National Asphalt Pavement Association in 1999. Mr. Spangler was a leader, a visionary, and a big supporter of NCAT.

2. AN UPDATED REVIEW OF SMA AND SUPERPAVE PROJECTS (Watson)

Stone Matrix Asphalt (SMA) and Superpave have represented relatively new mix design technologies in the US. Therefore, a condition survey was conducted of mixes that had been in service for several years in order to evaluate long-term performance of SMA and Superpave projects. This is a follow-up study to a 1995 review of SMA projects and a 1998 review of Superpave projects.

The purpose of this follow-up survey conducted in September 2001 was not to compare SMA to Superpave but to reevaluate the pavements after they had been in service for several additional years so that long-term performance of these mixtures could be evaluated. A total of 11 SMA projects and 18 Superpave projects located in five states were visited during this review.

Several of the SMA and Superpave projects that were reviewed are still in good to excellent condition after several years of service. For example, some SMA projects placed as early as 1992 are still in excellent condition with no rutting or cracking. Likewise, some of the earlier Superpave projects placed in 1996 are still in excellent condition. The following conclusions were drawn from the follow-up study:

- Both SMA and Superpave mixtures have been shown to be rut-resistant even when placed on high traffic volume facilities.
- Much of the observed cracking, especially load-related cracking, appeared to be more related to problems other than mix design or material properties (such as underestimating traffic volumes, or using less than the normal 20-year pavement design life) of the surface courses.

- Premature distress on some of the projects in this study was a result of end-of-load segregation and not necessarily a mix design problem.
- SMA mixtures can be expected to last longer than Superpave mixtures before reaching the same condition level.
- Several of the Superpave and SMA projects are still in excellent condition after being in service for 5 and 9 years, respectively.
- HMA overlays of PCC pavements performed better when at least 100 mm (4 in) of total mix was placed over the existing pavement.
- SMA mixes may significantly reduce the propagation rate of reflective cracking.

Based on observations made during this evaluation and from reports of state agencies concerning these projects, the following recommendations were made:

- A pavement design analysis based on existing layer thickness and projected traffic loading over a 20-year design life should be made of projects before scheduling maintenance overlays. The performance of even premium HMA mixtures will be less than satisfactory if there is inadequate pavement structural foundation for the project traffic loading.
- There is a need for additional research to determine a minimum overlay thickness of PCC pavement for optimal performance of SMA and Superpave mixtures.
- Consider additional research (based on Virginia experience) that would improve durability of Superpave mixes by using one gyration level lower than usual to increase asphalt content while using polymer-modified asphalt to stiffen the binder and improve rutting resistance.

3. WORKABILITY OF HOT MIX ASPHALT (Gudimettla and Cooley, Jr.)

Workability of HMA is a critical element in getting the desired density of asphalt pavements during construction. Adequate density is needed for obtaining durable and better performing pavements. Temperature as well as the constituents in the mix influence workability of HMA. Due to the increased use of modified binders and mixes with high level of filler content, both of which increase the viscosity of the binder, the workability of HMA mixes has become a more important issue and there was a need to develop equipment for measuring workability.

The workability device developed in this study consists of an iron frame above which a motor is mounted. A shaft is attached to the motor and a paddle is attached to the bottom of the shaft. The paddle is lowered into the bowl containing the mix. Instrumentation, which measures the voltage required to rotate the paddle in the mix at constant RPM, is used to convert voltage into torque units of inch-pounds. An infrared temperature sensor is used to measure the mix temperature in degrees Celsius. All of the data is obtained and recorded by an automated data acquisition system. Values of temperature and torque are measured every half-second and stored in a computer file.

Workability of different mixes was tested in the temperature range of 120 to 170°C. The device was tested with mixes with an expected range of workability. Once the device was able to distinguish different mixes based on workability it was tested with mixes with different combinations of nominal maximum aggregate size (12.5 mm and 19 mm), gradation shape (fine- and coarse-graded), aggregate type (granite, limestone, and crushed gravel) and binder type (PG 64-22, PG 70-22 and PG 76-22). The effects of each of the individual constituents and temperature on the mix workability were analyzed. The device developed was able to differentiate mix workability based on the constituents of the mix.

Next, testing was conducted on five different types of HMA mixes which were believed to have different workability characteristics. Mixes that were used in this testing phase were:

- Stone matrix asphalt having high filler content, fibers, and polymer modified asphalt binder and a very angular aggregate (granite).
- A coarse-graded Superpave mix with a polymer

modified binder and very angular aggregate (granite).

