

2006 NCAT Pavement Test Track Status Report

The Pavement Test Track is a full-scale accelerated performance test (APT) facility managed by the National Center for Asphalt Technology (NCAT) at Auburn University. The project is funded and directed by a multi-state research cooperative program in which the construction, trafficking, and pavement evaluation are carried out on 46 different 200-foot test sections around the 1.7-mile oval test track. Each test section is constructed utilizing the asphalt materials and design methods used by individual sponsors. A fleet of heavy trucks is operated on the track in a highly controlled manner in order to apply a design life-time of truck traffic (10 million equivalent single axle loads, or ESALs) in two years. The current project represents the third three-year research cycle of the NCAT Pavement Test Track. The primary objectives of the third research cycle are to: (1) identify pavement structures and materials with superior field performance and lower life cycle costs; and (2) provide information for the calibration and validation of the Mechanistic-Empirical Pavement Design Guide (MEPDG).

When each three-year research cycle is completed, test sections are either left in place for the application of additional traffic or rebuilt in the manner that best meets the needs of

sponsors. The third research cycle includes: eight sections built in 2000 (all mix performance sections), 16 sections built in 2003 (12 mix performance sections and four structural sections) and 22 sections built in 2006 (15 mix performance sections and seven structural sections). Mix performance sections are perpetual pavements in which distresses are confined to various combinations of experimental surface mixes. Structural sections are typically thinner, highly instrumented pavements that are intended to provide information for the MEPDG.

Thirty-one unique asphalt mixtures consisting of 27 Superpave and Stone Matrix Asphalt (SMA) mixtures as well as four permeable surface mixtures were used to build the 22 new sections built in 2006. The laboratory testing plan focuses on evaluation of the 27 Superpave and SMA mixtures. NCAT has finished testing asphalt binder samples as well as measuring dynamic modulus, flow number, flow time, and rutting susceptibility using the Asphalt Pavement Analyzer (APA) on plant sampled mix materials. Analyses of these test results will be summarized in an upcoming report. Determination of the endurance limit for the rich-bottom mixture used in two comparison perpetual pavement study sections (N8 and

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N9) is currently underway. The fatigue life of the mixture has been determined for two strain levels (400 and 800 microstrains). The endurance limit has been estimated based on the fatigue lives of the mix at 400 and 800 microstrains. A verification of this endurance limit in the laboratory will be conducted before the end of the research cycle. It is also planned to evaluate experimental mixes for cracking resistance using indirect tension (IDT).

Trucking operations for the third research cycle on the NCAT Pavement Test Track began after the completion of reconstruction activities in November of 2006. A fleet of five heavy triple trucks runs two shifts a day. An AM driver shift runs from 5:00 AM until approximately 2:00 PM, and a PM driver shift runs from 2:00 PM until approximately 11:00 PM. By November 15, 2008, a total of 9,798,751 ESALs (98 percent of the 10 million ESAL goal) had been safely applied to the surface of the 2006 NCAT Pavement Test Track. This means that the eight sections originally

placed in 2000 had been subjected to approximately 29.8 million ESALs and the sixteen sections built in 2003 had been subjected to approximately 19.8 million ESALs. All mixes in both previous studies were designed for 10 million ESALs.

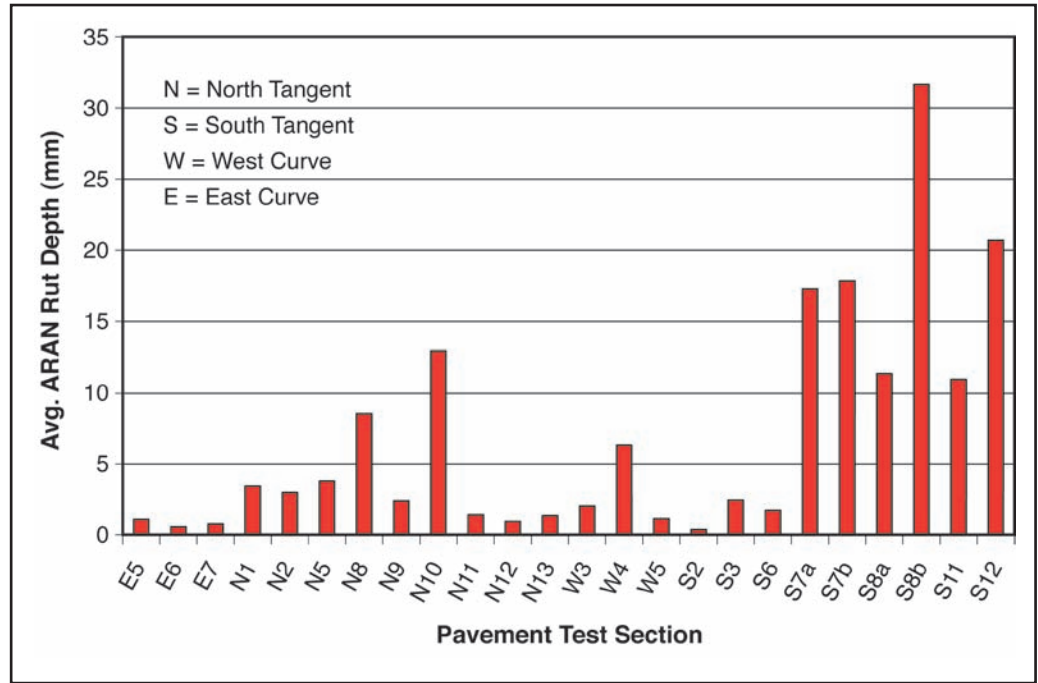


Figure 1. Average rut depths for 2006 test sections via scanning lasers.

Every Monday, trucking is suspended so that vehicle maintenance can be performed and pavement performance can be quantified. An inertial profiler equipped with a full lane width, dual-scanning laser "rutbar" is run weekly around the entire track in order to determine individual wheelpath roughness, right wheelpath macrotexture and individual wheelpath rutting for every experimental section. Additionally, three random locations were selected within each section in a stratified manner to serve as the fixed test location for nondestructive wheelpath densities. Transverse profiles are measured along these same locations regularly so that rutting may be calibrated with a contact method. Maximum rut depths in each individual wheelpath are also measured on a regular basis using a mechanical depth gauge developed by the Alabama Department of Transportation (ALDOT). Average rut depths for the 2006 test sections measured with scanning lasers in mid-November of 2008 are provided in Figure 1.

