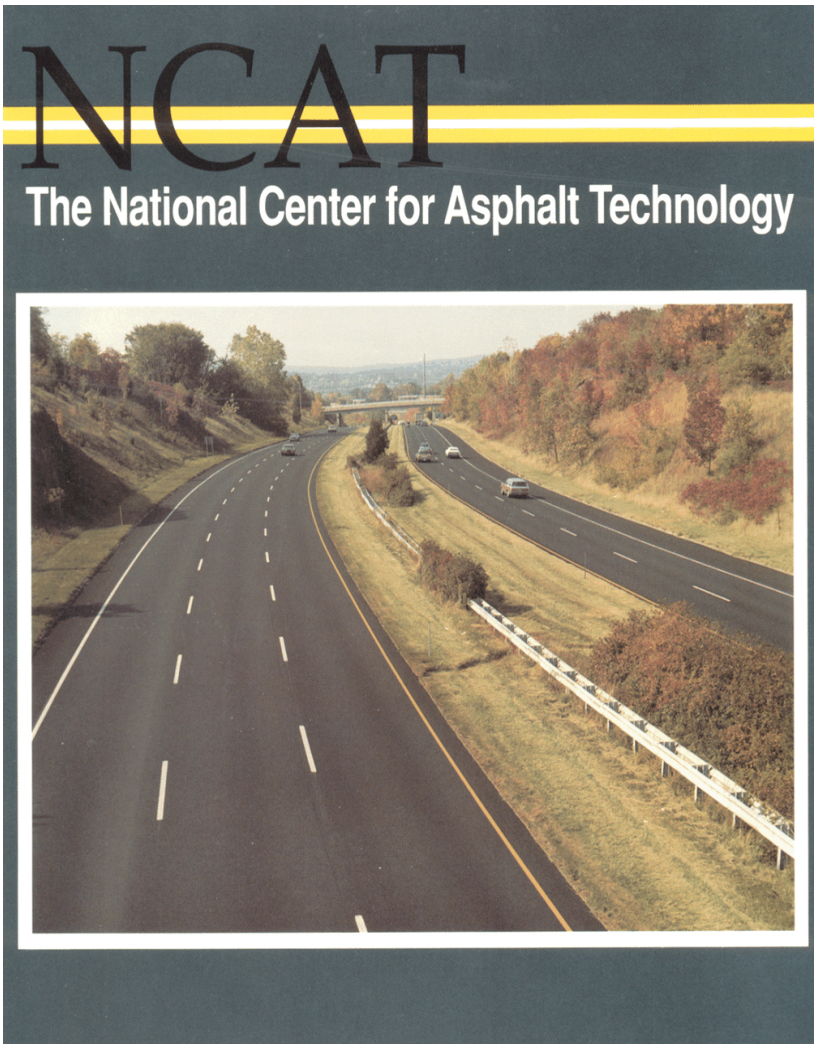
THE HISTORY OF THE NATIONAL CENTER FOR ASPHALT TECHNOLOGY (1986-2004)

by Prithvi (Ken) Kandhal
Associate Director Emeritus



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National Center for Asphalt Technology
277 Technology Parkway
Auburn, Alabama 36830

THE HISTORY OF THE NATIONAL CENTER FOR ASPHALT TECHNOLOGY
Auburn University, Alabama
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The Beginning (1986-88)

The National Center for Asphalt Technology (NCAT) was established at Auburn University in September 1986 when the NAPA Research and Education Foundation signed a five-year cooperative agreement with Auburn University. The visionary leadership of the National Asphalt Pavement Association (NAPA) raised $10 million to provide an endowment to be used to sponsor education, research, and information services in the field of hot mix asphalt (HMA).

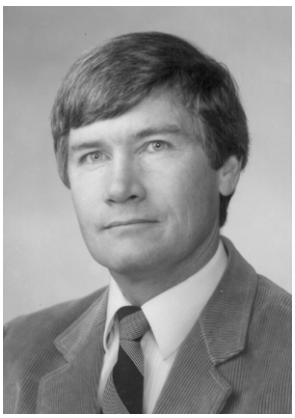
NCAT started in September 1986 in Harbert Engineering Center on Auburn University Campus.

Ninety-six percent of all paved roads and streets in the United States—almost two million miles—are surfaced with asphalt. In 1986, the industry produced and placed approximately 500 million tons of hot mix asphalt valued at some $11.5 billion. The HMA industry directly employed some 300,000 people and indirectly accounted for an additional 600,000 jobs. When combined with state and federal employees associated with the construction and maintenance of asphalt surfaced roads, the HMA industry has a significant impact on the economic vitality of the nation. NCAT was created to ensure the HMA industry's ability to meet this challenge and create opportunities for the future. Research, education, and information are the critical requirements for a quality product and a competitive HMA industry. NCAT was geared to meet these challenges.

Dr. Freddy L. Roberts was the first director of NCAT. He was professor of civil engineering at Auburn University. NCAT started its operations in the Harbert Engineering Center at AU campus. Joyce Woodfin assisted Roberts as an executive secretary. Guy Savage was appointed laboratory supervisor and Johnny Turner was appointed laboratory technician. About 5,300 square feet of materials testing space was made available to NCAT in the Harbert Engineering Center.

Dr. Freddy L. Roberts was the first director of NCAT. He was Professor of Civil Engineering at Auburn University.

Dr. E. Ray Brown joined NCAT in 1987 as assistant director. He came from the U.S. Army Corps of Engineers Waterways Experiment Station (WES) in Vicksburg, Mississippi, where he was chief of the Materials Research Center. Dr. Brown received his B.S. and M.S. degrees from Mississippi State University in 1969 and 1974 respectively. He received his Ph.D. from Texas A&M University in 1983. As chief of the WES Bituminous Section, he directed the work of an annual program that exceeded $3 million. His 17 years of HMA-related experience was extensive, including such areas as mixture design and construction, quality control, training, and development of specifications.



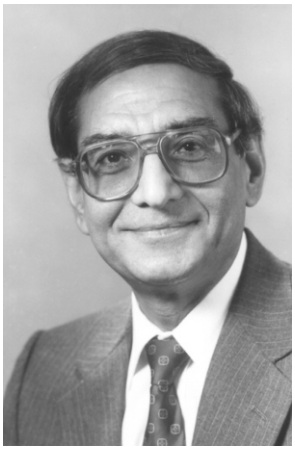
Dr. E. Ray Brown joined NCAT as Assistant Director in 1987. He was Chief of Materials Research at U.S. Army Corps of Engineers, Vicksburg, MS.