- A mixture similar to the above except using unmodified asphalt and a less angular aggregate (limestone).
- A fine-graded Superpave mix with an unmodified asphalt and crushed gravel.
- A mixture as above except using rounded gravel.

The following conclusions were drawn from the test data obtained with the workability device:

- The device was effective in measuring the workability of a large variety of mixes and was able to distinguish between different mix types.
- For every mix there is a definite relationship between temperature and torque values.
- The workability of mixes decreased as the level of modification (or PG grade) was increased.
- The workability of mixes decreased as the nominal maximum size of mixes increased.
- The device was able to differentiate the workability of mixes with aggregates having different angularities.

One of the problems with the workability device is its calibration. A standard material with known workability needs to be developed for a quick check on the device's calibration.

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4. INVESTIGATION OF THE TENDER ZONE IN THE COMPACTION OF COARSE GRADED SUPERPAVE HOT MIX ASPHALT (HMA) MIXES (Buchanan and Cooley, Jr.)

Tender hot mix asphalt (HMA) mixes have been observed and experienced by paving contractors for many years. However, during the field compaction of coarse-graded Superpave mixes, a "tender zone," is sometimes experienced. The tender zone occurs over a range of mix compaction temperatures during which the mix exhibits instability during roller action. There have been many possible causes of the tender zone presented including differences in asphalt absorption in the laboratory and during production, mix moisture, low dust to asphalt ratio, increased asphalt binder film thickness, and a temperature differential within the lift.

This study was conducted to document and evaluate field mixes exhibiting the tender zone to determine the possible cause(s) for its occurrence. Documentation included mix, production, and construction related items. Laboratory evaluation consisted of mix gradation and volumetric testing along with Superpave asphalt binder testing on the project asphalt binder before and after steam distillation. A total of five projects in Alabama, Florida, and Mississippi, which were experiencing tender zone problems were investigated.

The following observations were made during this study:

- Each paving project in which the tender zone occurred had its own set of weather, mix, and construction characteristics, making the determination of the causes for the tender zone an extremely difficult task.
- The tender zone generally occurred at approximately 110°C down to 60°C. It does not appear from the gradation, volumetric, or asphalt binder test results that any mix parameter can be singled out as directly causing the tender zone.

Based upon the observations during construction, two primary causes are provided as possible reasons for the occurrence of mix tenderness in the five projects. First, a common characteristic in four of the five projects visited (AL 157, FL I-10, FL 301, and MS 49) was very short haul times and very little mix storage time. Construction observations for these four projects indicated that each had haul times less than 15 minutes with little or no storage time. The percent absorbed binder during mix design for these four projects ranged

RESEARCH IN PROGRESS

We have discontinued the publication of this column in this newsletter because it can now be accessed on NCAT's homepage (<http://www.ncat.us>). Click on "Information" at the top of the page, then "Research in Progress." It is updated frequently based on the information received from the Departments of Transportation and other sources.

from 0.8 to 2.5 percent, indicating the use of high absorption aggregates. The combination of these absorptive aggregates and the relatively short time between production and laydown likely resulted in the aggregates not absorbing as much asphalt binder as was absorbed during mix design (short term aging procedure). The unabsorbed asphalt binder in conjunction with the lower total aggregate surface area of the coarse-graded mixes also resulted in increased asphalt binder film thicknesses. The end result is substantial over-asphalted mix behavior. Additionally, although not evaluated for the projects in this study, a temperature differential within the mat may have contributed to the observed tenderness.

The second probable reason for mix tenderness occurred during the Alabama Highway 78 project. This project was an overlay of a severely cracked asphalt pavement. The cracks were full depth down to a cement treated base material approximately 250-mm below. Because of the cracking, water had infiltrated the pavement. When the new mix was placed, water within the underlying pavement moved upward and turned to steam. This resulted in an increase in volume of the placed mix that was observed during construction.

As mentioned earlier, project results failed to clearly identify one particular reason for the tender zone occurrence. Clearly, there is a need to investigate more projects.

5. REFINEMENT OF NEW GENERATION OPEN-GRADED FRICTION COURSE MIX DESIGN (Watson, Moore, Williams, and Cooley, Jr.)

Open-Graded Friction Course (OGFC) has been used in the United States for over fifty years. In 2000, NCAT research led to a recommended mix design procedure for a New-Generation Open-Graded Friction Course, but the work involved only one aggregate source. Therefore, NCAT is in the process of refining this design procedure to ensure that it is applicable to other aggregate types used in surface mixes throughout the United States. The objectives of NCAT's current research are to refine and field validate the new-generation OGFC mix design procedure. This work has led to several experiments that are included in this paper.

