Asphalt

Philadelphia's Blue Route

An Environmental Showcase

The Magazine
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ASPHALT INSTITUTE

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Asphalt Institute, Research Park Drive,
P.O. Box 14052, Lexington, KY 40512-4052
(606) 288-4960 or fax (606) 288-4999

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Edward L. Miller, President
John Davis, Editor
Articles may be reprinted with credit lines.

President's Message

Meet Me on South Street

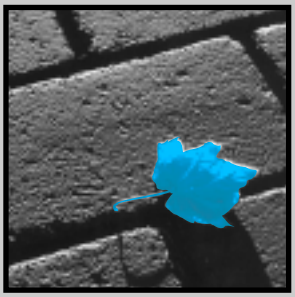
To those of you who are nostalgic song buffs, "Meet Me on South Street" should bring back memories of a vibrant and exciting, albeit unusually interesting place in Philadelphia where people are the first priority. In fact, this can be seen throughout the city, especially in the downtown area with its brick streets and Revolutionary War History boldly canvassed into modern society.

This philosophy of putting people first continued when Philadelphians recognized the need for better traffic flow for its suburban commuters while preserving environmental tranquility. The Blue Route story inside this issue of **Asphalt** shows how road construction and the environment can be integrally compatible, once you place people first. After many years of controversy over road width and noise concerns, the people came to the right conclusion: build the pavement with asphalt. The result has been a model for Philadelphians and other states. The city now has a better and more quiet system that serves the people. In fact, some even want to widen the pavement.

So, as you read the article, think of this: Should the song perhaps be modernized to "Meet me on the Blue Route"?

Today, people, road construction and the environment can always come together in harmony, but it also takes performance to bind the three. To highlight how asphalt pavements can serve as that binding force, this issue of Asphalt marks the inauguration of a new section, appropriately called the **Performance Corner**. Each future issue will continue to showcase an asphalt pavement that has demonstrated the performance needed to meet what the public demands. Keep your eyes open, though, because these pavements exist throughout the United States. You just might recognize one from your own home town.

Edward L. Miller, President



Features

In Every Issue

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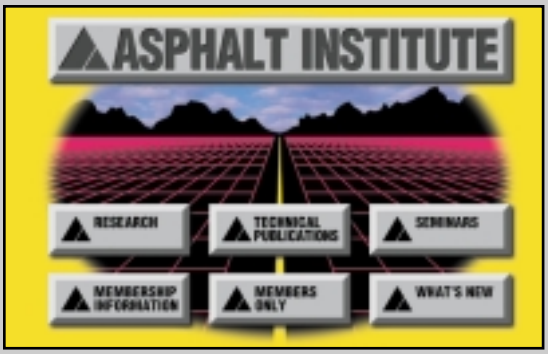
COVER: Interstate 476, the Blue Route, has brought needed relief to Philadelphia commuters. It has also brought relief to environmental anxieties about destruction of habitat and intrusion of the automobile into quiet, wooded, suburban life. Seamless asphalt pavement was the answer to a 25-year controversy about whether to build or not to build the Blue Route. Story begins on page 8.



Industry-Wide

The asphalt industry met with NIOSH representatives to continue its partnering efforts in health and exposure assessment issues. NIOSH reported on its proposed protocol for benzene soluble fraction sampling and health hazard evaluations. It outlined its plans for inhalation studies at the NIOSH facility in Morgantown, West Virginia. Institute members continue to be leaders in evaluating exposures, chemical composition and toxicology.

Roadrobot, hailed as the world's first computer-controlled road paver, was recently tested in Germersheim, Germany. Roadrobot is said to be the first paver in the world capable of navigating and steering itself. It performs all functions necessary for road pavement construction from asphalt leveling to spreading. Roadrobot aims to furnish roadbuilders with a machine that will construct roads in a more environmentally friendly manner.

AASHTO's Standing Committee on Research has approved new research projects for FY 1998, including investigation of the so-called forbidden zone in SHRP Superpave Aggregate Specifications and "Quality Characteristics of Hot-Mix Asphalt Pavements for use in performance related specifications." The research will further determine whether the forbidden zone is really unbreakable or may be interpreted as a guideline.

FHWA is offering three new training courses on Superpave, which will be conducted by the National Highway Institute. The courses are designed to provide three different audiences—senior managers, staff engineers and local government personnel—with the information to understand Superpave and how to apply it. Course materials were developed by the National Asphalt Training Center at the Asphalt Institute in Lexington, Kentucky. The courses may be sponsored by state and local highway agencies, FHWA field offices, industry groups, engineering firms and universities.

The Asphalt Institute extends a warm welcome to new regular members Murphy Oil USA, Inc., and Fina Oil and Chemical Company, and to affiliate member Hollywood Marine Inc.

The committee studying the feasibility of the National Highway System's Route I-69 from Indianapolis to the Mexican border has tentatively approved a 1,020-mile corridor at an estimated cost of $7.5 billion. That's a $2 billion increase above the original estimate. The corridor will skirt the cities of Memphis, Shreveport and Houston on its way to Laredo, Texas.