In February 1988, Prithvi (Ken) Kandhal joined NCAT as assistant director. He came from the Pennsylvania Department of Transportation where he was chief asphalt

engineer for 17 years. Kandhal received his M.S. degree in civil engineering from Iowa State University in 1969, specializing in asphalt materials. While at PennDOT he planned and executed numerous research projects on asphalt rheology and its effect on pavement performance, baghouse fines in HMA, statistical specifications, recycling and rutting. He also assisted materials and construction personnel statewide in resolving problems in the field related to asphalt mix design, production, and construction.

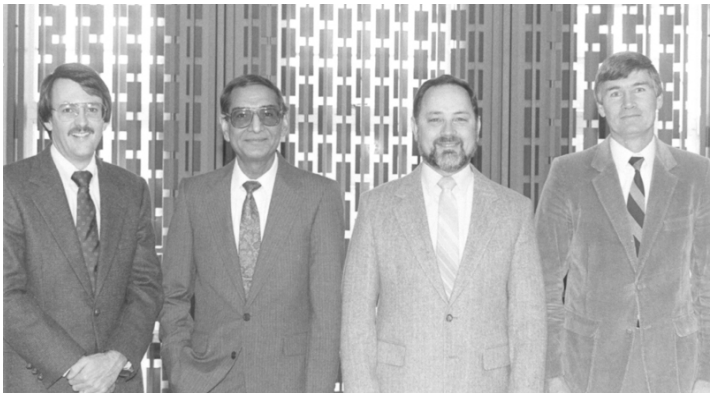
The need to balance long-term needs against short-term problems, and translate theoretical research into practical applications had high priority at NCAT. When NCAT was established, its research program focused on two major areas to improve the performance of HMA pavements:

- Minimization of rutting by developing simple tests to evaluate rutting potential of mixes, and analysis of in-service pavements across the U.S. This five-year research project was started in 1987.
- Elimination of stripping of asphalt from aggregates by discovering breakthroughs in the stripping mechanisms, and the development of tests to measure stripping potential of HMA mixes.



Prithvi (Ken) Kandhal joined NCAT as Assistant Director in February 1988. He was Chief Asphalt Engineer of Pennsylvania DOT from 1970 to 1988.

Ray Brown led the research on rutting with the assistance of Steve Cross, who joined NCAT in 1988 as a senior research associate. Dr. Badru Kiggundu, who came from New Mexico Engineering Research Institute, joined NCAT as research engineer in 1987 to initiate research on stripping. Drs. Christine Curtis, Ray Tarrer, and James Guin of Department of Chemical Engineering also assisted in carrying out fundamental research on asphalt-aggregate interactions which influence stripping. These stripping studies were already underway at NCAT for one and a half years when the proposals for the Strategic Highway Research Program (SHRP) Project A-003B on "Fundamental Properties of Asphalt-Aggregate Interaction Including Adhesion and Absorption" were invited. NCAT was awarded this $3 million, three-year research contract beginning in 1988.



L-R: Steve Cross (Senior Research Associate), Ken Kandhal, Freddy Roberts, and Ray Brown.

First NCAT Board of Directors. Seated, L-R: Dr. M. Dayne Aldridge; Dr. Paul F. Parks, Vice Chairmain; Harry Ratrie, Chairman; Dr. Freddy Roberts, Director; and Dr. Tom Kennedy. Standing, L-R: Charles Potts; James T. Tatum Jr.; Michael B. McCartney; John Gray; Robert G. Hunt; and Dr. Jon A. Epps. Not shown: William E. Clarkson Jr., Willis, H. Duininck, and Frank L. Whitcomb.

Harry Ratrie chaired the first NCAT Board of Directors in 1987. The 13-member Board consisted of seven members nominated by the NAPA Research and Education Foundation and six members (including two from academia) nominated by Auburn University. The list of people who have chaired the Board from 1987 to 2004 is given in Appendix A.

An NCAT Applications Steering Committee (ASC) was also established in 1988 to recommend and review the research projects undertaken by NCAT. Charles Potts chaired the first ASC. The list of people who have served as chairperson of ASC is given in Appendix B.

An NCAT Open House was held in November 1988, which was attended by industry representatives and personnel from state departments of transportation and the Federal Highway Administration. Thomas Deen, executive director of the Transportation Research Board, was the principal speaker at the dinner.

NCAT administrative offices moved from Harbert Engineering Center to 211 Ramsay Hall in 1989.

The primary NCAT thrust in education was to prepare a standard college textbook on asphalt technology, and to conduct preparatory courses for civil engineering faculty who teach materials technology.

NCAT conducted its first Professor Training Course on HMA technology in 1988. Since then it has been conducted yearly, and will be continued into the future. This course has encouraged and facilitated the inclusion of asphalt technology in the civil engineering curriculum of many universities. Personnel from several state DOTs and the Federal Highway Administration (FHWA) have also attended.

The first NCAT Board of Directors with AU President Dr. James Martin. L-R (seated): Jim Tatum, Harry Ratrie, James Martin, Paul Parks, and Mike McCartney. L-R (standing): John Gray, Robert Hunt, Frank Whitcomb, William Clarkson, Willis Dunnick, Lynn Weaver, and Charlie Potts.

NCAT Support staff: Johnny Turner, Laboratory Technician; Joyce Woodfin, Executive Secretary; and Guy Savage, Laboratory Supervisor.

Besides research and education, NCAT's mission was to provide information services to the HMA industry. Besides conducting research, Prithvi (Ken) Kandhal assumed the responsibility of providing information services. The goal was to make NCAT as a clearinghouse for state-of-the-art information on research data collected internationally, and to provide methods to bridge the gap between theory and field practice. A Transportation Research Information Service (TRIS) computer terminal was acquired by NCAT to retrieve research reports pertaining to HMA technology by using key words. The NCAT library was also established. Old books and journals dating back from 1905 to the present were purchased or acquired through donations from retired HMA industry people.

NCAT Administrative Offices moved from Harbert Engineering Center to 211 Ramsay Hall in 1989.

Discussing NCAT activities at the open house Nov. 15, 1988, L-R: Harry Ratrie, then chairman of the NCAT board of directors; Ronald D. Kenyon, then NAPA chairman of the board; Thomas B. Deen, executive director of the Transportation Research Board, who was principal speaker at the dinner; and Frank L. "Chip" Whitcomb, then chairman of the NAPA Education Foundation board of trustees.

1989

The first NCAT newsletter, "Asphalt Technology News," edited by Prithvi Kandhal, was published in January. It included regular columns such as Putting Research Into Practice, Specification Corner, and Asphalt Forum. It was well-received by the practicing engineers, both in the public and private sectors.