Dynamic pavement response data continues to be collected on a weekly basis. Each week, three passes of each truck in each test section are captured. The data are then processed and added to their respective



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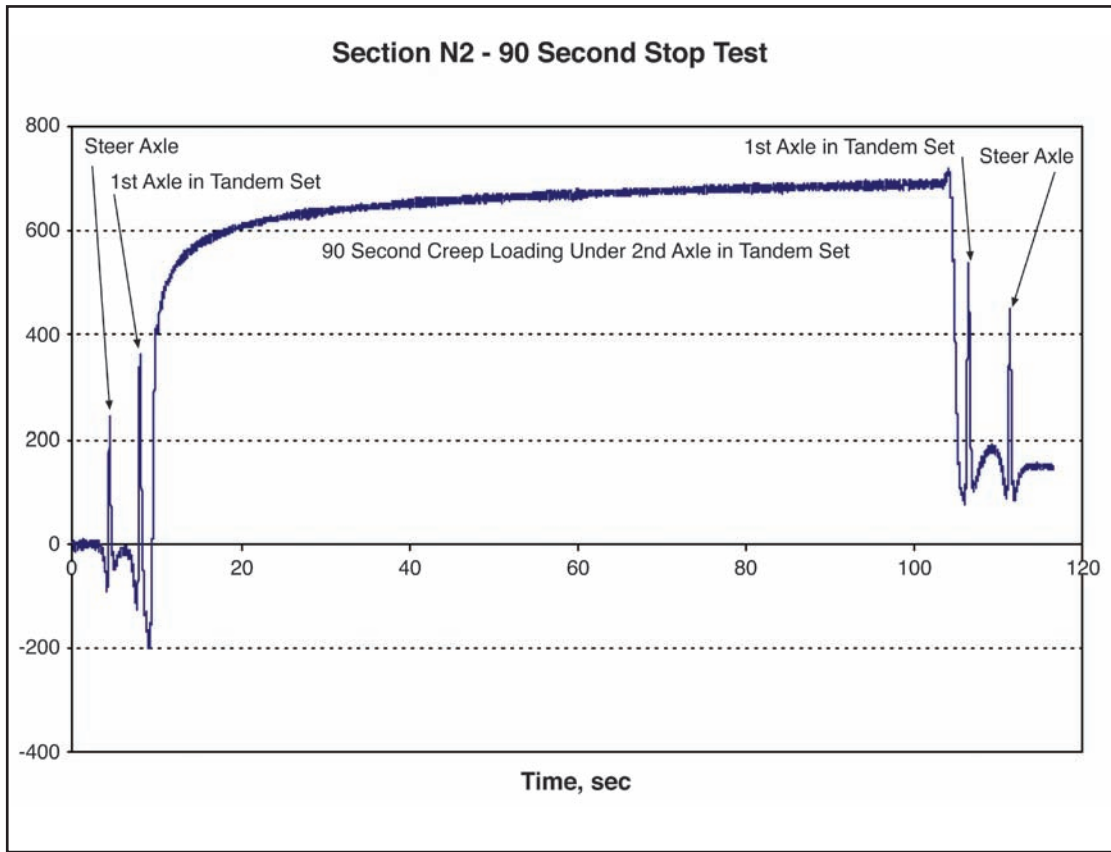


Figure 2. Measured creep response with longitudinal strain gauge in section N2.

databases, which facilitate the backcalculation of constituent pavement layer properties in each test section. Finalized cross-sections have been selected for each test section and comparisons have been made between measured and predicted pavement responses. Comparisons were generally favorable which allowed a full characterization of the HMA modulus versus temperature and unbound modulus versus stress state for each test section.

Testing has begun on the so-called “stopping experiment” as part of the structural study. This study is meant to simulate intersection traffic that comes to a complete stop for a short duration. The long-term objective of the study is to collect pavement response data under stopped traffic that can be used to improve intersection structural design. The overall plan is to collect data at a variety of test temperatures on sections N2, N3, N8, N9, N10 and S11. In each section, the fully-loaded drive tandem axle of a Class 9 vehicle is brought to a stop on top of the base pressure plate, followed by an asphalt strain gauge, concluding with the subgrade pressure plate. Each gauge is subjected to loading durations of 30 sec, 60 sec and 90 sec with three replicates at each load duration. Response

data are recorded using the high-speed data acquisition system. Figure 2 represents one such test where the creep under the second axle of the drive tandem is clearly evident between with first two axles as the truck pulls forward and the last two axles when the truck backs away from the gauge.

Representatives from each research sponsor were onsite while test sections were being built in order to provide oversight and ensure that as-built properties best met their research needs. Meetings of the entire sponsor group are hosted at the Track every 6 months thereafter in order to share preliminary results and plan for the

future. At each meeting, the first day consists of classroom presentations and discussions, while the second day is spent on the Track inspecting test sections. The last 6-month sponsor meeting was held on November 6th (beginning at 1:00 PM) and 7th (ending at noon), 2007, with a total of 22 non-NCAT personnel in attendance.

Planning is currently underway for the research cycle that will begin in 2009. Sponsor options will again include traffic continuation, surface mix performance sections, and structural test sections. More direct private entity financial sponsorship is expected. A group structural experiment that encompasses permeable surface mixes, several warm mix methodologies, several high RAP utilization methodologies, and sulfur extended asphalt mixture (SEAM) has been proposed. Findings from the 2006 research cycle will be disseminated during a Pavement Test Track Conference that will be open to non-sponsor participation. The conference has been planned for February 9th (dinner) through 11th (noon) of 2009.

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.

Connecticut (Nelio J. Rodrigues, Connecticut Department of Transportation)

Has any other state developed a positive incentive (bonus) on (a) HMA production testing and (b) pavement density? If so, is the incentive monetary or non-monetary (positive incentives negate negative incentives)?

Florida (Gregory Sholar, Florida Department of Transportation)

How are contractors managing their RAP piles? Are they allowed to continually add to them or do they have to have a separate pile for each source of RAP? We are finding that contractors that have the large, continuous piles, are having a hard time producing mix to match their mix design for mixtures that contain 30 to 45 percent RAP.

Kansas (Cliff Hobson, Kansas Department of Transportation)

When rehabilitating an existing HMA roadway that has transverse cracking or a PCCP roadway with joints, is the low temperature grade of the binder

typically changed to try and prevent the reflective cracking that will occur? If you have experience using different low temperature grade binders for rehabilitation actions, does using a lower temperature grade binder improve the pavement performance by delaying reflective cracking?

Kentucky (Allen H. Myers, Kentucky Transportation Cabinet)

KYTC plans to construct its first warm-mix asphalt (WMA) pavement sections this year, including significant WMA tonnage on interstate routes. We will attempt a couple of different techniques for producing the WMA, Astec's "Green" system and Ergon's "Evotherm 3G" technology.

New Hampshire (Denis M. Boisvert, New Hampshire Department of Transportation)

New Hampshire has been observing the performance of both joint adhesive and raised joints for several years. We have found that the combined techniques are giving the best results, and are now requiring both.

Asphalt Forum Responses

The following responses have been received to questions raised in the Fall 2007 **Asphalt Forum**.

1) Has any other state considered minimizing the number and use of some of the design levels and/or NMAS classes to ease up the large number of mixes currently available to be specified by contract?