People

Ronnie Goree is the Asphalt Institute's District Engineer for its new Nashville, Tennessee, office. Goree, formerly field bituminous construction engineer with Georgia DOT, filled the Institute's new position May 1, 1997. He is a native of Alabama with a civil engineering technology degree from the University of Alabama. Initially, he will provide asphalt field engineering and educational services in Tennessee and Mississippi.

Gary Ridley replaced Gerald Grimes as Executive Director of the Oklahoma Asphalt Pavement Association May 1, 1997. Ridley's former position was Division V Engineer with Oklahoma DOT.

Roger Smith, former Western Regional Engineer for the Asphalt Institute, is the new Director of the Northern California Asphalt Producers Association.

Around the Nation

A coalition of nearly 40 business organizations representing hundreds of thousands of employees, including the Michigan APA, Michigan Road Builders Association, Associated General Contractors, and major Chambers of Commerce, is asking Michigan legislators to secure an additional $400 million in funding for the state's roads. The Fix Our Roads Coalition is demanding that Michigan legislators respond before their summer recess.

The Ohio Turnpike Commission is adding a third lane in each direction along 160 miles of its 240-mile turnpike across northern Ohio from Toledo to Warren. Most of the pavement will be 15 inches of hot-mix asphalt on crushed aggregate subbase. Some sections will be 5 inches of HMA over a portland cement concrete base. A 14-foot-wide inside shoulder will be constructed primarily of asphalt and the outside shoulder will be milled and replaced with 3 inches of asphalt. The decision to use asphalt was based on a life-cycle cost analysis. Construction began in 1996 and is scheduled for completion in 2001.

New York State DOT plans 44 full Superpave design hot-mix asphalt projects in 1997. The total Superpave tonnage is approximately 2.4 million metric tons. A design-specific PG grade will be used for each project. NYSDOT's 44 projects will bring its Superpave implementation plan to 20 percent for 1997. Planned implementation levels for 1998 are 50 percent and 100 percent for 1999.

At the Minnesota County Engineers annual conference earlier this year, the Asphalt Institute summarized and outlined the benefits of Superpave. Eighty-five of the 87 county engineers plan to switch to the PG binder system in 1997. This is a major step because counties, cities and commercial/private mixes make up the majority of asphalt tonnage in Minnesota.

The Accelerated Pavement Load Facility (ALPF), a recent joint venture of Ohio University and Ohio State University, will conduct testing and research on flexible and rigid pavement structures. It consists of two truck-sized tires mounted on guide beams that allow the tires to apply a variety of rolling loads on various pavement structural configurations over an area 45 feet long by 40 feet wide. OU and OSU plan to conduct research on a national scale, particularly research that will complement the SHRP Long Term Pavement Performance program.

Representatives from the FHWA, Alabama APA, Asphalt Institute, Alabama DOT, Hunt Refining, Whitaker Contracting Corp., and Resonant Machines, Inc. recently met in Birmingham, Alabama, to discuss a showcase event for a concrete rehabilitation with asphalt overlay project. The showcase event, on I-65 north of Birmingham, will be held in October of this year and will provide project background, rubblizing techniques, structural pavement design considerations, permeable base construction and Superpave mix design technology, along with visits to the project site. The project involves widening I-65 from four to six lanes. A 7-inch thick asphalt overlay will be placed on existing pavement for a total of approximately 300,000 tons of hot-mix asphalt.

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"How Did We Make It Without You?"

Blue Route is Model for Co-Existen

By Carlos Rosenberger, Senior District Engineer, Asphalt Institute; and John Davis, Editor, Asphalt Magazine

More than five years after its opening, most Philadelphia commuters say they can't live without the Blue Route. A lot of them didn't want to see it built, but now they talk about widening a road that has become the model for the co-existence of man, nature and automobile.

Before it opened in 1991, I-476—the Blue Route—was the site of a classic environmental battleground. Suburban Philadelphia commuters, harassed by years of gridlock on local roads and Interstate 76/Schuylkill Expressway, desperately wanted to see the Blue Route built.

Environmental groups in the Nether Providence and Swarthmore College area opposed it because construction would disturb historical sites, wetlands and natural woodlands.

Using the Environmental Policy Act, a number of citizens' groups successfully protested the Blue Route and forced additional environmental studies. The legal battle continued for 11 years, effectively stopping future construction until 1985 when the U.S. District Court denied an appeal to prevent resumption of work while plaintiffs challenged the process by which the Supplemental Environmental Impact Statement had been approved. The Impact Statement forced the redesign of the Blue Route to make it more environmentally sensitive.

Meanwhile, the Council of Environmental Quality asked the Pennsylvania DOT (PennDOT) to chair a Task Force to work out environmental solutions that the community, PennDOT, and the federal government could support. The Task Force formed two subcommittees, a Noise Subcommittee and a Design Subcommittee. They called in sonics and acoustics expert Lou Cohn, Professor of Engineering at University of Louisville, to help with sound mitigation, and Swarthmore's design consultant, Don Smith of Andrews & Clark, to assist with environmental design.

Environmental Design

Cohn and Smith were instrumental in getting PennDOT to reduce the grade design of the Blue

Route adjacent to Swarthmore from 3.8 percent to 2.8 percent. The lower percentage meant that heavy trucks would make substantially less noise when ascending the grade. The Task Force also insisted on a "seamless" asphalt pavement because it would make less noise than jointed pavement.