The second NCAT Open House was held in March. Speakers at the function included: Francis Franchois, executive director AASHTO; Ron Kenyon, who helped coordinate raising the $10 million endowment fund for NCAT; Bob Thompson, chairman of the NCAT Board of Directors; Frank (Chip) Whitcomb, chairman of NAPA REF; William Walker, dean of engineering; and NCAT staff: Freddy Roberts (director), Ray Brown (assistant director), and Prithvi (Ken) Kandhal (assistant director).

NCAT's newsletter "Asphalt Technology News" edited by Ken Kandhal.

Francis Franchois, Executive Director, AASHTO.

Ron Kenyon, who helped coordinate raising $10 million endowment fund for NCAT.

Dr. Freddy Roberts, NCAT Director.

The Association of Asphalt Paving Technologists (AAPT) presents the W.J. Emmons Award for best paper every year, and recognizes the runner-up paper. Both the best paper and the runner-up papers were submitted by NCAT researchers. Prithvi (Ken) Kandhal received the best paper award for a paper on stripping, and Ray Brown and Steve Cross were recognized for the runner-up paper on rutting. As mentioned earlier, NCAT's primary initial thrust was to conduct research on rutting and stripping.

Prithvi (Ken) Kandhal, NCAT Assistant Director.

Dr. Ray Brown, NCAT Assistant Director.

Prithvi (Ken) Kandhal receiving W.J. Emmons Award for best paper from AAPT President Thomas W. Kennedy in March 1989.

1990

An Australian group of nine people, comprised of senior engineers from state road authorities, the Australian Road Research Board, and the HMA industry, visited NCAT in February for exchange of information on HMA technology.

In keeping with its mission of continuing education, a third professor training course was conducted by NCAT in the summer. The training course was shortened from four weeks to two in response to input from faculty who reported difficulty in leaving their university posts for a longer period.

Dr. Freddy Roberts showing NCAT laboratory in Harbert Engineering Center.

Prithvi Kandhal became contributing editor of "Roads & Bridges" magazine, which started a column "Asphalt Answers."

The leadership of NCAT changed in August when Ray Brown was named as acting director succeeding Freddy Roberts, who accepted an endowed chair at Louisiana Tech, in Ruston, Louisiana. Roberts had served as director of NCAT since its founding in 1986.

NCAT Staff bids farewell to Dr. Freddy Roberts, who resigned as NCAT Director to join Louisiana Tech University. L-R: Bob Johnson, Ray Brown, Freddy Roberts, Joyce Woodfin, Ken Kandhal, and Steve Cross (August 31, 1990).

Ray Brown, Director NCAT.

1991

Ray Brown was selected as director of NCAT on April 1.

NCAT published the "first-ever" comprehensive textbook on hot mix asphalt (HMA) technology in spring of 1991. Entitled *Hot Mix Asphalt Materials, Mixture Design and Construction*, the book presented a systematic treatment of the entire subject of hot mix asphalt.

This book was a direct result of the nation's hot mix asphalt contractors and National Asphalt Pavement Association's concern regarding the lack of material on asphalt technology for engineering students in colleges and technical schools. In fact, two of NCAT's principal educational activities have been to provide an opportunity for civil engineering faculties to study asphalt technology through NCAT's summer course, and to prepare a book suitable for college and field use.

NCAT's HMA textbook published in 1991.

This book was prepared to help those individuals teaching asphalt technology to ensure that future engineers and technicians do their job. This book was also intended for the practicing engineer who is involved to any extent with hot mix asphalt. This includes personnel that work for the Federal Highway Administration, state departments of transportation, the Federal Aviation Administration, Corps of Engineers, Air Force, Navy, county and city engineers, consulting engineers, and contractors.

Ray Brown (second from right) with U.S. and German engineers looking at SMA (April 1991).

The textbook contained nine chapters of about 500 pages. These chapters covered asphalt refining, uses, and properties; aggregates; HMA mixture design methodology; characterization of asphalt mixtures; equipment and construction; special mixtures, recycling, and

additives; performance/distress of HMA; and maintenance, rehabilitation, and reconstruction of HMA. Of the 4000 copies of the textbook printed, about 3000 copies were sold by August.

NCAT received a lot of visitors in 1991, which included Charlie Miller, associate administrator FHWA; Tom Epsy, chief engineer, Alabama DOT; Georgia DOT engineers; engineers from W.E.S., U.S. Corps of Engineers; Dutch highway engineers; Canadian highway engineers; and Australian highway engineers.

Members of SHRP Project A-003 B Advisory Committee met in May at NCAT. This important project on asphalt-aggregate adhesion and interaction undertaken by NCAT was nearing completion. NCAT also completed a Pennsylvania DOT rutting study, "Evaluation of Bituminous Pavements for High Pressure Truck Tires," which evaluated 34 in-service heavy-duty pavements in Pennsylvania.

Ray Brown (left) showing NCAT laboratory to Charlie Miller, Associate Administrator FHWA (second from left), Tom Epsy, Chief Engineer, Alabama DOT (third from right) and other engineers (1991).

NCAT director Ray Brown visited Europe with a group of state DOT and FHWA engineers to become acquainted with stone matrix asphalt (SMA) technology. NCAT was involved in the mix design and evaluation of SMA projects placed in the U.S. for the first time in 1991.

The NCAT Board of Directors was expanded to include representatives from the Transportation Research Board (TRB), the Federal Highway Administration (FHWA), and the American Association of State Highway and Transportation Officials (AASHTO) as ex-officio members. Messrs. Thomas Dean of TRB, Byron Lord of FHWA, and Francis Francois of AASHTO joined the Board.

Charles Miller, Associate Administrator, FHWA (Open House, 1991).

Members of SHRP Project A-003 B Advisory Committee wich met in May 1991 in Auburn. NCAT conducted this project.

NCAT held an Open House in October. Over 100 people, including DOT officials from various states, FHWA officials, and representatives of the HMA industry, attended. Charles Miller, associate administrator of the FHWA, was the featured speaker. Other speakers included Ned Bechthold, chairman of the NCAT Board of Directors; Paul Parks, vice-president for research, Auburn University; and John Gray, president of NAPA.

A meeting of the NCAT Board of Directors was held in Washington, DC in December to develop NCAT's Strategic Plan.

Bob Johnson, NCAT lab manager (1991).

Paul Parks, AU Provost (Open House, 1991).

Charles Potts, APAC, and John Gray, NAPA (Open House, 1991).

1992

Additional space was made available in Ramsay Hall for NCAT administrative offices and library.