Several objectives have been identified which need to be addressed. Superpave technology and use of the Superpave gyratory compactor (SGC) needs to be incorporated into the mix design procedure. The Cantabro test for durability and resistance to stone loss needs to be adapted to SGC prepared specimens and performance parameters established. The asphalt draindown test, AASHTO T 305-97, which was developed for Stone Matrix Asphalt mixtures, needs to be evaluated for applicability to OGFC mixtures as well. In addition, a method for effectively evaluating air void criteria needs to be investigated.

Based on the test results and analyses, the following conclusions have been drawn from this research:

- The gyratory compaction effort of 50 gyrations generally results in approximately the same level of density as the 50 blow Marshall procedure.
- There was less aggregate breakdown in samples compacted with the Superpave gyratory compactor than for samples compacted with the Marshall hammer to the same density.
- The Cantabro test appears to be a good method for evaluating the cohesiveness and durability of OGFC mixtures. The test parameters for maximum stone loss by the Cantabro method may need to be adjusted for SGC samples.
- Polymer-modified asphalt significantly improves the performance of OGFC mixtures as determined by the Cantabro test.
- The repeatability of the draindown test was improved by using the 2.36 mm (No. 8) wire mesh rather than the standard 4.75mm (No. 4) mesh.
- The addition of fiber stabilizers was the most

significant factor in reducing binder draindown.

6. AN INVESTIGATION OF FACTORS INFLUENCING PERMEABILITY OF SUPERPAVE MIXES (Hainin, Cooley, and Prowell)

Permeability has become a continuing issue discussed in the hot mix asphalt (HMA)

community, especially with the introduction of Superpave mixes in late 1990s. Permeability can cause an increased potential for oxidation, raveling, cracking, and water damage in HMA pavements.

The objective of this study was to evaluate the permeability characteristics of Superpave pavements and determine the influence of in-place density, nominal maximum aggregate size (NMAS), gradation, lift thickness, and design compactive effort (N_{design}) on the permeability of these pavements. A total of 354 cores were obtained from 42 different Superpave projects immediately after paving. Five different mix types utilized in this study were fine-graded 9.5 mm, 12.5 mm, and 19.0 mm NMAS mixes and coarse-graded 9.5 mm and 12.5 mm NMAS mixes. Bulk specific gravity of cores was determined using AASHTO T166 and a vacuum sealing method (Corelok). The permeability test was performed according to ASTM PS129-01.

The results of the investigation indicate that in-place void content is the most significant factor affecting permeability of Superpave pavements. Air voids determined using vacuum sealing method (Corelok) is better correlated with permeability than AASHTO T166 method. This is followed by coarse aggregate ratio, N_{design} , and lift thickness. As the values of coarse aggregate ratio and N_{design} increase, permeability increases. For coarse-graded mixes, as the coarse aggregate ratio approaches 1.0 or higher, permeability increases significantly. Permeability decreases as lift thickness increases.



ASPHALT FORUM

*NCAT invites your comments and questions. Questions and responses are published in each issue of **Asphalt Technology News**. Some are edited for consistency and space limitations.*

Arizona (Julie Nodes, Arizona DOT)

The Arizona Department of Transportation (ADOT) is beginning a three-year program that will overlay the majority of the PCCP freeways in the Phoenix metropolitan area with a 1-inch thick asphalt-rubber friction course (AR-FC). The majority of these freeways are less than five years old or have not yet been constructed. The primary purpose of these AR-FC overlays is as a noise mitigation measure and it is being called the Quiet Pavements Project. The project is expected to cost about \$34 million; some of the funding for this project comes from an existing half-cent sales tax. The decision to begin this project was based on the successes that ADOT has had with existing AR-FC on PCCP (durability, smoothness, and noise reduction) and hurried along by considerable public and political pressure. ADOT has had very favorable public response to previous AR-FC over PCCP projects.

Colorado (Bill Schiebel, Colorado DOT)

Which other states require Micro Deval test for aggregate quality and how did they establish their specification criteria for percent loss allowed? How is the Micro Deval test used (for example, pass/fail, price reduction, or for quality control at established frequencies throughout production)?