The Task Force also recognized that the cost of initial construction for asphalt would be less than concrete. PennDOT decided to pave all sections of the Blue Route with asphalt, even though two short concrete sections had been placed on the original route 17 years ago.

Construction Challenges

Although the Task Force was able to reconcile the environmental and design controversy, building the Blue Route posed some major environmental and construction challenges, including: preservation of two environmentally sensitive creek valleys that run parallel to the Blue Route, construction of 56 bridges, preservation of numerous historic sites, parks and wetland areas.

Much of the soil along the Blue Route contained mica schist, which has a low structural strength. Consequently, PennDOT increased its pavement thickness design from 13 to 16 inches of asphalt. The asphalt base course on the 21-mile six-lane and 4-lane highway contained 9.5 inches of 2-inch topsize rock. The 5-inch-thick intermediate course was also composed of 2-inch topsize rock, and the 1.5-inch surface course contained a 2-inch topsize rock.

"The Blue Route was the first major project where we used the heavy-duty ID-2 specifications," says Michael Scarpato, District Materials Engineer for PennDOT's District 6. After six years, pavement performance ratings are "very good" to "excellent" along the route.

Best Road Ever

Scarpato says that District 6 gets the highest traffic densities, and adds that the ID-2 mix has been the mainstay of District 6, as well as for the Commonwealth of Pennsylvania. Currently, traffic on the Blue Route runs between 70,000 and 83,000 vehicles per day, with as much as 12 percent truck traffic. It has already exceeded use estimates for the year 2000.

"We used good quality materials when building the Blue Route," says Scarpato. "Everybody involved in producing the Blue Route did an extremely good job. All parties paid the kind of

nce of Man, Nature and Automobile

The Blue Route (I-476) was designed to siphon traffic from Interstate 76/Schuylkill Expressway and to be an environmental showpiece. It has accomplished both.

attention necessary to build a winner."

He adds that drainage was an important part of the project, too. "To have a successful, well-performing highway, you need to get the drainage right. Drainage on the Blue Route was done right." Scarpato thinks that the Blue Route could be a model for future urban roads. "Even one of the politicians that resisted the Blue Route came back and agreed that it was the best road ever built in District 6. Add to that, it's a pretty road, and it's pleasant to drive on."

Four contractors paved the Blue Route. One of the pavers, Glasgow, Inc. of Glenside, Pennsylvania, recalls that it was the first Deep-Strength job that District 6 ever did. "The road was constructed Deep-Strength shoulder-to-shoulder," says Glasgow's Jack Rath. That means that PennDOT can maintain the mainline while routing traffic to the shoulders. Rath says that Glasgow paved bridge to bridge—one lane a day—on all courses. "Because it was new construction, there was no traffic. That gave us a quality job and insured good performance."

Designed for the Community

Eugene Blaum, Assistant Press Secretary for PennDOT's District 6, says that the Blue Route has been amazingly successful and heavily used. He believes it's because the road was designed with the community in mind. "All the community's environmental concerns were incorporated into the design," says Blaum. "The wetlands, Crumm Creek and Darby Creek are all working well. Matsonford Road Park & Ride is successful. And we're currently investigating the addition of more Park & Rides to promote car pools."

Blaum emphasizes the key role of the Blue Route was not only to improve traffic flow in the region, but to complete the Interstate system around Philadelphia.

The Blue Route serves as the connector to I-95 to get to Philadelphia International Airport; it directly intersects the Northeastern Extension of the Pennsylvania Turnpike, which takes one to Allentown, Scranton and to the northern and eastern interstates into New York; it intersects with the east/west leg of the Pennsylvania Turnpike, which goes to Harrisburg and Pittsburgh.

The Blue Route was designed to siphon traffic from the Schuylkill Expressway and it has done just that. Planners know that it has absorbed 50 percent of the traffic on roads running parallel to it, in particular the perpetually congested Route 320. But from West Chester Pike south, the Blue Route constricts from six to four lanes. Narrowing it was a compromise that PennDOT and the Task Force made with environmentalists and citizens groups of Swarthmore, Nether Providence and Springfield. According to highway planners and users, dropping the two lanes was the only mistake made on the Blue Route. Now, the same communities that protested its construction want to widen it.

Showcase

Less than a year ago, *The Philadelphia Inquirer* proclaimed the Blue Route "an environmental showcase." It is "an especially beautiful and environmentally pleasing road," stated The Inquirer. "From the earth-tone paint used on its guardrails and bridge abutments, to the thousands of day lilies and roses, to walls of cascading evergreens adapted from European parkways, the Blue Route was meant to be an environmental showpiece."