The five-year rutting study led by Ray Brown was completed and recommendations were made to minimize or eliminate rutting in HMA pavements.

Ray Brown, Director, and Ken Kandhal, Associate Director, in NCAT administrative office in Ramsay Hall (1991).

Douglas Hanson joined NCAT as assistant director in January. He came to Auburn from the New Mexico State Highway Department, where he was chief of the materials laboratory for ten years. Hanson received his B.S. degree from the South Dakota School of Mines and Technology in 1965, and his M.S. degree from the University of New Mexico in 1969. He served in the U.S. Air Force for ten years in a number of engineering assignments dealing with airfield pavement design, construction, and maintenance. He also served as district engineer of the Asphalt Institute for five years.

L-R: Mike McCartney, Tom Epsy, Ned Bechthold, and Ray Brown (Open House 1991).

NCAT initiated a five-year national study on HMA longitudinal joint construction techniques. The study, led by Prithvi Kandhal, comprised of 7-8 test sections constructed in Michigan, Wisconsin, Colorado, New Jersey, and Pennsylvania.

By the end of June, 85 faculty members had been trained in HMA at NCAT under the professor training program.

NCAT was visited by the Fifth Overseas Pavement Study Group of Japanese Road Contractors Association in October.

Doug Hanson appointed Associate Director.

1993

NCAT held its first short course in asphalt technology in February. The course was intended for practicing engineers from both private and public sectors in the United States and abroad.

NCAT acquired SHRP binder and mix testing equipment. After that acquisition, NCAT had in place equipment worth about $770,000.

Since the five-year Strategic Highway Research Program (SHRP) had ended in 1992, there was a need to implement the technology developed under this program. NCAT conducted four-day SHRP Binder and Mixture Testing workshops in November 1993 and January 1994. The purpose of these workshops was to provide a general understanding and hands-on training on testing asphalt binders and HMA mixtures using the SHRP technology.

1992 Professor Training Course attendees on the way to Chattanooga, TN.

Doug Hanson, Ray Brown and Ken Kandhal in 211 Ramsay Hall (1993).

German engineers visiting NCAT (1993).

1994

NCAT had a total staff of 13 people: one director, two assistant directors, three engineers, four technicians, and three secretaries.

NCAT began two major National Cooperative Highway Research Program (NCHRP) research projects on stone matrix asphalt (SMA) and aggregates. The $500,000, two-year NCHRP Project 9-8, "Designing Stone Matrix Asphalt (SMA) Mixtures" was led by Ray Brown. The $500,000, three-year NCHRP Project 4-19, "Aggregate Tests Related to Asphalt Concrete Performance in Pavements" was led by Prithvi Kandhal and Frazier Parker.

A team of German engineers visited NCAT in December.

Don Brock, chairman of the NCAT Applications Steering Committee, re-organized the membership to include people from the HMA industry, DOT, asphalt suppliers, equipment manufacturers, HMA state executives, TRB, and NAPA on a 3-year rotation basis.

1993 Professor Training Course attendees in NCAT laboratory.

After four years of research led by Ray Brown, NCAT developed an ignition method for determining asphalt content of HMA mixtures. At that time, many agencies used chlorinated solvents (such as 1,1,1 - trichloroethane) to dissolve and remove the asphalt binder from the aggregate. Such solvent extraction methods provide two important properties: asphalt content and aggregate gradation of HMA mixtures. However, the solvents used for extraction were expensive, difficult to dispose of, and unsafe. Growing health and environmental concerns associated with the use of chlorinated solvents were major factors in the search for alternate methods of determining asphalt content.

Newer types of solvents, generically called biodegradable solvents, had been evaluated and used by some agencies as a replacement for chlorinated solvents. Biodegradable solvents, however, require a modified extraction procedure which is time consuming. The proper disposal of biodegradable solvents containing the dissolved asphalt binder was also a problem in some states.

Cynthia Lynn (center) conducting aggregate test for NCHRP 4-19.

Nuclear asphalt content (NAC) gauges were substituted for solvent extraction in some states. NAC gauges are capable of rapidly measuring the asphalt content of HMA mixtures with accuracy at least comparable to solvent extraction methods. Although NAC gauges solved many of the problems associated with solvent extraction methods, these methods did not allow for determination of aggregate gradation. Furthermore, the solvent extraction test was still required for determining the asphalt content of reclaimed asphalt pavement (RAP) materials.

Because NAC gauges and biodegradable solvents had not successfully eliminated the use of chlorinated solvents, other test methods were sought to determine asphalt content.

In the ignition method, a sample of HMA mixture is subjected to very high temperatures in a furnace resulting in virtually complete combustion (or burning off) of the asphalt binder. The difference in weight of the HMA mixture before and after ignition indicates the asphalt content of the HMA mixture. The aggregate is then subjected to sieve analysis to determine its gradation. During four-year research, NCAT

NCAT ignition oven from Barnstead Thermolyne (1995).

experimented with various equipment and procedures to minimize the aggregate mass loss (0.2-0.3 percent for some aggregates) and the testing time.

The finalization of the ignition method was a significant breakthrough in testing of HMA mixtures. This method was subsequently adopted by the AASHTO and the ASTM and is now used worldwide.

1995

NCAT was designated by the FHWA as the regional Superpave Center for the Southeast. The Superpave Center had the objectives of facilitating the implementation of Superpave technology by providing support services and training on Superpave binders and mixture testing. With the addition of the Superpave equipment, NCAT had more than $1.5 million in equipment.

Prithvi (Ken) Kandhal was promoted and made associate director of NCAT. Shane Buchanan joined NCAT as research engineer.

Don Lucas, chief engineer, Indiana DOT, was a keynote speaker at the open house held in April 1996.

1996

Byron Lord, FHWA (Open House, 1996).

NCAT celebrated its tenth anniversary with an open house in April. About 100 participants from state DOTs, the Federal Highway Administration (FHWA), academia, and industry from 20 states attended the event. Don Lucas, chief engineer of the Indiana DOT, was the keynote speaker.

Mike Acott, president of the National Asphalt Pavement Association; Byron Lord, chief of the FHWA Pavement Infrastructure Division; and Ray Brown, director of NCAT, made presentations.

Acott cited many examples of NCAT's achievements during the past 10 years, such as the development of HMA textbook, annual professor training course in HMA technology, a national rutting study, major participation in SHRP research, stone matrix asphalt (SMA) research, and the development of NCAT's ignition oven for determining asphalt content without solvents. He stated that in addition to the industry sponsored research, NCAT is conducting numerous research projects for the FHWA, various state DOTs, and the National Cooperative Highway Research Program (NCHRP). Very rapid and successful implementation of SMA technology and the ignition test method for asphalt content in the U.S. can be attributed to NCAT's central and active role at the national level, in co-operation with the FHWA, state DOTs, and the industry.