(Keith R. Lane, Connecticut Department of Transportation)

Florida (Gregory Sholar, Florida DOT)

FDOT only uses 9.5, 12.5 and 19.0 mm mixtures. We use traffic levels A-E.

Kentucky (Allen H. Myers, Kentucky Transportation Cabinet)

The number of HMA bid items potentially specified in contracts has been a major issue with the HMA industry in Kentucky for several years. KYTC has addressed this concern by consolidating polish-resistant aggregate categories and reducing the number of performance-graded (PG) binders utilized. Another step taken in this regard was to eliminate the lowest 20-year ESAL tier (less than 0.3 million) in AASHTO R 35 ($N_{des} = 50$ gyrations). Kentucky currently requires an N_{des} value of 75 gyrations for all 20-year ESAL counts less than three million. We observe the ESAL categories specified in AASHTO R 35 for N_{des} values of 100 and 125 gyrations. KYTC specifies all six possible nominal-maximum aggregate sizes of HMA (4.75 mm through 37.5 mm).

Mississippi (James A. Williams, Mississippi DOT)

Mississippi DOT currently allows five different NMAS classes at three design levels. However, due to aggregate availability typical HMA will be either a 19.0, 12.5, or 9.5 mm NMAS at one of three design levels.

Ohio (Dave Powers, Ohio DOT)

Ohio only uses Superpave on heavy routes as determined by truck counts. We use one gyration level of 65 as durability has been a concern in our experience with higher compaction levels. Go to section 442 at: <http://www.dot.state.oh.us/construction/OCA.Specs/default.htm>.

2) NCAT has conducted extensive field research in the area of HMA longitudinal joint construction over the years, which has been reported from time to time in the Asphalt Technology News and has been published in various technical journals. Many state highway agencies such as Kentucky and Wisconsin have also conducted field experiments using different techniques of longitudinal joint construction. Various techniques such as rubberized joint adhesive, notched wedge joint, cutting wheel, joint maker, and infrared joint heaters have been evaluated in the field by NCAT and other states. We would like to know how severe the longitudinal joint problem is in your state and what are you doing about it in terms of specifications and/or research.

(Prithvi “Ken” Kandhal, NCAT)

Colorado (Roy Guevera, Colorado DOT)

CDOT has a longitudinal joint specification that is end-result. The joint is cored and must meet 92 +/- 4 percent joint density. The link to our specification follows: <http://www.dot.state.co.us/DesignSupport/Construction/2005SpecsBook/2005SSP/401lj.doc>

Connecticut (Nelio J. Rodrigues, Connecticut DOT)

We have had a mixed performance history of longitudinal joints in Connecticut. We have increased the hot-side longitudinal joint density requirements to 92 percent of Gmm (minimum) with some limited success. We are currently re-evaluating various longitudinal joint construction techniques, including the methods stated above, in order to improve on this issue.

The longitudinal joint problem in Connecticut has become more severe. In response, CTDOT is experimenting with another notched-wedge joint. Engineers at the Connecticut Advanced Pavement Laboratory (CAPLab) are evaluating its use and comparing it to traditional butt joints. Results indicate that “the use of the notched wedge joint did not

impede the paving process during two investigated pilot projects.” The researchers have suggested “crews will also become more familiar and efficient with this process as they gain experience with it.” The preliminary results of the comparison between the two different joint construction methods show a higher level of density on the cold side of the joint for the notched wedge joint than for the butt joint. Additional findings will be available by the end of this construction season.

Kentucky (Allen H. Myers, Kentucky Transportation Cabinet)

The longitudinal joint construction research in Kentucky referenced in the introduction to this question resulted in the implementation of a joint density specification in 2004. Despite this requirement, the performance of longitudinal joints continues to be of great concern in Kentucky. We routinely observe significant moisture infiltration, cracking near the joint, and separation of the joint relatively early in the life of the pavement. We are considering an increase in the minimum density required at the longitudinal joint, expanded usage of joint adhesives, and a renewed emphasis on quality joint construction techniques to improve the performance of longitudinal joints in our HMA pavements.

Ohio (Dave Powers, Ohio DOT)

Ohio has considered many of the methods NCAT has evaluated over the years. Our joint performance has improved dramatically on the whole, but isolated issues still arise. We have put in place a change to our density spec (446) where three of a 10 core lot are taken randomly from near the joint. In addition, we require a PG Binder (any approved grade) as the seal of the joint in place of standard emulsion because the binder gives a thicker film to seal with. We have tried tape and other methods and believe the PG binder a reasonable compromise. We have placed some jobs with the wedge joint maker but have had trouble with this method being consistent, especially when a thinner lift with polymer binder is placed. If the wedge is not a higher overall density than the standard approach, it is not worth the effort and could lead to a worse problem in terms of joint failure if poorly placed and very low in density.

Rhode Island (Michael Byrne, Rhode Island DOT)

We have found that keeping the roller on the second pass (the hot side) approximately 6-10 inches away from the joint yields the best results. Since both sides of the unrolled 6-10 inch section are “locked” in place, when this small area is rolled the mix has no where to go but down, resulting in a long-lasting

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Specification Corner

Connecticut - We are currently reviewing the following Superpave specifications with consideration to improving economic costs and material availability:

- a. Increasing the permitted RAP content to 15 percent with no additional imposed requirements
- b. Reduction in Superpave levels and classes being currently specified
- c. Modifying the specified PG binder grade specifications
- d. Developing fine aggregate specifications
- e. Developing new specifications for longitudinal joint techniques

CTDOT is also beginning implementation of a new HMA core correlation specification for nuclear density gauges by using the proposed procedure on select projects.

Florida - We will start allowing 15 percent RAP in final asphalt layer provided that there is at least 60 percent granite in the mix. The granite is to insure adequate friction is obtained. Warm mix is allowed at the contractor's option (still on a pilot project basis).

Kentucky - The Kentucky Transportation Cabinet (KYTC) published an updated *Standard Specifications* manual in December 2007. The major change in the hot-mix asphalt (HMA) area was a revision of the KYTC procedure for verifying the contractor's test results for acceptance. For HMA bid items of 20,000 tons or more, the verification specification now includes a statistical comparison of the contractor's and KYTC's test data using the *F*-test, *t*-test, and paired *t*-test. A spreadsheet is available to perform the statistical calculations and provide notification when the contractor's data and KYTC's data are not in the same statistical population.

Mississippi - MDOT performs quality reviews of our QC/QA program to ensure the program specifications are being followed and to identify potential problems or changes that need to be addressed. We are currently satisfied with the program and specifications in place.

Ohio - We have implemented some more prescriptive requirements on RAP and RAP handling. See section 401.04 of the 2008 Ohio book. <http://www.dot.state.oh.us/construction/OCA/Specs/default.htm>

We have cleaned up our section 441 QA/QC section to bring language up to date and add some clarifications and simplifications.