An *Inquirer* editorial summed up the sentiments of the people in Philadelphia about the Blue Route. "It's hard to believe we ever thought we could live without you. Hard to believe we almost didn't get you. So, please, hang around and grow, but not too fast. Keep working hard. And plan on taking care of us when we grow old." Truly, the Blue Route is a model for the co-existence of man, nature and automobile. ▲

Performance Corner

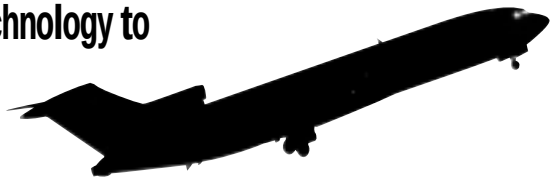
This Corner is dedicated to well-performing asphalt pavements carrying a high volume of traffic for an extended period of time that show no or minimal pavement distress. The reason for their exceptional performance is a combination of proper design, quality construction and quality control.

The westbound lanes of I-40, in Arkansas, St. Francis County, from Hwy 38 to Shearerville was the first full QC/QA project for the Arkansas Highway Department. It consisted of milling off approximately 4 inches of existing hot-mix asphalt, then placing a 4-inch binder course and a 1.5-inch surface course on 32 lane miles. The original overlay of the original pcc pavement was placed in 1978 and consisted of 3.5 inches of crack relief layer, 4 inches of intermediate course, a 1.5-inch surface course and an open-graded friction course. The new overlay was designed with an Arkansas high traffic mix using a 75-blow Marshall mix design. A standard AC-30 asphalt cement was used. The specifications called for full volumetrics (voids, voids-in-mineral-aggregate, voids filled with asphalt, and maximum gravity) for field verification. The QC was performed by the contractor (Gilbert Central Corp.) and a private laboratory. The project was opened to traffic in November 1990.

This route is one of the most heavily traveled truck routes in the U.S. The current ADT on these westbound lanes is 29,000 with 62 percent trucks and 52 percent heavy trucks. The project shows no rutting or cracking after seven years of service.▲

Consultants Apply Elastic Layer Theory and Crack and Seat Technology to

Rehabilitate Taxiway at Memphis International Airport



by Frank Gianotti, Vice President, PDR Engineers, and Ron Powell, Principal Engineer, PDR Engineers

Crack and Seat technology, along with application of elastic layer theory, enabled PDR Engineers, Inc. and its consulting team to rehabilitate Taxiway "N" at Memphis International Airport in 30 days at a cost of less than $2 million.

The airport is the global headquarters for Federal Express and a major passenger hub for Northwest Airlines/-KLM Royal Dutch Airlines. It is the world's largest cargo airport, which dictated a taxiway design for 50,000 MD-11 annual departures.

PDR looked at six paving alternatives to rehabilitate the taxiway's 14 to 16-inch thick concrete pavement built more than 20 years ago. The cement-treated base built at the same time was also rapidly deteriorating. The six alternatives included total replacement with concrete, total replacement with asphalt, an unbonded concrete overlay, a partially bonded concrete overlay, an asphalt overlay, and cracking and seating with asphalt overlay.

Alkali silica reaction

PDR concluded that a partially bonded overlay would not last because of alkali silica reaction (ASR) in the concrete. ASR is a chemical process where the alkali in the cement reacts with silica in the aggregate in the presence of moisture. The process forms an expansive jell that breaks the cement paste between the aggregates. This weakens the concrete pavement by causing it to expand. Heat and moisture causes steam to occur within the pavement structure, which also leads to stripping and deterioration of the asphalt overlay, as well as continued deterioration of the concrete. Although not often recognized, the presence of ASR is a leading cause of poor performance in asphalt overlays over concrete pavements.

Cracking and seating or fractured-slab mechanics reduces ASR and rubblization eliminates it. PDR brought in Roy McQueen of Oakton, Virginia, as a consultant in the areas of pavement design and for specialized testing before, during, and after construction. He also acted as special consultant on the ASR problem.

PDR knew if we simply overlaid the taxiway with asphalt, we would be fighting a reflective cracking problem. By cracking the concrete, we allowed the pavement to breathe. That, in turn, permitted ASR to occur and not damage the concrete.

Part of PDR's evaluation was gathered from a petro-graphic analysis, a technology that was not available when the taxiway was first constructed 20-some years ago. This chemical, microscopic examination showed us if ASR was present or not. The petro-graphic analysis, along with crack and seat research and asphalt overlay data provided by Dr. Bob Boyer, Senior District Engineer for the Asphalt Institute, indicated that crack and seat with

asphalt overlay was a viable option. AI's Boyer also provided support for PDR's engineering presentation to Memphis Airport officials.

Critical Design

Another problem was that the concrete pavement wasn't thick enough to accommodate Memphis International's heavy aircraft. The pavement was 14 to 16 inches thick but should have been at least 18 inches thick with substantially more subgrade preparation. All this meant that time was running out for Taxiway N. Even If the concrete would have been in good shape, it would still fall short of the design for the annual 50,000 Equivalent Annual Departures of MD-11s over the next five to twenty years. An MD-11 weighs approximately 605,000 lb. at takeoff. As with all airports, design of the taxiways are critical.

Taxiway N couldn't be out of service very long or it would cause chaos at the airport. Concrete rehabilitation would take at least 6 months. After careful evaluation of the rehabilitation alternatives, PDR concluded that crack and seat technology with asphalt overlay was the best option. PDR believed the construction team could complete the project in 30 days. PDR convinced the airport authority that McQueen Associates should do pavement tests with the Falling Weight Deflectometer (FWD) while the taxiway was under construction. In addition, PDR did four different test strips with different patterns. McQueen came right behind the pavement breaker and made adjustments while the cracking was in progress.