Bob Thompson, Thompson-McCully Co. (Open House, 1996)

Lord cited NCAT as a perfect example of partnership between government, industry, and academia. He lauded the great vision of industry people like Ron Kenyon and John Gray in establishing a $10-million endowment fund for supporting NCAT at Auburn University.

Brown highlighted the progress made by NCAT since its inception in 1987. NCAT's permanent staff had grown from 1 to 17 during the last ten years. Its annual budget had increased from $500,000 to about $1.5 million. He cited five accomplishments in particular.

AU President Bill Muse welcoming the open house attendees (1996).

- **HMA Textbook.** The first-ever HMA textbook was developed by NCAT in 1991, and some 10,000 copies had been sold. It was used in many universities to teach HMA technology. Work was underway to publish a revised edition of the textbook in early summer. The revised edition would contain Superpave technology, stone matrix asphalt (SMA), and modifiers/additives.
- **Professor Training Course (PTC).** This course in HMA technology was developed by NCAT in 1988 for university faculty so that they could teach HMA technology at their institutions. The PTC had been held successfully every year since 1988. Until 1995, some 123 professors from 38 states had been trained.
- **National Rutting Study.** NCAT undertook a major five-year rutting study in 1988 which involved many HMA pavements nationwide. The findings and recommendations from this study have been effective in minimizing or eliminating rutting on heavy duty pavements. Many state DOTs had implemented recommendations from this study.
- **NCAT Ignition Oven for Determining Asphalt Content.** This innovative method of determining asphalt content of HMA mixtures without any solvents was developed by NCAT in 1994. Its high accuracy and precision was established in the spring of 1995 through a round robin national study in which 12 laboratories participated. Numerous NCAT ignition ovens were now in use and the number was increasing at a rapid rate, as many highway agencies were switching from solvent extraction methods to this method. The method was drawing world-wide attention because many agencies were phasing out the use of chlorinated solvents, which are considered hazardous to human health and the environment. Asphalt content can be obtained within 30-40 minutes by this method which also allows the determination of the recovered aggregate gradation.
- **NCAT Newsletter *Asphalt Technology News*.** The newsletter has been acclaimed by the HMA industry to be very practical and informative. It has provided a forum to the highway agencies and the industry for exchanging ideas and experiences in HMA technology.

Mr. and Mrs. Ron Kenyon with Joyce Woodfin (right) at the Open House, 1996.

L-R: Jack Mathews, Joe Wilkerson, Bill Deyo, and Larry Lockett (Open House, 1996).

Ray Brown (right) showing the model of NCAT proposed test track to Prof. Steve Brown of University of Nottingham (1996).

Second edition of NCAT Textbook with NCAT newsletters (1996).

NCAT Board of Directors held a Strategic Planning Meeting in August to plan for 3-5 years. The Board also approved the concept of building a full-scale test track at NCAT.

Allen Cooley and Rajib Mallick joined NCAT as research engineers.

NCAT came on the internet when its world wide web site was located at http://www.eng.auburn.edu/center/ncat. Rajib Mallick, NCAT research engineer, created the home page of NCAT.

Rajib Mallick updating NCAT website (1995).

NCAT was visited by highway engineers from Japan and Dr. Steve Brown of University of Nottingham (U.K.).

NCAT completed a major research project, "Designing Recycled HMA with Superpave Technology" which was led by Prithvi (Ken) Kandhal.

Allen Cooley (left) demonstrating tests during the open house (1996).

Rajib Mallick in Research Park (1996).

The second edition of the HMA text book, "Hot Mix Asphalt Materials, Mixture Design and Construction" was prepared by Ray Brown and Prithvi Kandhal and was made available in December. The revised edition had about 100 additional pages to cover Superpave (asphalt binder and mix design), stone matrix asphalt (SMA), and modifiers. The first edition had been well-received by civil engineering faculty and practicing engineers across the United States. The revised edition contained the latest asphalt technology of 1996.

NCAT library in Ramsay Hall (1996).

Ken Kandhal and Jim Soreson (FHWA) (Superpave Conference, 1997).

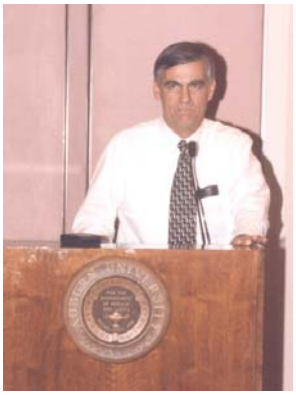
1997

NCAT hosted a FHWA-sponsored Regional Superpave Conference in February. Its stated purpose was to provide a forum for discussing Superpave implementation by various state DOTs, to identify problem areas that had been encountered, and to offer solutions where possible. The conference was attended by 240 people, consisting of FHWA personnel, DOT personnel, contractors, and academia.

Two delegations, consisting of government and industry engineers from South Africa and Australia, visited NCAT in August.

John D'Angelo making a comment (Superpave Conference 1997).

Attendees of Superpave Conference (1997).



Jon Epps discussing WesTrack performance at the Superpave Conference (1997).

Ray Brown, NCAT Director, welcoming the attendees to the Superpave Conference (1997).

Cynthia Lynn and Ray Brown (AAPT Meeting, Boston, 1998).

Shane Buchanan (left) discussing Superpave testing with state DOT engineers (1997).

NCAT completed the $500,000 three-year NCHRP Project 4-19, "Aggregate Tests Related to Asphalt Concrete Performance in Pavements," which was led by Prithvi (Ken) Kandhal and Frazier Parker. New aggregate tests such as Micro-Deval test, Methylene Blue test, and Coarse Aggregate Angularity (CAA) test were recommended.

South African Bitumen Association (SABITA) officials visited NCAT. From left to right: Doug Hanson (NCAT), Martin van de Ven (SABITA), Rob Vos (SABITA), Mike Zacharias (SABITA), and Ken Kandhal (NCAT), 1997.

Government and industry engineers from Australia visited NCAT in 1997.

Government and industry engineers from South Africa's Society for Asphalt Technology visited NCAT (1997).

1998

The Alabama Department of Transportation and NCAT began planning to construct and operate an oval test track (accelerated pavement loading facility) to evaluate the performance of various HMA test pavements. Auburn University had purchased 310 acres of land approximately 15 minutes from the university for the test track. The ground-breaking ceremony was held on September 29.