Ontario - MTO is always conducting reviews of our specifications. Task groups are set up with representatives of MTO and industry to develop new specifications (e.g. Inertial Profiler Task Group) and committees (also with industry participation) are set up to review existing specifications, propose changes and monitor impacts of those changes. Some examples of specifications developed or changed in this way are as follows:

Ontario Provision Standard Specification 313PROV – Asphalt Construction Specification

- *MTO is considering allowing the use of mix designs and performance-graded asphalt cements for highways which exceed the requirements for the design traffic category by one level.*
- *An MTO/industry task group has been established to investigate how to deal with early low friction concerns that have occurred with SMA.*

Special Provision 103F31Modified – Smoothness by Inertial Profilers

- *An MTO/Industry task group was set up to investigate how MTO can begin the transition from acceptance based on PI measurements by California Profilograph to acceptance based on IRI measurements by inertial profiler. The task group has developed a list of requirements for the equipment and software, a draft special provision and a new specification for calibrating, correlating and taking measurements with inertial profilers. The raw data files will be run through @ProVAL using their "Ride Stats at Intervals" option for IRI and "localized roughness" option for localized roughness. Implementation will begin in a limited way during this construction season.*

Tennessee - This year, TDOT will be letting seven Marshall-designed thin-lift projects throughout the state at various NMAS (1/4" and 3/8") and lift thicknesses in an effort to investigate the feasibility of thin-lift HMA as an effective pavement preservation technique. TDOT also intends to place additional pavement preservation trials including scrub seals, penetrating fog seals, chip seals, and a 65 gyrations 4.75 mm overlay.

Summary of NCAT Survey on RAP Management Practices and RAP Variability

Randy C. West
July, 2008

Introduction

From September 2007 until June 2008, NCAT posted an on-line survey to gather information from contractors on how they currently manage and process RAP materials and to gather quality control statistics on their RAP stockpiles. This paper summarizes the results of that survey. The survey was set up to gather specific information about individual plant operations. Responses were accumulated from eighty-one operations in 26 states.

General Plant Operations

The survey began with general questions about the plants. Three fourths of the asphalt plants from responders were continuous mix plants; one fourth were batch plants. This is probably a fair representation of the proportion of plants across the U.S. Of the continuous mix plants, the point of RAP entry was 38% in the outer drum (i.e. Astec Double Barrel), 32% behind the burner (inferred as counter-flow driers), 24% as mid-drum (inferred parallel-flow drier), and 6% in a second mixing drum. When running recycled mixes, it is generally believed that emission problems are more likely to occur with mid-drum entry in parallel-flow driers. For the batch plant responses, the point of entry for the RAP was 62% at the pugmill with the RAP weighed separately for each batch, 31% in the weigh hopper, and 7% at the bottom of the hot elevator. Sixty-one percent of all plants in the survey had only one RAP bin; 36% had two RAP bins, and 3% had three RAP bins.

When asked about the supply of RAP on hand, 51% responded that the supply was stable, 24% indicated a declining supply, and 25% indicated an increasing supply. A histogram of the quantity of RAP stockpiled at the plants is shown in Figure 1. It can be seen that the amount of stockpiled material is a highly skewed distribution, with a large number of responders having stockpiles less than 80,000 tons. The median quantity of total RAP stockpiled was 25,000 tons. A few responders had much larger RAP stockpiles.

RAP Management

The survey also gathered information on RAP management practices. Half of the responders indicated that they combined all RAP sources into

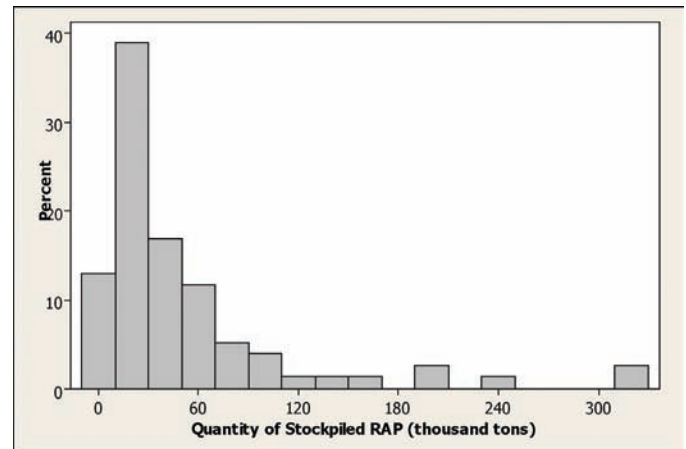


Figure 1. Histogram of the quantity of stockpiled RAP.

a single pile for processing, whereas the other half maintained separate stockpiles for different sources of RAP. Reasons for this included (1) agency specifications allowed only DOT RAP in mixes for DOT projects, (2) to keep millings separate from other multiple source RAP material, and (3) to improve the consistency within the RAP stockpiles.

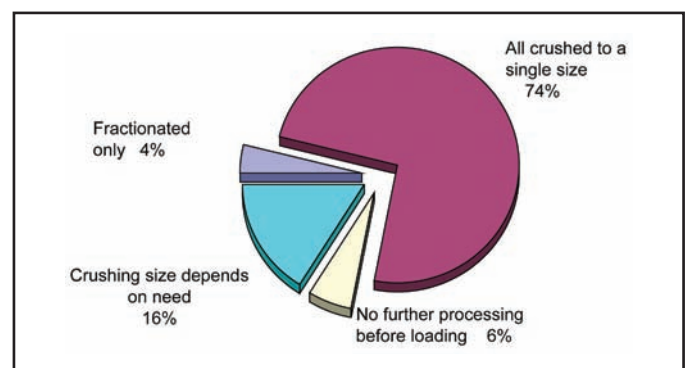


Figure 2. Summary of how RAP is crushed.

With regard to crushing and processing of RAP materials, the pie chart in Figure 2 shows how the respondents indicated RAP is crushed. The chart shows that the vast majority of the operations crush all of their RAP stockpiles to a single size. The survey indicates that only a small percentage of operations are fractionating RAP into different sizes at this point in time. Also, a small percentage of respondents

do not process RAP stockpiles further before using the material in a new mix. This is only feasible when millings from different sources are stockpiled separately.

Table 1 shows the screen size (i.e. maximum particle size) to which responders indicated they crush their RAP stockpiles. A popular size is 1/2 inch.

Screen Size	Percent of Responses
< 1/2 inch	6%
1/2 inch	52%
5/8 inch	16%
3/4 inch	11%
1 inch	5%
> 1 inch	11%

Table 1. Screen Sizes Used in RAP Crushing

Figure 3 shows a summary of the responses regarding RAP stockpiling practices. Most of the responders indicated that they treat RAP stockpiles in the same way as other aggregate materials. This indicates that, in general, some improvements in RAP stockpiling can be made. Each of the bottom three practices can benefit the plant operation by reducing RAP moisture contents. This would allow for higher production rates, lower superheating temperatures for virgin aggregates, better transfer of heat from virgin materials to the RAP, and less fuel usage per ton of mix.