The airport is the global headquarters for Federal Express and a major passenger hub for Northwest Airlines/KLM Royal Dutch Airlines.

Cracking and Seating

The theory of cracking and seating is that fracturing the slab turns the rigid pavement into a flexible one. Our purpose was to create a compatible modulus—one that would be equal to the new asphalt overlay. To determine the optimum cracking pattern, these variables with the guillotine breaker were evaluated on the test strip:

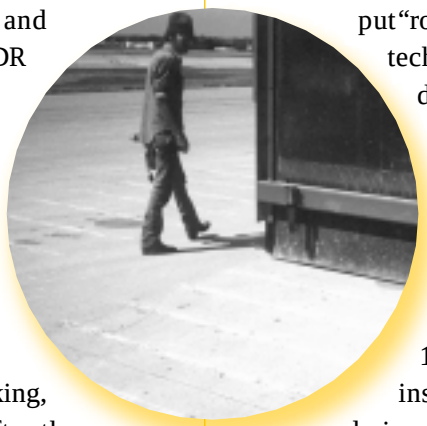
- 2-foot drop, 18-inch spacing, 2 passes across slab;
- 3-foot drop, 20-inch spacing, 2 passes across slab;
- 3-foot drop, 20-inch spacing, 3 passes across slab;
- 4-foot drop, 20-inch spacing, 2 passes across slab;
- 4-foot drop, 20-inch spacing, 3 passes across slab;
- 3.5-foot drop, 16-inch spacing, 3 passes across slab.

Modulus is an engineering term used in elastic layer theory to describe the stiffness or flexibility of a material layer. The higher the modulus, the stiffer the material. An ideal modulus for compatibility of the cracked concrete and the asphalt overlay would be between 500 and 700 ksi.

McQueen Associates conducted pavement tests with the Falling Weight Deflectometer (FWD) to help determine the pavement modulus of the test sections. After the optimum cracking procedure was chosen, McQueen continued with FWD testing while the taxiway was under construction, and necessary adjustments were made while the cracking was in-progress.

Elastic Layer Theory

FWD data on the rigid concrete was used to determine the modulus of the existing pcc pavement. In order to effectively use the elastic layer theory, the modulus of the concrete had to be substantially reduced to work with the asphalt overlay. To make the concrete and asphalt compatible, PDR made the rigid concrete into a flexible base with a similar modulus to asphalt.



To assure quality throughout the cracking and seating operation, PDR tested the pavement before cracking, during cracking, and after the cracking. It was the first project where PDR collected pre-project, in-progress and post-project data. With that information, PDR and the Asphalt Institute will continue to compare and analyze Taxiway N's pavement performance.

After cracking, we rolled the cracked concrete with a 50-ton roller. As we rolled, we adjusted the number of roller passes to create the proper modulus.

Mix Design

The mix design was conducted in accordance with the Federal Aviation Administration P401 specification. PDR made the mix slightly stiffer, however, by making the mix on the coarse side of the specification band. This resulted in a slightly higher stability to meet the heavy Federal Express plane loads and the sharp turns necessary when preparing for takeoff. We designed the mix to fit our specific needs within the context of the FAA P401 specification. To assure consistency of the mix, we put "round-the-clock" lab technicians in the field, directly supervised by PDR's engineers.

We started work on the project September 15, 1995 and completed it October 15, 1995. PDR also installed new edge drains. The taxiway was 4,400 feet long and 75-feet-wide. The project encompassed the northern half of Taxiway N. The pavement has been in service for two winter seasons and is performing very well. There is no cracking and no visible rutting.

PDR was the prime engineering consultant and construction manager on the project. Roy McQueen Associates provided special pavement non-destructive testing and

Quality Assurance. APAC Tennessee was the paving contractor and was also responsible for the cracking and seating. S & ME Laboratory of Arden, North Carolina, and Kimley-Horn supplied design assistance and construction administration assistance.

The theory of cracking and seating is that fracturing the slab turns the rigid pavement into a flexible one.

Partnering was also an important aspect of the project. Nick Haynes, Division President for APAC Tennessee, Inc. said that the success of the project "couldn't have happened without our partnering agreement." Haynes said that both contractors and engineers from the industry told him that the project couldn't be built in the time specified, but it was. "We've been involved in several projects that endorsed partnering," said Haynes. "But this was one project where we did more than talk the talk. We walked the walk."

Memphis International Airport president Larry D. Cox accurately summed up the success of the project with these words: "The timely and successful completion of the Taxiway N Rehabilitation project was of critical importance to the Memphis hub and its tenant airlines. The unusual demand to compress what would normally be a 4 to 6 month replacement project into a 30-day period required exceptional and unique attention and techniques. We commend PDR Engineers, Inc. for meeting our requirements under pressing and unusual circumstances. We are hopeful that this project could set a national precedent as another option for airfield pavement repair."▲

Asphaltnews *from page 7*

Florida DOT is developing a Warranted Asphalt Specification and plans to build one project on lower traffic volume roads in each District to evaluate the specification. It includes a five-year maintenance warranty based on milling and replacing one inch of the structural course plus the friction course. The pavement would be evaluated on the basis of ride, rutting, cracking and initial skid resistance.