Ray Brown discussing proposed NCAT Test Track with DOT engineers (1998).

Ray Brown with DOT engineers participating in NCAT Test Track (1998).

Test Track (1998).

The ground-breaking ceremony of NCAT Oval Test Track held on September 29, 1998. L-R: Bill Muse, Bill Walker, Paul Parks, John Spangler, Ray Bass, Mike McCartney, Don Gallagher, Dale Decker, Tim Docter, Ray Brown.

At the Test Track ground-breaking ceremony, from L-R: Hal Smith, Ted Little, Ray Brown, and Ray Bass.

All NCAT research reports were put on NCAT's web site so that they could be downloaded as PDF files world wide at no cost.

Carol Mims joined NCAT in September as executive secretary for overall administration of all secretarial staff.

Carol Mims joined NCAT in September 1998 as Executive Secretary.

NCAT completed the following two major NCHRP projects, both led by Ray Brown:

- NCHRP 9-8, "Designing Stone Matrix Asphalt (SMA) Mixtures." The primary objective of this $1 million, four-year research effort was to develop a straightforward, standard mix design procedure for SMA and validate it in the field.
- NCHRP 9-9, "Refinements of Superpave Gyratory Compaction Procedure." The primary objectives of this $500,000, two-year research effort were to determine if the SHRP-developed compaction matrix could be consolidated and to evaluate other compaction parameters.

Allen Cooley and Rajib Mallick at AAPT meeting (1998).

Allen Cooley with NCAT permeability device (1998).

Gordon Chism, AU co-op, and Mike Huner with NCAT ignition oven (1998).

Ken Kandhal in Research Park office (1998).

Linda Kerr in Research Park office (1998).

First prototypes of NCAT SSD device (1999).

Some Superpave mixtures designed on the coarse side of the restricted zone were experiencing permeability problems. There was a need to devise a field permeability device which could be used to test in place pavements. NCAT developed such a device in 1998. The project was led by NCAT Research Engineer Allen Cooley, Jr.

Ronald and Margaret Kenyon established a $1-million Endowment Fund for providing scholarships to graduate students doing research in asphalt technology at NCAT.

Allen Cooley in Research Park office (1998).

1999

Highway engineers from People's Republic of China attended a training course in SMA Mix Design and Construction at NCAT in March.

Messrs. Tim Vollor and Buzz Powell joined NCAT as laboratory manager and test track manager, respectively.

NCAT completed the NCHRP Project 9-11, "Segregation in Hot Mix Asphalt Pavements." The primary objective of this project, led by Mary Stroup-Gardiner and Ray Brown, was to develop non-destructive methodology for detecting and measuring different levels of segregation. Infrared thermography and ROSAN surface texture measurements were recommended in the study.

NCAT hosted a meeting of Asphalt Pavement Analyzer (APA) User Group in September.

The construction of the NCAT Test Track and new NCAT building began in late 1999. Funding for construction of the 1.7-mile oval test track facility built on 310 acres of land purchased by Auburn University was provided by the Alabama Department of Transportation (ALDOT). A state-of-the-art 4,700 sq. ft. on-site testing laboratory was part of the test track facility. The construction of NCAT's new administration and laboratory building in the City of Auburn's Technology Park was facilitated by a funding plan jointly developed by the NAPA Research and Education Foundation and Auburn University. The building facility was estimated to cost $3.6 million.

NCAT developed a prototype apparatus for establishing saturated surface dry (SSD) condition of fine aggregates.

NCAT Test Track construction (1999).

Highway engineers from People's Republic of China attended a training course on SMA (1999).

2000

Ron Kenyon was made member emeritus of the NCAT Board of Directors on April 3. The NCAT Board also approved a new logo for NCAT, which is still in use.

October 23, 2000 was a historic day for NCAT when the dedication ceremonies for the new offices, laboratories, and test track facilities took place. Over 550 people from all over the United States were in attendance. The dedication ceremony was presided over by Mac Badgett, chairman, NAPA Research and Education Foundation. Remarks were made by William Muse, president, Auburn University; Hon. Don Siegelman, governor, State of Alabama; Hon. Spencer Bachus and Bob Riley, U.S. House of Representatives; Hon. Jeff Sessions, U.S. Senate; Mike Mangum, chairman, National Asphalt Pavement Association; Paul Parks, provost emeritus, Auburn University; Mack Roberts, transportation director, State of Alabama; Byron Lord, Federal Highway Administration; and James Samford Jr., president pro tempore, Auburn University Board of Trustees.

NCAT's new building in Auburn Technology Park under construction (2000).

Ben Brock, Chairman, Hotmixers, presenting a check for $42,275 to Ray Brown, NCAT Director, in support of NCAT's Professor Training Course (Open House 2000).

NCAT Open House for New Building and Test Track, October 2000.

James Samford Jr., president protempore, Auburn University Board of Trustees presented a resolution to the representatives of the NAPA Research and Education Foundation (L to R: Tim Doctor, James Samford Jr., Mac Badgett, and Don Gallagher) in appreciation of their support to NCAT (Open House 2000).

The dedication ceremonies surrounding the new offices, laboratories, and test track facilities represented the culmination of a vision that a group of hot mix asphalt industry leaders first discussed in the late 1970s and brought to Auburn University in the mid 1980s. It was then, as mentioned earlier, that the leadership of the National Asphalt Pavement Association (NAPA) raised $10 million to provide an endowment to be used to sponsor research and outreach activities at the newly formed National Center for Asphalt Technology (NCAT). In 1986 the NAPA Research and Education Foundation signed a cooperative agreement with Auburn University that set the stage for

Hon. Don Siegelman, Governor; State of Alabama, at the podium (Open House 2000).

Mack Roberts (right) Transportation Director Alabama DOT, receiving award from Gov. Siegelman (left). James Samford, Jr., Auburn University president protempore is in the middle (Open House 2000).

William Muse, president of Auburn University welcoming the guests at the Open House 2000.

Paul Parks, provost emeritus, Auburn University, spoke on the history of NCAT (Open House 2000).

New NCAT building (2000).

Luncheon at the Open House 2000.

Chris NeSmith, NCAT engineer (left) demonstrating test to Roger Yarbrough, Carl Monismith and Jon Epps (Open House 2000).

wide spectrum of NCAT activities, ranging from on-campus classroom seminars that "teach the teachers"—college-level faculty from throughout the nation—to state of the art testing of asphalt mixes at the center's 1.7-mile test track in neighboring Opelika.