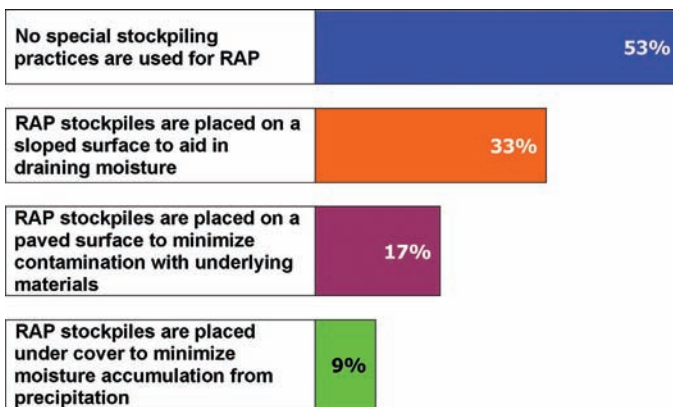


Figure 3. Summary of RAP stockpiling practices.

Utilization of RAP

Figures 4 and 5 summarize how much RAP the responders typically use in surface and no-surface mixes, respectively. The average RAP content used in surface mixes from the survey was 16%, and for non-surface mixes, the average was 20%. Interestingly,

46% of the responses indicated that they typically used the same percentage on RAP in surface and non-surface mixes.

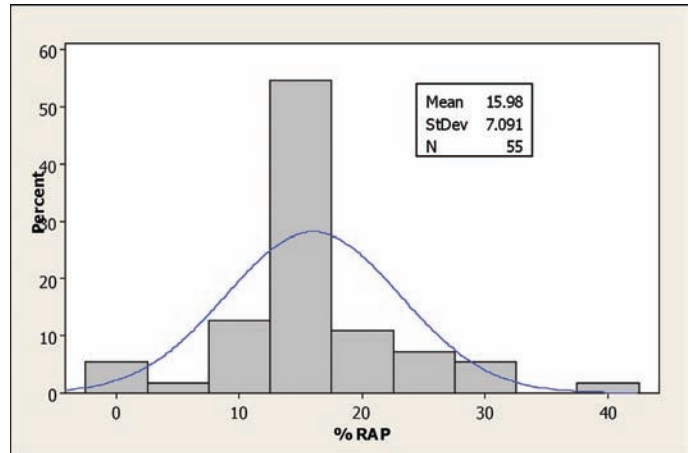


Figure 4. Histogram of typical % RAP used in surface mixes.

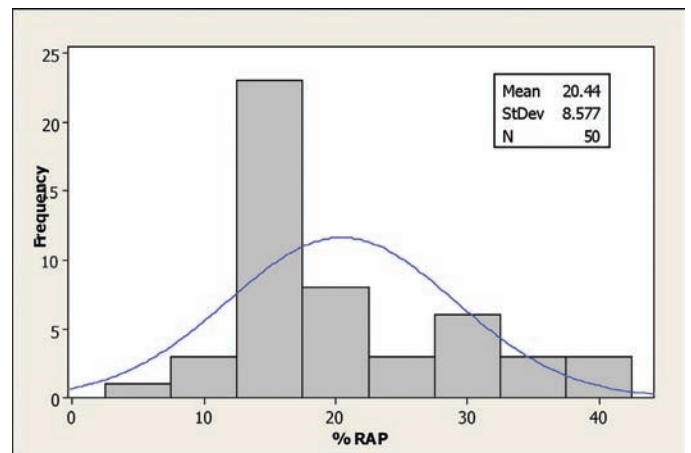


Figure 5. Histogram of % typical RAP used in non-surface mixes.

The survey did not ask how much of the typical annual production was government work versus commercial work, nor did it ask how much of the overall tonnage is surface mixes.

The survey also explored what were the limiting factors that prevented higher RAP contents in surface and non-surface mixes. Figures 6 and 7 summarize the responses to those questions. As can be seen in Figure 6, which summarizes responses on limitations for surface mixes, plant limitations were either not a factor or only sometimes a factor in using higher RAP contents. A similar response was received on whether RAP variability was a problem that limited RAP contents. In contrast, agency RAP specifications

were either always or often a factor in increasing RAP contents. Meeting volumetric properties was considered not a factor or sometimes a limiting factor by the same number of responders, but also had several responders reporting that it was often a factor in trying to use higher RAP contents. The supply of RAP was not a limiting factor for most responders, and sometimes a factor for the second highest response. Responses were similar for non-surface mixes, shown in Figure 7. The noteworthy differences between the two were the lower number of responses that agency specifications were often a limiting factor in using higher RAP contents, which reflects the fact that agency specifications are most restrictive on RAP contents in surface mixes.

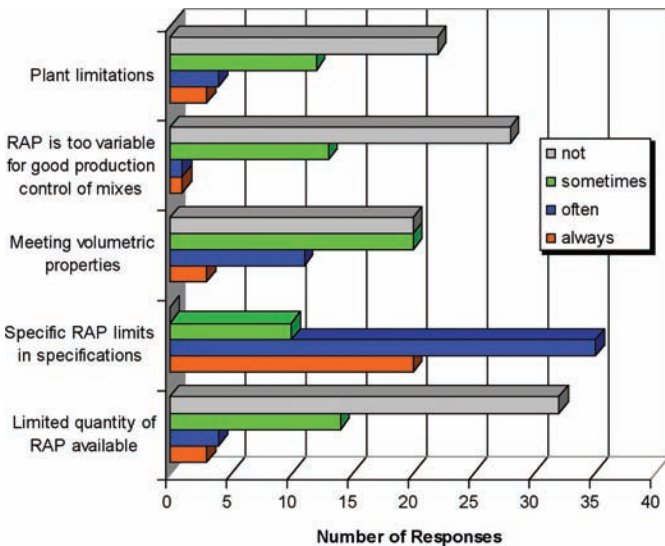


Figure 6. Responses regarding factors that limit higher RAP contents in surface mixes.

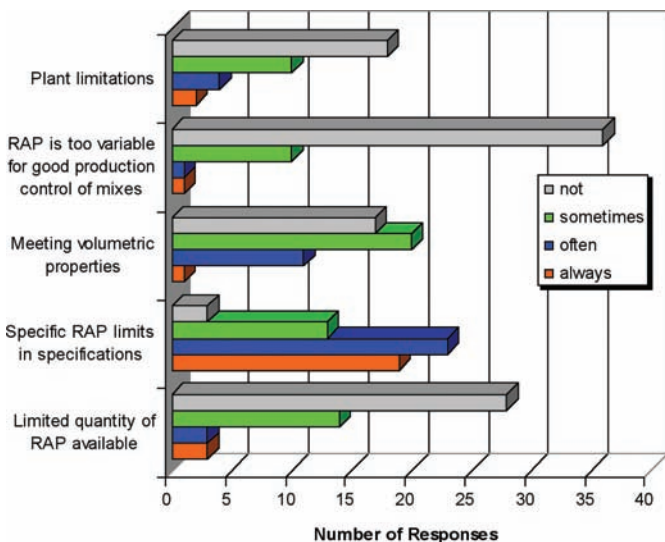


Figure 7. Responses regarding factors that limit higher RAP contents in non-surface mixes.