In June of this year, Michigan DOT began letting 11 asphalt mill-and-overlay resurfacing projects with preventive maintenance warranty provisions. Each warranty will be for three years. The warranties, in part, reflect MDOT's attempt to manage projects with fewer personnel as a result of ongoing reductions in work force. The agency also intends to require warranties on chip seal, microsurfacing, crack-filling and concrete joint repair projects.

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Hot In-Place Recycling Resurfaces North Carolina County Roads

by Jim Trogdon, P.E., Assistant State Road Maintenance Engineer, North Carolina DOT

In an effort to increase the efficiency and cost effectiveness of paving or resurfacing a portion of its 66,000 centerline-mile paved inventory, North Carolina DOT is turning to hot in-place recycling (HIPR).

With more demand and less funds available for maintenance, theoretical resurfacing cycles in North Carolina have gone from a 16-year resurfacing cycle in 1989 to a 33-year resurfacing cycle in 1996. Because it would reduce trucking and traffic costs, as well as the frequency of pavement patching, NCDOT decided to evaluate HIPR on two new projects.

The two projects involved 40 miles of roadway and included 587,000 square yards of HIPR. Both projects are on two-lane primary highways in eastern North Carolina.

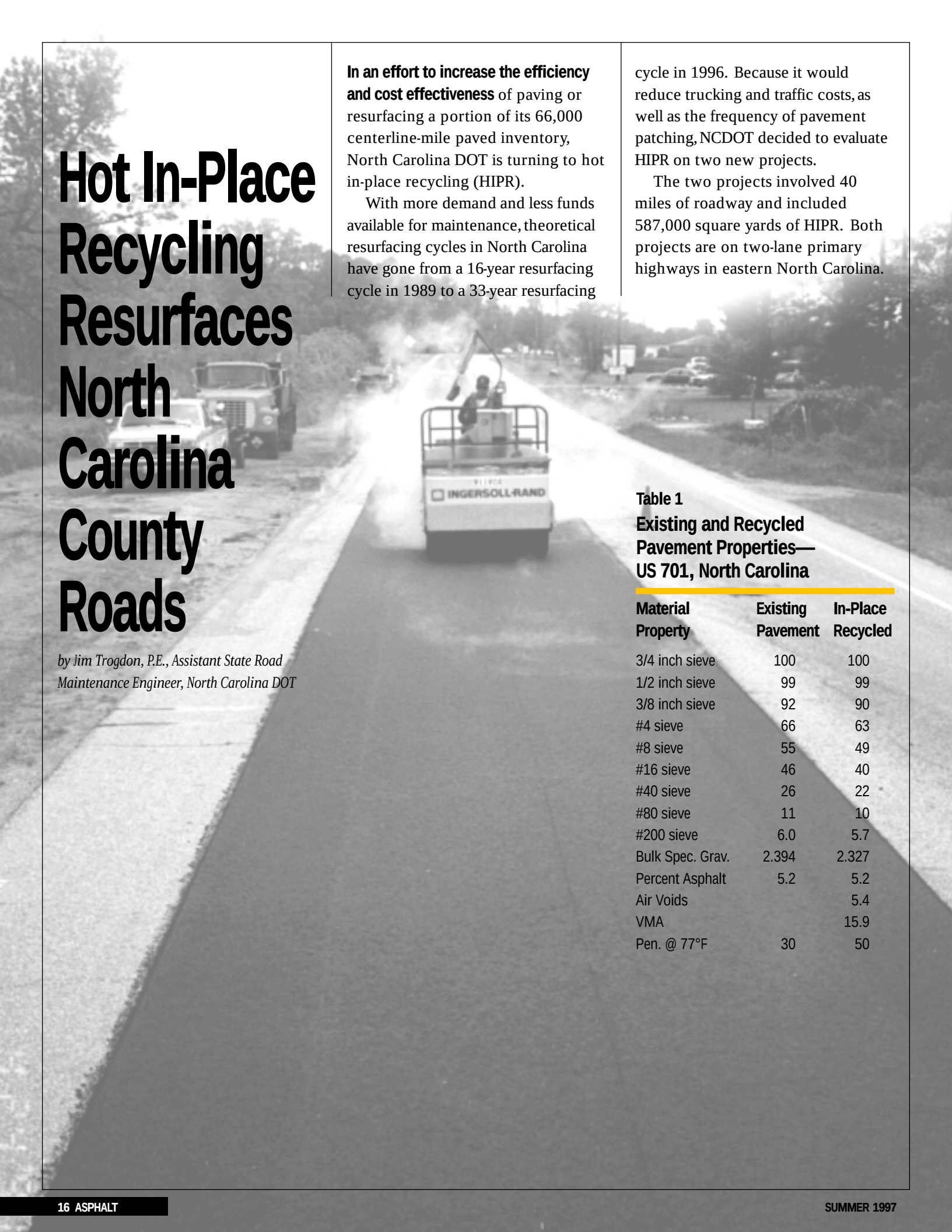


Table 1
Existing and Recycled Pavement Properties—US 701, North Carolina

Material Property	Existing Pavement	In-Place Recycled
3/4 inch sieve	100	100
1/2 inch sieve	99	99
3/8 inch sieve	92	90
#4 sieve	66	63
#8 sieve	55	49
#16 sieve	46	40
#40 sieve	26	22
#80 sieve	11	10
#200 sieve	6.0	5.7
Bulk Spec. Grav.	2.394	2.327
Percent Asphalt	5.2	5.2
Air Voids		5.4
VMA		15.9
Pen. @ 77°F	30	50