Several individuals had leadership roles in establishing and guiding NCAT since 1986; they include John Gray, past president, NAPA; Ron Kenyon, director emeritus, NCAT Board; Harry Ratrie, chairman, NCAT Board, 1986-1989; Bob Thompson, chairman, 1989-1991; Ned Bechthold, chairman, 1991-1994; Roger Yarbrough, chairman, 1994-1996; Charlie Potts, chairman, 1996-1998; Don Gallagher, chairman, 1998-2002; John Spangler, chairman 2002-2003; and Chuck van Deusen, chairman 2003-present.

(Right to Left) Larry Lockett, Tim Vollor, and Gale Page (Open House 2000).

Buzz Powell (left), showing HMA test specimens (Open House 2000).

The NCAT staff had grown from a group of four in year1987 to 28 staff members in 2004. Oversight was being handled by a board of directors that consisted of seven members from industry and six from the university, in addition to ex-officio members from the Transportation Research Board, American Association of State Highway and Transportation Officials (AASHTO), and the Federal Highway Administration.

NCAT began its operation with a budget of approximately $500,000 annually; by 1990 that figure had grown to $1 million per year, and by 1995 to $1.5 million per year. The budget for fiscal year 2004 exceeded $4.5 million.

NCAT, which began its program at Auburn with a one-man office in the Harbert Engineering Center, had grown rapidly in an effort to fulfill its mission. Before its consolidation in the new offices in Auburn's Technology Park, it had facilities in three separate buildings.

By 1990, NCAT operations were carried out from five offices located in Ramsay Hall and 4,000 square feet of laboratory space in the Harbert Engineering Center. In 1993, NCAT was provided with two more offices in Ramsay Hall, as well as a conference room/library facility.

Fewer than five years later, the growth of the program dictated that four new offices be added, this time in Auburn Research Park because there was no additional room in Ramsay. And while 3,000 additional square feet of laboratory space was made available in Harbert, several storage facilities were being rented at locations in Auburn to handle NCAT's needs.

With the move to its new building at Auburn Technology Park, NCAT's facilities had finally been centralized, with adequate office

NCAT's staff at AU Research Park (Ken Kandhal, Linda Kerr, and Allen Cooley) getting ready to move into new building (2000).

NCAT Test Track after HMA base course paving (2000).

space, teaching and research laboratories, storage and related facilities. The new center comprised 40,000 square feet and would allow room for growth in its programs.

NCAT's research component had already become widely respected among the nation's asphalt industry. Research had been conducted with a dozen state departments of transportation, the Federal Highway Administration, and the National Cooperative Highway Research Program. Probably the most well-known accomplishment by NCAT researchers was the development of an environmentally-friendly asphalt content tester that had allowed the use of solvents to be greatly reduced or eliminated; this device was being used widely not only in the U.S., but also internationally. NCAT also developed the first-ever textbook on hot mix asphalt technology which was used in several universities.

The most talked about component of the dedication ceremonies was already up and running—NCAT's 1.7-mile asphalt test track, which had been designed and built to predict the performance of roadway surfaces, and as a result increase cost savings, safety and comfort on asphalt highways.

HMA plant for NCAT Test Track (2000).

Located about 15 miles east of the Auburn campus, the track was designed so that individual state departments of transportation could sponsor track sections composed of their own locally available aggregates and binder and constructed according to their specifications.

The 1.7-mile oval NCAT Test Track was completed in August 2000, and loading began during the third week of September. The track has 26 test sections (each 60 m long) on the tangents, sponsored by the Federal Highway Administration and nine states (Alabama, Florida, Georgia, Indiana, Mississippi, North Carolina, Oklahoma, South Carolina, and Tennessee). Additionally, 20 test sections were located on the curve. 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 some test sections. Because of the thick structural sections, fatigue cracking was not expected to be a problem.

Visiting the NCAT Test Track (L to R): Bob Thompson, Ned Bechthold, John Spangler, Mike Acott, Don Brock, and Ben Brock (Open House 2000).

The Test Track was to be subjected to 10 million ESALs with four tractor/trailers over a period of two years. Each tractor pulled three fully loaded trailers.

2001

NCAT completed the NCHRP Project 9-14, "Investigation of Restricted Zone in the Sperpave Aggregate Gradation Specification." Prithvi (Ken) Kandhal was the principal investigator for this project.

NCAT also developed a "new generation" open-graded asphalt friction course (OGFC) based on research done at NCAT and experience gained in the U.S. and Europe. The study led by Kandhal recommended specifications and mix design procedures for the OGFC.

Shane Buchanan, research engineer, resigned from NCAT. Two research engineers, Brian Prowell and Don

NCAT Laboratory Staff (2001).

Brian Prowell joined NCAT in 2001.

Don Watson joined NCAT in 2001.

Jason Moore (2001).

Watson, joined NCAT in August.

Brian Prowell had received his B.S. from Penn State in 1990 and M.S. from Virginia Tech in 1992. Prior to joining NCAT, Brian worked as an instructor for Virginia Tech, teaching civil engineering materials courses and as a senior research scientist for Virginia Transportation Research Council (VTRC).

Brian had conducted research on aggregate properties, asphalt content determination, cold-mix, pavement density and permeability, performance graded (PG) binders, recycling, rut testing, SMA Superpave mix design, and testing variability. Brian had developed a state-of-the-art binder laboratory for VTRC and oversaw Virginia DOT's PG binder testing program. He was the lead implementation engineer for Superpave in Virginia. He also performed troubleshooting and forensic testing for Virginia DOT.

Don Watson received his B.S. in Civil Engineering Technology from Southern Polytechnic State University in 1986 while working for the Georgia Department of Transportation (GDOT). During his career with GDOT Don served as state asphalt engineer and then as assistant state materials and research engineer.

Don had experience in laboratory and field testing, construction inspection and investigating construction problems, conducting pavement evaluations, and writing specifications for materials and construction procedures. Don wrote the specification for and implemented the Superpave asphalt mixture requirements as well as developing and implementing the contractor QC/QA testing program for GDOT.

Mike Huner, CAT research engineer (2001).

Chris NeSmith, NCAT research engineer (2001).

(L-R) Ray Brown, NCAT; Mike Acott, NAPA; Bernie McCarthy, Asphalt Institute (AI); Peter Glass, (AI); Tim Vollor, NCAT; and Mike Anderson (AI) in NCAT Lab (August 2001).

After a distinguished service of 13½ years at NCAT, Prithvi "Ken" Kandhal, associate director of NCAT retired on August 1. He was named associate director emeritus by William Walker, president of Auburn University. Kandhal joined NCAT as assistant director in February 1988, when NCAT was just

(L-R) Allen Cooley, Uma Kandhal, Prithvi "Ken" Kandhal, and Ray Brown.