Quality Control

The survey also asked a few questions about quality control practices for RAP materials. One of the questions asked how frequent samples were obtained and tested for asphalt content and gradation. Responses are summarized in Table 2.

Testing Frequency (one test per...)	Percent of Responses
500 tons or less	43%
Greater than 500 tons less than or equal to 1000 tons	33%
Greater than 1000 tons less than or equal to 2000 tons	20%
Greater than 2000 tons	4%

Table 2. Frequency of Testing RAP Asphalt Content & Gradation

The test methods used for determining asphalt contents are summarized in Figure 8. Clearly a very high percentage of responders are using the ignition method. This method requires an aggregate correction factor, which is an unknown for RAP materials. Three respondents noted that they correlated the ignition test results with one of the solvent extraction procedures, which could be used to make adjustments for the unknown aggregate correction factors.

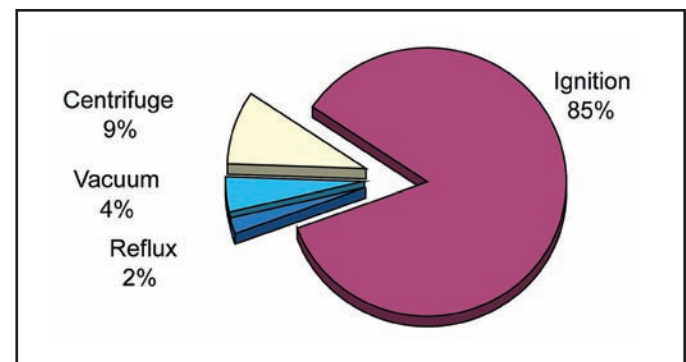


Figure 8. Methods used to determine asphalt content of RAP stockpiles.

Responders were asked to input average and standard deviations for their RAP quality control data. These statistics were gathered on asphalt content and gradation on two sieves: the 75 micron sieve and the median sieve size. The median sieve size is the sieve that is closest to having 50% passing of the extracted

RAP aggregate. For 72% of the stockpiles with reported data, the median sieve was the No. 8 (2.36 mm). Other reported median sieves were the 3/8 inch (9.5 mm sieve) 3%, the No.4 (4.75 mm) sieve, 10%, the No. 16 (1.18 mm) sieve, 10%, and the No. 30 (0.60 mm) sieve, 4%.

RAP property	n	Average Percent	Standard Deviation Percent	
			Average	Range
Asphalt Content	70	5.0	5.0	0.1 to 1.5
% Passing Median Sieve	58	51.7	51.7	0.78 to 9.0
% Passing Micron Sieve	58	7.37	7.37	0.3 to 3.0

Table 3. Summary of QC Statistics for RAP Stockpiles.

Summary

Based on the responses of this detailed on-line survey which received responses from plant operations across the U.S., some general observations can be made.

Most contractors currently follow simple practices of managing RAP materials. Half of the plants combine RAP materials from different sources into a single pile and then process it into a usable RAP material by crushing and/or screening. The other half of responders keep separate stockpiles for RAP from different sources. Many that do this, do so because the state specifications require it.

Regardless of whether the contractors keep RAP from different sources separated or combine them, the vast majority crush all RAP to pass a single size screen. The most common screen size is 1/2 inch. The majority of the contractors follow the same RAP stockpile management practices as with other aggregates. Relatively few take additional steps to minimize moisture content in RAP stockpiles.

Overall, the general perception of the responders is that the main limitation to increasing RAP contents is agency specifications. Other factors that sometime limit higher RAP contents were meeting volumetric requirements, plant limitations, and supply of suitable RAP. The responders also tend to consistently believe that RAP variability is not a limitation on increasing RAP contents in asphalt mixes.

Many contractors sample RAP stockpiles for quality control at frequencies of one test per 500 tons or less. About three quarters of responders used sampling frequencies of one test per 1000 tons or less.

—Asphalt Forum Responses

(continued from page 5)

joint. Although this technique does not yield the best-looking joint (the roller will sometimes break the surface of the aggregate), it is a small price to pay for longevity.

Although our experience with the notched wedge joint is limited, the projects that it has been specified on have had good results. Initially we specified rubberized joint sealer with the notched wedge joint but we now feel that this is unnecessary. An unmodified tack coat should be adequate.

Ontario (Kai Tam, Ontario Ministry of Transportation)

Poor longitudinal joints have been an issue in Ontario for a long time. Since 1997, MTO has been focusing on developing specifications that encourage contractors to construct good joints. We have tried infrared joint heaters, the joint maker, joint tapes and extruded joint adhesives and have constructed 11 contracts with payment adjustments linked to the compaction achieved along the lane edge. Also, MTO has recognized that the contractor's ability to construct good joints is limited to site and traffic conditions. As a result, we are in the process of finalizing a document which will encourage designers to consider various issues that are related to the constructability of good joints and to increase the opportunities for contractors to pave in echelon. Additionally, MTO is obtaining compaction data which would allow us to determine the relationship between the compaction along the lane edge to the compaction adjacent to it. This will assist us in establishing a specification for compaction acceptance that does not eliminate the testing of material within 250 mm of the lane edge (i.e. right now, compaction cores for acceptance are not taken in that area).

Tennessee (Gary Head, Tennessee DOT)

Tennessee has recently identified the issue of premature joint failure on multiple projects within the state, and we are currently investigating/addressing the issue through multiple venues. In Fall 2007, TDOT funded a longitudinal joint research project with the University of Tennessee at Knoxville with the intention of evaluating the effect of various compaction techniques, heaters, wedge plates and adhesives on joint life. TDOT has also implemented a provisional joint density specification on all 2008 projects with >10,000 ADT.

3) Please refer to the cover story on the NCAT Field Compactability Study in the Fall 2007 issue of the **Asphalt Technology News** (you can also access this newsletter on the NCAT website, <http://www.ncat.us>). Several important

findings resulted from the study. We would like to have your comments on the following items:

#1. The study considered $\%G_{mm}$ @ N_{ini} which has been used in the past as a measure of compactability during construction. Have specification requirements for $\%G_{mm}$ @ N_{ini} changed since your agency originally implemented Superpave mixtures; if so, what changes have been made and for what reasons?

#2. Fine- and intermediate-graded mixtures were easier to compact with the gyratory compactor than coarse-graded mixes. Has your agency begun using more fine-graded Superpave mixtures in order to improve the ease of obtaining density in the field? If so, is there selection criteria for when to use fine-graded versus coarse-graded mixes?