Are other states that use nuclear asphalt content gauge or ignition furnace for determination of asphalt content aware of the impact of amount of lime on the accuracy of results? Colorado has determined +0.37 percent impact on ignition test and approx. -0.3 percent impact on nuclear gauge when one percent required lime included during calibration is not present in the production material? What is the experience of other states and how are they dealing with it?

Kentucky (Allen H. Myers, Kentucky Transportation Cabinet)

How many states give bonus payment for consistency of asphalt content? How many states utilize VMA as an acceptance property? Is the laboratory minimum VMA required for full pay, or is some tolerance below the

laboratory minimum permitted?

Louisiana (Chris Abadie, Louisiana DOT)

Does any state require laboratory or in-situ strength testing for information or acceptance of stone base or flexible base construction?

Missouri (Mark Shelton, Missouri DOT)

Is anyone using the CoreLok device to determine aggregate specific gravities for mix design or field verification?

We plan to implement tensile strength testing of plant produced HMA mixtures using AASHTO T283. This would allow us to eliminate requirements for anti-strip additives, the method of introducing the additives, and the requirement for aggregates to be nonplastic. We would appreciate other states' comments and experience with TSR testing of plant produced mixtures.

Montana (R. Scott Barnes, Montana DOT)

We recently checked dimensions of the molds for gyratory compactors. A large number of molds have worn to be out of specification on diameter. The estimated cost to replace is about \$850 each. We believe the specification is too restrictive on diameter—the tolerance is much tighter than it was for Marshall

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Prithvi (Ken) Kandhal
Associate Director Emeritus, NCAT
277 Technology Parkway
Auburn, AL 36830

molds. Should the tolerance be loosened? Our molds have only worn a couple of thousands of an inch—they were made to the top end of the tolerance.

New Hampshire (Charles Dusseault, New Hampshire DOT)

Has any state revised the Superpave VMA criteria to make any modifications to their asphalt mixes?

South Carolina (Milton Fletcher, South Carolina DOT)

As part of our implementation of the Asphalt Pavement Analyzer, South Carolina is using 150 mm gyratory specimens compacted to 4 percent air voids with a specification limit of 5 mm maximum rut depth for a mixture with PG 76-22 and 7 mm maximum rut depth for a mixture with PG 64-22. The APA test is conducted with 100 psi hose pressure at 64EC test

temperature.

Ontario (Kai K. Tam, Ontario Ministry of Transportation)

Ontario has no comments or experience with regards to most of the questions asked in the Fall 2002 Forum.

Ontario is also interested in Tennessee's question regarding switching to lightweight profilers. Although the project is only beginning, Ontario is planning to do a side-by-side smoothness comparison between PI determined by California Profilographs, PI/IRI determined by lightweight profilers and IRI determined by our ARAN for a group of asphalt and concrete pavements. This will be used to define similar levels of smoothness between PI and IRI using different devices and thereby fix categories for payment adjustments based on IRI.

NCAT's Superpave Mix Design Course, February 18-21, 2003



Back, L-R: Brian Prowell, Donald B. Stewart III, Kevin Hendrickson, J. Scott Alston, Mike Poole, Charles Williams
Middle, L-R: Robert James, Don Watson, Hank Gehm, Calvin Smith, Rachel Thomas
Front, L-R: Diane Franseen, Bill Lawton, Dave Scott, Charles Borromeo, Frank Vargas, Clinton Peoples

ASPHALT FORUM RESPONSES

The following responses have been received to questions raised in the Fall 2002 *Asphalt Forum*.

Have any states used the CoreLok for G_{mm} or G_{sb} testing using medium to highly absorptive aggregates? If so, please comment on the accuracy obtained. (Greg Sholar, Florida DOT)

Colorado (Bill Schiebel, Colorado DOT)

Colorado briefly evaluated the CoreLok for HMA testing last year. Our mix technicians used it on a few compacted specimens of a known G_{mb} (from SSD bulk technique). The CoreLok test values were different than those obtained by the SSD method. However, more tests are warranted.

Indiana (Tommy Nantung, Indiana DOT)

An on-going research study showed no statistically significant difference between G_{mm} and G_{sb} obtained using CoreLok and conventional methods, for 12 mixtures collected during the 2001 and 2002 construction seasons. No absorptive aggregate were used on these mixtures. In examining the accuracy of the test, the variability of the CoreLok was similar to the variability experienced with the conventional methods.