Prithvi "Ken" Kandhal, NCAT Associate Director, retired on August 1, 2001.

(L-R) Bonnie Hanson, Rowan Kerr, Linda Kerr, Carol Mims, Jingna Zhang, Uma Kandhal, and Brenda Watson. Ken's retirement party.

Engineers from the DOT's participating in the NCAT Pooled Fund Study on New Generation OGFC met in October 2001.

NCAT Applications Steering Committee met in December 2001.

beginning its education, research, and information programs. He actively participated in all three programs. Kandhal was recognized by the NCAT Board of Directors by a resolution adopted in August 2001 for his many accomplishments.

NCAT Board of Directors, August 2001.

2002

The first meeting of the Perpetual HMA Pavement Task Group was held at NCAT in July. Ten members who represented industry, government, and academia attended this first meeting.

Brian Prowell was appointed as Assistant Director.

A review of the Professor Training Course program at NCAT was made. This course had been offered once each summer since 1988. Including the summer of 2002, 299 participants had attended this course in the previous 14 years. The geographical distribution of attendees covered 48 states and Canada. Over 80 percent of the attendees were from four-year state-supported universities. Attendees from U.S. educational institutions do not pay any fee for the course. Their travel and living expenses were offset through funds raised by the NAPA Hotmixers and some state asphalt pavement associations. The Professor Training Course is the only program of its kind in the nation and it has been a great success.

NCAT's Mobile Testing Laboratory (2002).

NCAT organized a two-day National Transportation Symposium at Auburn University in November, which was attended by about 250 people. The symposium featured research results from concept to performance, from the 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.

Ray Brown and Chuck Van Deusen reviewing the agenda of NCAT Applications Steering Committee (July 2002). Chuck served as chairman of the committee.

Committee on Perpetual Pavements met at NCAT in July 2002.

William Walker, president of Auburn University welcomed the delegates to the symposium. Speakers and moderators included: Byron Lord of the FHWA; Mack Roberts, retired director of the Alabama DOT; John Spangler, chairman of the NCAT Board of Directors; and Ray Brown, director of NCAT.

Test Track reconstruction in progress for installing eight structural test sections (2003).

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 (2003).

2003

After the successful completion of the first cycle of loading of the NCAT Test Track in December 2002, the construction of the new test sections for the second cycle of loading began in May and was completed in September.

Test sections for the second cycle of loading were sponsored by the Federal Highway Administration and ten states: Alabama, Florida, Georgia, Indiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, and Tennessee. Trafficking of the second-cycle test sections began in October to apply 10 million ESALs in about two years (by December 2005).

Chuck van Deusen (center), chairman, NCAT Board of Directors discussing the agenda for the July meeting of the NCAT Applications Steering Committee (ASC) with Ray Brown (left), NCAT director, and Jack Weigel (right), chairman of ASC (2003).

Dr. Allen Cooley, NCAT research engineer, resigned from NCAT in summer. Dr. Randy West joined NCAT in fall as assistant director. Randy had worked in the hot- mix asphalt industry for over 17 years. He received his Ph.D. in Civil Engineering from the University of Florida in 1995. He received his Bachelors and Masters degrees from Auburn University in 1987 and 1989 respectively.

Prior to joining NCAT, Randy worked for APAC, Inc. in Atlanta, GA, first as Manager of Materials Services, and later as the Director of Materials, Plants, and Quarry Services. He directed a staff of materials engineers and technologists in the testing, training, trouble-shooting, and development activities related to hot mix asphalt.

He began his career with the Florida Department of Transportation in 1988 where he was the Bituminous Research Engineer at the department's State Materials Office. His responsibilities included coordinating asphalt related laboratory and field research and review of external research contracts,

Randy West joined as Assistant Director fall 2003.

NCAT Applications Steering Committee (July 2003).

NCAT Board of Directors met at NCAT (August 2003).

conducting pavement forensic investigations, and assisting in the development of new tests, specifications, and training programs.

Committee on Perpetual Pavements met at NCAT (July 2003).

2004

NCAT completed NCHRP Project 9-27, "Relationships of HMA In-Place Air Voids, Lift Thickness, and Permeability," which was led by Ray Brown.

Pamela Turner joined NCAT as a laboratory engineer in March. After Pamela received her Bachelor's degree in Civil Engineering from the University of Kentucky in 1996, she worked at the Asphalt Institute as a materials engineer. Scott Parker was appointed assistant track manager. Chris NeSmith and Kevin Williams, laboratory engineers, resigned.

Participants from twelve countries besides the U.S. registered at the International Symposium (June 2004).

NCAT hosted an International Symposium on Long-Lasting Asphalt Pavements in June. The International Society for Asphalt Pavements was the primary sponsor of this symposium, which was attended by some 220 people.

NCAT also hosted "Automated, Real-Time Quality Control" open house in July. The open house showcased the following automated equipment at the Opelika plant of East Alabama Paving Company: belt sampling; moisture content of aggregate and RAP using moisture probes on belt; gradation of aggregates; viscosity of asphalt binder; calibration of asphalt meters; measurement of mix temperature; and data collection and management.

More than 100 asphalt industry professionals attended the open house for automated, real-time QC for HMA plant (July 2004).

NCAT's 18-year history (1986-2004) is remarkable in terms of making a difference in the hot mix asphalt industry through its various research, education and information programs. NCAT has established itself as a world-class, premier center in asphalt technology.

Prof. Carl Monismith, University of California at Berkeley, was the keynote speaker at the International Symposium (June 2004).

Ray Brown, NCAT director (center) with Don Brock (left) and Mike Acott at the International Symposium (June 2004).

Microwave aggregate moisture probe installed on a conveyor belt was demonstrated in the QC open house (July 2004).

APPENDIX A
CHAIRPERSONS, NCAT BOARD OF DIRECTORS

PERSON	TERM SERVED
Harry Ratrie	1987 - 89
Bob Thompson	1989 - 91
Ned Bechthold	1991 - 94
Roger Yarbrough	1994 - 96
Charles Potts	1996 - 98
Don Gallagher	1998 - 2002
John Spangler	2002 - 2003
Chuck Van Deusen	2003 - Present

APPENDIX B
CHAIRPERSONS, NCAT APPLICATIONS STEERING COMMITTEE

PERSON	TERM SERVED
Charles Potts	1988 - 1991
Gail Jensen	1991 -1993
Don Brock	1993 - 1998
Chuck Van Deusen	1998 - 2003
Jack Weigel	2003-Present