#3. The study found that lift thickness/NMAS ratio and mat temperature significantly affected roadway density. Has your agency increased layer thickness to NMAS ratio in order to improve field density?

(Don Watson, Research Engineer, NCAT)

Colorado (Roy Guevera, Colorado DOT)

#1. CDOT dropped the N_{ini} specification.

#2. Contractors in Colorado choose their mix, although most use fine-graded mixes.

#3. CDOT has not changed layer thickness from previous policy.

Connecticut (Nelio J. Rodrigues, Connecticut DOT)

#1. We have raised the N_{ini} requirement from 89.0 to 90.0 for all classes of Superpave mixes for Levels 3 and 4. This change was made in order to address concerns in meeting this criteria during production, without eliminating it all together.

#2. We moved to fine-graded Superpave mixes of all classes for Levels 1, 2 and 3 and required the gradation to be above the Primary Control Sieve (PCS) several years ago with great success. Our motivation was as much to minimize permeability (and porosity) as it was to address easier compaction.

#3. Typically, yes.

Florida (Gregory Sholar, Florida DOT)

#1. No change in $\%G_{mm}$ at N_{ini} . Still follow AASHTO.

#2. FDOT primarily uses fine graded mixtures now, even for higher traffic levels. Fine graded mixtures are allowed on all classes of FDOT roads.

#3. FDOT uses layer thicknesses as follows: four times the nominal maximum aggregate size for coarse graded mixtures and three times for fine graded mixtures. This does help with obtaining density.

Kentucky (Allen H. Myers, Kentucky Transportation Cabinet)

#1. Kentucky's HMA specification does not modify the $\%G_{mm}$ @ N_{ini} requirements in AASHTO M 323. We have utilized these requirements for laboratory mix designs since first implementing Superpave.

#2. In recent years, HMA contractors in Kentucky have started utilizing more fine-graded mixtures in order to address pavement permeability concerns (not necessarily to improve compactability). However, we are aware of anecdotal evidence that compaction, and particularly longitudinal joint construction, is facilitated with fine-graded mixes. The choice of coarse-graded or fine-graded HMA is not specified; the HMA contractor has the option of designing either.

#3. HMA layer thickness in Kentucky is based on a minimum "lift thickness-to-nominal maximum aggregate size" ratio of 3:1. We have observed this policy for several years.

Mississippi (James A. Williams, Mississippi DOT)

#1. Mississippi DOT currently specifies that the $\%G_{mm}$ @ N_{ini} must be less than 90 percent.

#2. Most all HMA mixes produced in Mississippi are coarse-graded mixes (below the maximum density line). This is mainly due to the available gradations of our current aggregate sources.

#3. Mississippi DOT currently specifies a minimum single lift laying thickness of three times the NMAS.

Ohio (Dave Powers, Ohio DOT)

#1. No changes in $\%G_{mm}$ at N_{ini} have been made.

#2. We have not changed gradings recently because we had changed gradings earlier to stay away from the extreme coarse mixes due to permeability issues.

#3. No, we place a 19mm mix down to 1.75 inch lift and we place a 12.5mm mix down to 1.5 inch. We have been placing these with an incentive spec to achieve density above 94 percent for several years and it has been working out for us.

Ontario (Kai Tam, Ontario Ministry of Transportation)

#1. Ontario is no longer enforcing compliance to N_{ini} or N_{max} for production mixes (however compliance is required for mix designs).

#2. The only "selection criteria" MTO uses so far is to simply encourage the use of fine-graded mixes on bridge decks and in maintenance patches.

#3. No recent changes in layer thickness. However, MTO has been moving towards specifying 50 mm thickness for the construction of Superpave 19.0.

NAPA President Shares the Benefits and Research Needs of Hot Mix Asphalt with Congressional Subcommittee

NAPA president Mike Acott and vice president for research and technology Dr. David Newcomb formally testified at a June 24, 2008 hearing on Sustainable, Energy Efficient Transportation Infrastructure by the House Committee on Science and Technology's Subcommittee on Technology and Innovation. Acott shared the ways that the HMA community is developing technologies to reduce energy costs and environmental impacts. Newcomb presented NAPA's response to testimony from the American Concrete Pavement Association. The following are excerpts from Mr. Acott's testimony. A full copy of NAPA's testimony can be downloaded from their website.

From Mike Acott's testimony:

"The asphalt pavement industry would like to see continued vigorous federal research programs to address the issues that have been identified within the *National Asphalt Roadmap*."

"Recycling ... the asphalt industry is America's number one recycler. Recycling saves precious natural resources and reduces the carbon footprint of pavement construction. Of the 100 million tons of asphalt pavement reclaimed each year, about 75 million tons is mixed with virgin materials and incorporated into new asphalt pavement. This is called the *highest and best use* ..."

"Smooth Roads We know that smooth roads conserve energy and extend the life of pavements."

"Reducing Congestion Asphalt pavements can be designed so that they only need periodic resurfacing, and the work to accomplish this can be scheduled during non-rush hours, facilitating the movement of vehicles through the work zone, reducing fuel consumption and improving safety"

"Safety Using porous friction courses on pavement surfaces helps to eliminate tire splash and spray in rainstorms. Not only does this enhance tire-to-pavement contact, and therefore safety, it also improves drivers' visibility."

"Porous Asphalt Pavement Porous asphalt pavements decrease runoff and increase filtration, improving water quality."

"Quiet Pavements Using a low-noise asphalt surface means that the volume can be turned down at the source and that noise walls can be reduced in height."

"Rubblization When confronted with reconstruction or major rehabilitation of a concrete pavement, rubblization in-place of the concrete with an asphalt overlay is the easiest, lowest cost, and most effective way to rehabilitate the pavement in the shortest amount of time."

"Perpetual Pavement ... the asphalt pavement is engineered and built to last without requiring major structural rehabilitation or reconstruction, and needing only periodic surface renewal in response to distresses confined to the top of the pavement."

"Warm-mix Asphalt Technologies ... these technologies reduce emissions and lower energy consumption. Continued research and demonstration projects will be required to assist in the full implementation of warm-mix asphalt."

"Automation of Construction Practices Another facet of research needed is in the automation of construction practices. NAPA is very supportive of national efforts such as the development of intelligent compaction, automated sampling and testing, and other tools to enhance worker safety."

"As many of our nation's highways and bridges exceed their design life, they will require significant improvements. An ongoing research and technology program aimed at continuous improvement in the performance of asphalt pavements is vital to the national interests."

"NAPA respectfully urges the Committee on Science and Technology to reauthorize the existing asphalt research program under the Federal-aid Highway Program and increase the funding to achieve the vision as outlined in the *National Asphalt Roadmap for Research and Technology*."