Oklahoma (Kenneth Hobson, Oklahoma DOT)

G_{mm} and G_{sb} by the CoreLok protocols were investi-

gated to a very limited degree in recent research performed by the University of Oklahoma. The title of the research is "An Alternate Method For The Determination Of Asphalt Content." The combined G_{sb} values by the CoreLok methods were within 2.6 percent of the combined AASHTO T84 and T85 results. The G_{sa} values were within 0.1 percent. The percent absorptions were significantly different. Much of this testing was not explored further due to high variability of AASHTO T84 and T85 test results. The repeatability of the Core-Lok G_{mm} test was near that of the Rice Flask method in AASHTO T209. In other research that we've seen, G_{mb} and G_{mm} results of CoreLok methods versus AASHTO methods were comparable. Taken alone, CoreLok G_{mb} values tend to show higher air voids (~0.5 percent) when AASHTO T209 G_{mm} is used. Conversely, AASHTO T166 G_{mb} values tend to show lower air voids (~0.5 percent) when CoreLok G_{mm} is used.

(a) Is any state DOT currently using AASHTO TP 8-Beam Fatigue Apparatus to evaluate mixture fatigue property—as part of the hot mix asphalt design process? If so, what testing mode—constant stress or constant strain—is used? What is the specification requirement for fatigue life?

(b) Is any state DOT using reclaimed asphalt pavement (RAP) in stone matrix asphalt (SMA)? If so, what is the maximum percentage of RAP allowable in SMA? (Peter Wu, Georgia DOT)

Louisiana (Chris Abadie, Louisiana DOT)

The Louisiana Transportation Research Center has beam fatigue apparatus; sample preparation and testing has just now started. It would be interesting if we could optimize the allowable RAP percentage in SMA with the beam fatigue test.



Consortium of transportation engineers from California, Minnesota, Texas, and Washington visited NCAT last fall.

For those states that have implemented or plan to implement a rut specification utilizing the Asphalt Pavement Analyzer, how are you incorporating the revised test parameters resulting from the NCHRP 9-17 project? (Allen H. Myers, Kentucky Transportation Cabinet)

Mississippi (Richard Sheffield, Mississippi DOT)

We have an ongoing research project with Mississippi State University to determine what APA rut parameters, if any, we can incorporate into our mix designs.

Oklahoma (Kenneth Hobson, Oklahoma DOT)

There are few significant differences between NCHRP 9-17 and our OHD L-43 rut test procedure. The only significant difference is that we compact to 7 ± 1 percent air voids and use the CoreLok's G_{mb} to determine the air voids.

What is the experience of other states with reheating "cold" asphalt mixture samples and compacting them in the gyratory compactor? How does the bulk specific gravity of the reheated mix compare to that of the original sample compacted while the mix was still hot? (Allen H. Myers, Kentucky Transportation Cabinet)

Colorado (Bill Schiebel, Colorado DOT)

Colorado gyratory test procedure specifies sample conditioning requirements to ensure uniform handling and comparable results when tested either holding the sample hot or cooling and reheating before compaction. Our comparison bulk specific gravity test results indicate that both conditioning methods are typically equivalent.

Louisiana (Chris Abadie, Louisiana DOT)

Sometimes the bulk specific gravity values are significantly different and sometimes the values are about the same. It probably depends on the absorption of the aggregate, the PG grade of the binder, holding time, and reheating temperature.

Mississippi (Richard Sheffield, Mississippi DOT)

This is a standard procedure for our quality control/quality assurance (QC/QA) operations, in that QC samples are generally compacted just after being sampled from the truck. The QA sample split from QC sample is usually tested within 14 days, and by necessity

PROFESSOR TRAINING COURSE IN ASPHALT TECHNOLOGY

NCAT has written and published an up-to-date college textbook on asphalt technology. NCAT has also developed a training program for college and university civil engineering faculty that will allow them to offer state-of-the-art undergraduate and elective courses in asphalt technology. This 8-day intensive course is conducted at NCAT in June every year. It will be held on June 17-26 this year. The course has been updated to include Superpave binder and mix technology, and stone matrix asphalt (SMA). Some financial assistance in attending this course is possible. Please call NCAT at (334) 844-NCAT for brochure or information or visit our web site at <http://www.ncat.us>.

has to be reheated. By specification, the G_{mb} has to compare within 0.020, and generally we don't experience many problems with this. The samples will usually compare fine, if time is allowed for complete absorption of asphalt binder before compacting the QC samples that are not reheated.