US 701 was a 16-mile project, previously resurfaced in 1984; NC 87 was a 24-mile project, previously resurfaced in 1983. The daily traffic range is between 5,000 and 6,000 on US 701. Average daily traffic is about 3,500 on NC 87.

Pavements on both roads met ten conditions needed to qualify them for HIPR:

- A minimum of 3 to 4 inches of existing asphalt pavement.
- Relatively homogenous materials with minimal patching.
- Uniform mix properties, no significant stripping, and a minimum recovered asphalt penetration of 20. These properties were confirmed with pavement cores.
- No fabrics or interlayers within the top 2 inches.
- Light to moderate surface distress.
- Minimum structural distress.
- A minimum resurfacing quantity of 100,000 square yards.
- A minimum pavement width of 22 feet plus 3 feet of stable shoulder on each side of the pavement.
- Adequate night parking areas at one-mile intervals, or the ability to use temporary signals to maintain lane closure at night.
- An asphalt plant within an 80-mile radius.

Mix Design

The purpose of using HIPR is to correct existing distress and restore ride quality. The contractor accomplished this by heating, scarifying and rejuvenating the top 2 inches of existing pavement. Slight to moderate rutting indicated that the in-place voids in the existing pavement might be low.

In order to heat, scarify, rejuvenate, and replace the existing mix, the hot-mix asphalt added to the heated-in-place pavement had to increase the voids in mineral aggregate (VMA) and decrease the existing asphalt cement (AC) content. As a result, NCDOT designed a modified surface mix to add at a rate of 50 pounds per square yard, or 25 percent of the total mix. The AC content in the mixture was reduced during the first two days of operation to 2.5 percent in order to achieve Marshall samples with 5.0 total voids, 5.2 percent asphalt cement, a VMA of 16, and a percentage passing the 200 sieve of 5.9 percent. Table 1 shows average gradations of existing mix and average properties of the new recycled mixture for US 701.

Above photo: Heated asphalt mix being removed by one of the milling head extensions. Left photo: Typical pavement condition on US 701.

HIPR Process

US 701 NC 87

The HIPR contractor on US 701 was Remixer, Inc. of Tyler, Texas. The hot-mix asphalt producer was Crowell Constructors, Inc. of Fayetteville, North Carolina. Remixer used three preheaters and a Wirtgen Remixer 4500 to heat and scarify the top 1.75 inches, add 50 lbs. per square yard of new mix, and rejuvenate and place the combined material.

The three preheaters heated the existing pavement to 175°, 250° and 300°F, respectively. Each preheater has approximately 50 feet of heater banks covering a full lane width from 11 to 14 feet. There is generally a 12 to 30 foot gap between preheaters during their operation.

The preheaters heat the pavement prior to the operation of the remixer unit. Trucks discharge the hot-mix asphalt into the remixer hopper following the last preheater. The material moves by slat conveyor over the heaters in the remixer unit, through a small surge bin, and discharges into the on-board pugmill that blends the hot-mix asphalt with the reclaimed mix.

Simultaneously, the main milling section and two extensions remove the existing material and auger all reclaimed material to the center of the remixer. At this point, rejuvenator is added at the specified rate, and the reclaimed material is discharged directly into the pugmill.

Conventional Laydown and Compaction

US 701 NC 87

The remainder of the remixer unit is similar to a conventional paver. Recycled mix is moved by augers and spread prior to entering a heated, vibratory screed. The screed section is hydraulically extended to widths of 11 to 14 feet. Laydown temperatures ranged from 240 to 250°F. Paving speeds ranged from 10 to 12 feet per minute. Conventional compaction equipment is used to finish the mat.

Conclusions

US 701 NC 87

HIPR is a viable option for correcting surface distresses on projects that satisfy the selection criteria. Because the operation does not start and stop with the frequency of normal paving trains, the pavement surface is noticeably smoother. HIPR advantages increase as hot-mix haul distances increase. Proper analysis of existing pavement materials before the project begins is critical to success, as is extensive quality control and evaluation of the recycled mix on a daily basis during the project. That evaluation should include:

- Total asphalt cement content;
- Total voids content (Marshall compaction);
- Voids in the Mineral Aggregate (Marshall compaction);
- Dust/asphalt cement ratio (production samples);
- In-place density;
- Mix production temperature;
- Depth of cut by remixer;
- Thickness of recycled material placed.

Marshall stability, flow, and tensile strength ratio (TSR) of conditioned versus unconditioned samples for stripping also should be evaluated on a weekly basis.