NCAT Training Opportunities

NCAT provides a variety of training opportunities to fit any need. Courses in mix design, asphalt technology, asphalt binder training, and professor training are provided annually. Technicians, engineers, graduate students, professors, contractors and local, state and federal agency personnel benefit from these training courses which are designed to give specific technical information as well as a general overview of the HMA industry.

If you are interested in attending these programs, or if you would like additional information, please contact Linda Kerr: phone 334.844.7308, Fax 334.844.6248 or by e-mail at kerrlin@auburn.edu

ASPHALT TECHNOLOGY

The Asphalt Technology course is a one-week training program designed to provide a basic understanding of asphalt technology for technicians, engineers, and employees from all sectors of the asphalt industry. If you are looking for a general overview of HMA technology and how all the aspects from design, production, construction, to maintenance come together, this is the course for you. Participants will be better able to communicate effectively with asphalt specialists and suppliers will be better able to understand customer needs. Attendees will be provided a copy of the NCAT textbook, "Hot Mix Asphalt Materials, Mixture Design, and Construction" that will be a valuable reference resource for years to come.

NCAT's Asphalt Technology Course (January 28 - February 1, 2008)



Two Asphalt Technology courses are held each year. For 2009 the courses are scheduled January 26-30 and February 23-27. The registration fee is \$850/person, which includes the training program, course materials, and breaks. The course provides 32 professional development hours.

SUPERPAVE MIX DESIGN

This workshop provides a more technical understanding of materials specifications, test procedures, mixture performance tests, and general mix design requirements. The objective is to provide technicians, engineers, testing personnel and inspectors with an understanding of the development of a Superpave volumetric mix design. Upon completion of the workshop, participants will be able to develop a Superpave volumetric mix design in their laboratories.

2008 Superpave Mix Design Course Participants

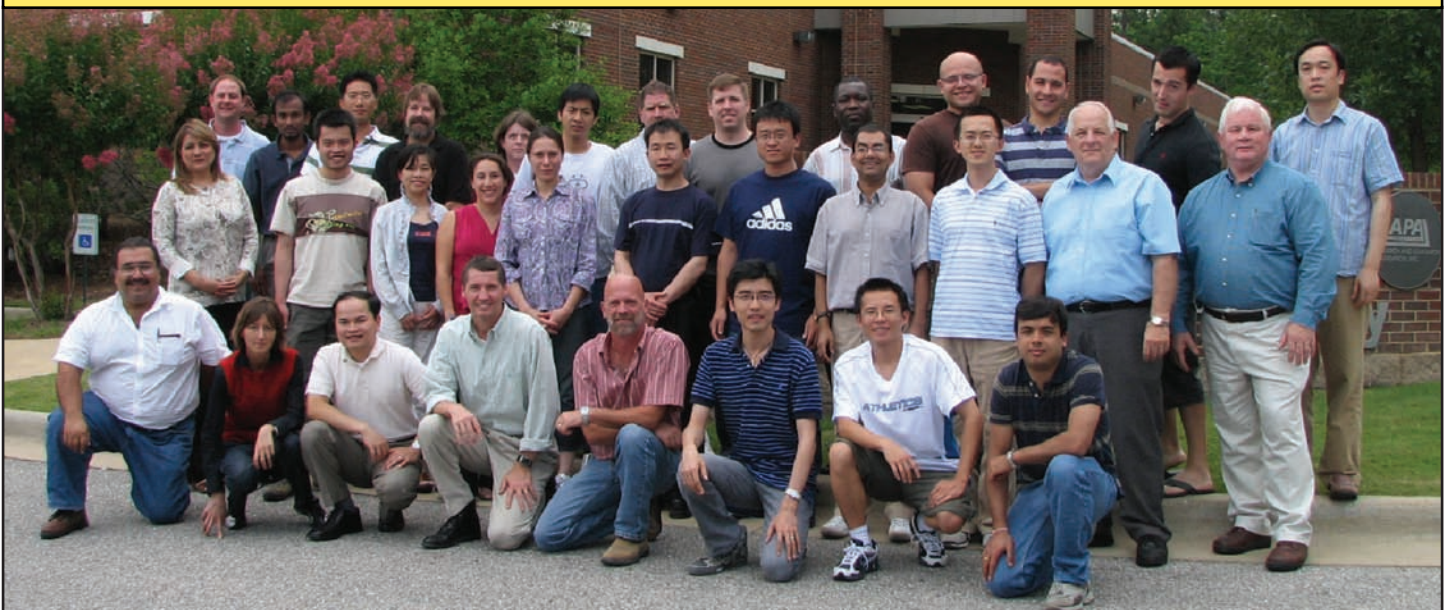


The Superpave Mix Design Course is offered March 23-26, 2009 at NCAT facilities in Auburn, Ala. Continuing education units/professional development hours are available.

PROFESSOR TRAINING

Each year NCAT hosts a special course designed for college and university civil engineering faculty that will allow them to offer undergraduate and graduate courses in Asphalt Technology. The program is also designed to allow graduates to have an educational background in Hot Mix Asphalt and asphalt technology. There have been more than 420 attendees through this program since it began in 1988. The 2008 class consisted of 26 attendees representing 14 universities and 13 states plus the U.S. Coast Guard Academy and the country of Ecuador.

2008 Professor Training Attendees and Instructors



All course materials, handouts and other resource materials are provided at no cost to participants. Thanks to funds provided through efforts of the NAPA Young Leaders and the NAPA Research and Education Foundation, a stipend is provided to help pay travel costs as well.

The 2009 Professor Training Course will be held at NCAT facilities in Auburn, Ala. June 16-25.

CUSTOMIZED TRAINING

NCAT will also provide customized training to meet your individual training needs. Various workshops have been held for contractors, consultants, private laboratories and special agency interests. For example, in 2008 a custom-tailored workshop was held for Nigerian engineers who wanted special training in Pavement Management Systems. Course topics included pavement condition surveys, pavement management systems, preventive maintenance and types of repairs, pavement design software and thickness design procedures, and HMA recycling and rehabilitation methods.

Nigerian Engineers Attending Customized Pavement Management Training



Contact Don Watson: phone 334.844.7306, Fax 334.844.6248, or E-mail at watsode@auburn.edu for your specialized training needs.

EVERYONE HAS A CHANCE TO BE A WINNER!

The NAPA Research and Education Foundation is conducting a raffle for a unique chopper, the Asphalt Smooth Rider. The bike is the only one of its kind and was created by Thunder Mountain Motor Sports. NAPA's Associate Members have organized the raffle and funds will be used to purchase much needed equipment for the National Center for Asphalt Technology. That way everyone benefits.

Raffle tickets are \$100 each and are available at www.smoothrider.org. Purchase your tickets today and you may be the lucky winner! The drawing will be held at the 2009 World of Asphalt Show and Conference. The World of Asphalt will be held in Orlando, Florida March 9-12, 2009.



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