Oklahoma (Kenneth Hobson, Oklahoma DOT)

We have not looked at this directly. At Superpave 2000 Conference in Denver, Colorado, this issue was discussed. The change in G_{mb} from hot to cold was 0.015. The standard deviation in ASTM D2726 is 0.0124. Reheating does increase the air voids and especially so for the highly absorptive aggregates. Reheating is generally necessary due to logistics of quality assurance (QA) testing for most state DOTs. Offsets could be used by the quality control (QC) laboratories to assure that their data generally conforms with the QA test results. This difference is sometimes attributed to the use of different Superpave gyratory compactors in QC and QA operations. However, this difference could be resulting from reheating or just normal testing variations.

The coarse aggregate angularity requirement for 30 million ESAL design level is 100/100 for fractured faces. This requirement excludes some gravel aggregates from use for this design level. Is any state not following this requirement? If not, are there any long-term pavement performance concerns? (Zoeb Zavery, New York State DOT)

Louisiana (Chris Abadie, Louisiana DOT)

At present we require a minimum of 98 percent fractured faces for our highest traffic level mix. Industry has requested that we consider decreasing the fractured faces requirement especially for the coarse aggregate in intermediate size stockpiles, that is, the coarse aggregate from those stockpiles with more than 50 percent passing the No. 4 sieve.

Ohio (Dave Powers, Ohio DOT)

Ohio has a version we call Type B that allows less crush count in coarse aggregate but compensates for this by a more tightly controlled gradation. It is not commonly used by most districts. Our Type A, following Superpave requirements, is most commonly used. We know that in general our Type B does perform adequately, unless a truly high stress condition exists.

Oklahoma (Kenneth Hobson, Oklahoma DOT)

This requirement is followed in Oklahoma. Performance testing such as rut testing might be worth considering when such requirements are waived or reduced.

The Tennessee DOT is pursuing a specification change in smoothness/roughness acceptance criteria. Please respond with relevant information as to how your state changed from Mays Meter or other testing equipment to Road Profilers. How did you implement the change for longer projects that extended beyond the change date? How did you correlate the equipment to obtain relatively the same level of smoothness? (Greg Duncan, Tennessee DOT)

Louisiana (Chris Abadie, Louisiana DOT)

Louisiana has recently approved an International Roughness Index (IRI) specification for asphalt construction contracts, which will be piloted this construction season. Our first step was to accumulate PI

data (Louisiana specification used the California type profilograph) and compare it to IRI measurements on newly constructed projects. This data was correlated and a new PI specification was adopted. You mentioned the Mays ride meter. Our profilograph specification was correlated to Mays and using this correlation, we were able to provide a correlation of IRI measured by the inertial profiler to the Mays Ride Number. This first specification simply takes our current PI specification and converts it to IRI. Also, a monetary incentive will apply if the entire project achieves a 45 IRI with no must grinds in the wearing course or pay penalty on roadway density or plant volumetrics.

Mississippi (Richard H. Sheffield, Mississippi DOT)

On October 1, 2000, the Mississippi DOT began a research study with the goal of improving our smoothness specifications. Prior to the beginning of this research, the department utilized the California type profilograph with a 0.2" blanking band for construction acceptance.

The first goal of this research activity was to eliminate the 0.2" blanking band. In order to achieve this goal, data had to be collected on projects to determine what zero blanking band profile index values would be required with the revised specification.

As of February 2002, all MDOT projects utilized the zero blanking band for construction acceptance.

The next goal of the project is to phase out the profilograph and utilize inertial based profilers for acceptance. This will be achieved utilizing the IRI for acceptance. Currently MDOT is working on a method to identify areas of localized roughness (similar to the bump/dip template utilized with the profilograph) using IRI. Data is being collected on projects to see if there is a correlation between areas that the profilograph has identified as a bump/dip and the IRI value produced by the inertial profilers. MDOT is hoping to have an IRI based acceptance specification in place by January 2004.

New York (Zoeb G. Zavery, New York State DOT)

Prior to 2002, the New York State DOT had ride quality specifications for rigid paving only. The specification required the pavement have a profile index below a maximum threshold, as measured by a California type profilograph. That specification is still in place; however, the department is developing standards for flexible paving based on IRI. We are developing our

specifications according to the AASHTO Provisional Standards 02-50 through 02-53. The standards include procedures to ensure that different pieces of equipment are reporting similar results. There is also a FHWA pooled fund study beginning soon that will develop comprehensive procedures for calibrating inertial profilers. If you are interested in using inertial profilers you may want to consider participating in the study.

Oklahoma (Kenneth Hobson, Oklahoma DOT)

Although the Oklahoma DOT did have a Mays Ride Meter at one time, it was used for inventory-type testing only, not for acceptance testing. Since the department began smoothness testing for acceptance we have used the California Profilograph. Recently (within the last 2

years) our specifications have been changed to allow the use of lightweight profilometers, in addition to profilographs. All of the lightweight profilometers that we know of are capable of simulating California profilograph (Calpro) results. Since we allow both types of equipment, and because our smoothness specifications are actually written for testing by profilographs, we require the lightweights to test in the Calpro mode. Before changing the specifications to allow the lightweights, we did extensive comparison testing, where both the lightweight profilometer and the profilograph tested the same projects. We require profilographs to be certified annually, based on results they produce on a test track, and the lightweight profilometers have the same requirement.

NCAT's Asphalt Technology Course, February 3-7, 2003



Back, L-R: Don Watson, Donald B. Stewart III, Ryan Taylor, Kevin Ervin, Sam Hester, Michael Wittmann, Ben Carroll, Brian Prowell, Bonita Skrine, Doug Hanson, Tim Vollar, George P. Sugars, Jeremy A. Day
Front, L-R: Demetrio Tolentino, Enoch Lum, Brad Slone, Jason S. Poor, Brian Johnson, Carl Palmer, James Watkins, Tom Knostman

SPECIFICATION CORNER

Arkansas - Arkansas will eliminate the restricted zone requirement from HMA specifications this year. All Superpave HMA mix designs must meet the maximum allowable rut depth limits of 5 mm for 205 and 160 N_{max} mixes and 8 mm for 115 N_{max} mixes. Rut depths will be measured with an Asphalt Pavement Analyzer.

Colorado - A longitudinal joint specification will be used this year to address poor performance of joints in asphalt pavements. This is an incentive/disincentive specification with joint density as a new HMA pay element. The joint density will be measured with a core taken directly over the joint. The effectiveness of this joint specification will be studied over a long term by comparing test sections on old projects with test sections on projects with the new specification.

The following specification changes will also be implemented this year on all projects:

- Strict compliance of 1.25° angle in gyratory compactors. All machines have been recalibrated to fix error.
- Although historic Superpave design requirements have been maintained, a voids shift (down 1 percent) has been introduced to establish production targets from the optimum in the Superpave Mix Design. This was done to increase asphalt content recognizing relatively lower asphalt contents in Superpave mixes. There were also increasing concerns with early cracking, low durability, and difficulty with construction of Superpave mixes.

Kentucky - The ride quality specification has been revised this year to include the International Roughness Index (IRI) for measuring smoothness. A “sliding scale” for the payment adjustment schedule has also been implemented; a one-point change in IRI corresponds to a 1.5-percent change in pay value. IRI values between 47 and 66 result in full pay. IRI values below 47 produce a bonus; values above 66 result in a deduction or corrective action.

Louisiana - Louisiana has recently approved an IRI specification for asphalt construction contracts, which will be piloted this construction season. A monetary incentive will apply if the

entire project achieves IRI below 45 with no “must grinds” in the wearing course or pay penalty on roadway density or plant volumetrics.

Mississippi - The following revisions to HMA specifications are being made:

- Mix design and QC/QA procedures are being revised by compacting to N_{design} instead of N_{max} and back-calculating G_{mb} at N_{design} . N_{design} levels are also being revised. The Mississippi DOT has historically had three traffic levels to design for (<1M ESALs, 1M – 3M ESALs, and >3M ESALs). The N_{design} levels are being changed from 68, 86, and 96 to 50, 75, and 100 gyrations, respectively, for these traffic levels.
- The minimum roadway density requirements are being increased to 93 percent of theoretical maximum density on certain type projects.
- For QC/QA purposes, the tolerance on asphalt content during production is being changed from ± 0.3 percent to a range of -0.2 to $+0.4$ percent.
- At the request of the HMA industry in Mississippi, storage of HMA in heated silos will be permitted up to 24 hours (for 19 and 25 mm mixtures) and 36 hours (for 9.5 and 12.5 mm mixtures).

Montana - Superpave designed mixtures will be accepted based on volumetrics with incentives and disincentives on voids, VMA, VFA, and fines/asphalt



NCAT has a close-proximity noise trailer which is used to measure noise near the tire/pavement interface. It has been used on the NCAT Test Track to evaluate different mix types.

ratio. Acceptance of completed asphalt pavement based on density and ride quality stays the same.

New Hampshire - Superpave specification has been revised to address concerns about permeability and durability. The revisions include adjusting the ESAL level upward for the 50 gyrations designs, stipulating some minimum asphalt contents for the lower ESAL levels, and increasing the amount of fine aggregate in the mix through adjustment of the percent passing the No. 8 sieve. These changes follow last year's elimination of the restricted zone as recommended by AASHTO. The goal of the changes is to get finer mixes and more asphalt binder in the mix, potentially leading to less permeable and more durable mixes. Specifying minimum VMA was considered. However, it was not certain using VMA criteria would necessarily produce the desired results of increased asphalt content in the mixes. Also, there is some debate in the industry about VMA criteria and its uniform applicability to coarse and fine graded mixtures. With the minimum asphalt content approach, there is a recognized potential for over-asphalted mixes that have aggregates with high specific gravity values. Fine tuning of specification modifications is anticipated in the future.

New Jersey - HMA specification was revised to require the trucks transporting HMA to be permanently equipped with an airfoil to deflect air over the tarp and to prevent air from going under the tarp. The revision also added the option of a heavyweight tarp to be used in place of a tarp with tie-downs.

Ohio - HMA pavement density specifications were revised to include random coring within three inches of a cold joint. Incentives have been included when the pavement density is in the range of 94 to 96 percent of theoretical maximum density.

NCAT HAS NEW DOMAIN NAME

NCAT has a new domain name, to make it easier to find our web page. <<http://www.ncat.us>> is the new address, but you can also reach our web page by going to our old address, <<http://www.eng.auburn.edu/center/ncat/>>.

Oklahoma - The following APA maximum rut depths have been specified:

Compaction Level	ESALs × 10 ⁶	N _{design}	Max Rut mm
1	\$ 30	125	3
2	\$ 10 and <30	100	4
2	\$ 3 and < 10	100	5
3	\$ 0.3 and <3	75	6
4	<0.3	50	8

Other revisions are as follows:

- The coefficient of permeability "k" as determined in the laboratory is required to be less than 125x10⁻⁵ cm/s.
- Mixes for lifts greater than 5 inches depth and shoulders will be designed at one ESAL level less than mainline mix.
- Projects over 30 million ESALs may require a maximum of 25 percent loss by AASHTO TP58, Micro-Deval; and a minimum of 75 psi indirect tensile strength (ITS) by AASHTO T283 for conditioned specimens.

South Carolina - South Carolina has revised its percent within limits (PWL) specification to include Superpave and base mixtures. A series of short training workshops are being conducted to educate department and contractor personnel on the new specification.

Standard HMA specifications now include an APA maximum rut depth specification for high volume routes and optional use of roofing shingles.

Ontario, Canada - Ontario Provincial Standard Specification on materials and construction of hot mix has been updated recently with the aim to improve the consistency between municipal and provincial specifications/practices.

Ontario's newly completed special provision for SMA will be used on all new projects with over 30 million ESALs.

Penalties for smoothness will now be phased-in for some single lift contracts which were previously exempt from penalties.

A draft end-result specification for acceptance of surface course thickness using 50 mm cores and a non-destructive method is being developed.

NCAT's Asphalt Technology Course, March 3-7, 2003



Back, L-R: Robert James, Don Watson, Fred Koch, Darrell Roberts, Art Griffith, Scot Lewis, Scott Alston, John Johnson, Terry Benton
Front, L-R: Brian Prowell, David Jensen, Rachel Thomas, Jorjean Rice, Julie Sampson, Karl Lucero, Felipe Llerus, Charles Tscherner III

INTERNATIONAL SYMPOSIUM ON LONG-LASTING ASPHALT PAVEMENTS

An international symposium on Design and Construction of Long-Lasting Asphalt Pavements will be held in Auburn, Alabama June 7-9, 2004. The International Society for Asphalt Pavements (ISAP) is the primary sponsor of this specialty conference. The National Center for Asphalt Technology (NCAT) will host the conference in Auburn, Alabama (100 miles southwest of Atlanta, Georgia). The conference is also co-sponsored by the Federal Highway Administration, the National Asphalt Pavement Association, and the Alabama DOT.

The objective of this conference will be to address materials, mix design, and construction procedures to ensure long-lasting (perpetual) asphalt pavements. Topics will include: perpetual pavement design, materials and mix design, quality control/quality assurance, construction issues, contracting methods, and other related subjects.

Abstracts (150 words or less) of potential papers can be sent to ISAP by email at <isap@eng.auburn.edu> and must be received by June 6, 2003.

For additional information concerning the conference, contact ISAP at <isap@eng.auburn.edu> or call (334) 844-6228.