NCDOT will continue to evaluate the performance of the US 701 project and analyze its test data in order to compare operational tolerances and mix production data with conventional HMA operations. NCDOT anticipates that hot in-place recycling may, with adequate performance history, effectively supplement conventional hot-mix operations. It may be especially effective on projects requiring long hauls.▲

Fumes Update

research issues pertaining to asphalt fume exposures.

They want to continue the research partnership that has been established between government, industry and labor.

Recently, NIOSH investigators presented a report on Health Hazard Evaluations from data that has been collected at conventional and crumb rubber modified asphalt paving projects. The report showed that personal breathing zone concentrations at all the evaluation sites were below the current NIOSH recommended exposure limit (REL) of 5 milligrams per cubic meter for asphalt fume. Higher concentrations of particulate polycyclic aromatic compounds (PAC's), sulfur compounds and benzothiazole were found in the crumb rubber modified paving projects. Volatile organic compounds (VOC's) concentrations were either not detected or very low.

Toxicology Program (NTP). The NTP-funded research will be a chronic inhalation bioassay using asphalt fume that is intended to be representative of real-world fumes.

NIOSH-planned research on asphalt fumes is divided into three general categories:

- Field Research that will assess biomarkers of exposures, acute human health effects, and personal exposure assessments
- Fume generation and toxicology studies that will include short-term animal studies and in-vitro studies
- Chemistry or fume analysis that will include fractionization and mutagenesis of asphalt fume and analysis of field samples

NIOSH has stated its intention to publish a new protocol for benzene soluble fraction sampling, which will be identified as NMAM 5042. NIOSH has also outlined its intent to evaluate acute and chronic response to inhalation of asphalt fume.

You've heard it a hundred times before, but it's still true: Traffic loads and traffic volume on our highway system have increased dramatically, and at an astonishing rate. According to the Federal Highway Administration, traffic volumes have increased nearly 120 percent and traffic loads more than 450 percent.

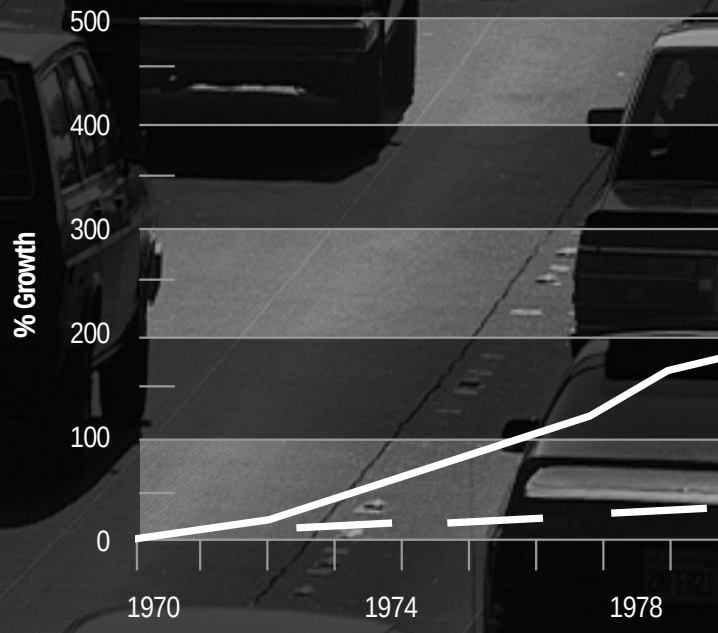
Superpave for Higher Pavement Performance

By Phillip Blankenship, National AC Technical Support, Koch Materials Company; and Tisha Jones, Technical Support, Koch Materials Company

Both factors, increasing loads and volumes, mean that asphalt highways have to be tougher and more durable. A new, effective tool, Superpave, can help us meet these demands.

Superpave has already provided improvements to current binder and mix technology. The improvements to current practices include: 1) aggregate and asphalt criteria selection; 2) mix design criteria and tools; and 3) performance criteria and tools. Similar to the Marshall hammer, the Superpave Gyratory Compactor (SGC) allows us to simulate traffic densification for low and high traffic environments. With its kneading action, the SGC can simulate much higher traffic loads than the Marshall hammer with its impact compaction.

Several states have been aggressive in implementing Superpave and gained much experience with the Superpave mix design procedure in 1996. From an industry perspective, the greatest improvements that Superpave has provided are increased asphalt binder thickness that aid in increased fatique resistance, decreased moisture sensitivity and stronger aggregate skeletons.



Voids in Mineral Aggregate

There are many positive contributions that will result from better asphalt mixture volumetrics such as higher voids in mineral aggregate (VMA). Higher VMAs also contribute to reduced rutting due to better aggregate skeletons or aggregate interlock and flatter VMA curves.

Superpave volumetrically proportions the aggregate, asphalt and air so that all modes of distress are minimized. In the past, the design engineer would increase the asphalt content to reduce cracking. This often resulted in premature rutting. Next, the designer reduced the asphalt content to fix the rutting problems, but that would cause cracking. Superpave tries to optimize all performance factors by using volumetric parameters such as air voids, VMA and voids filled with asphalt (VFA).

Better Surface Texture

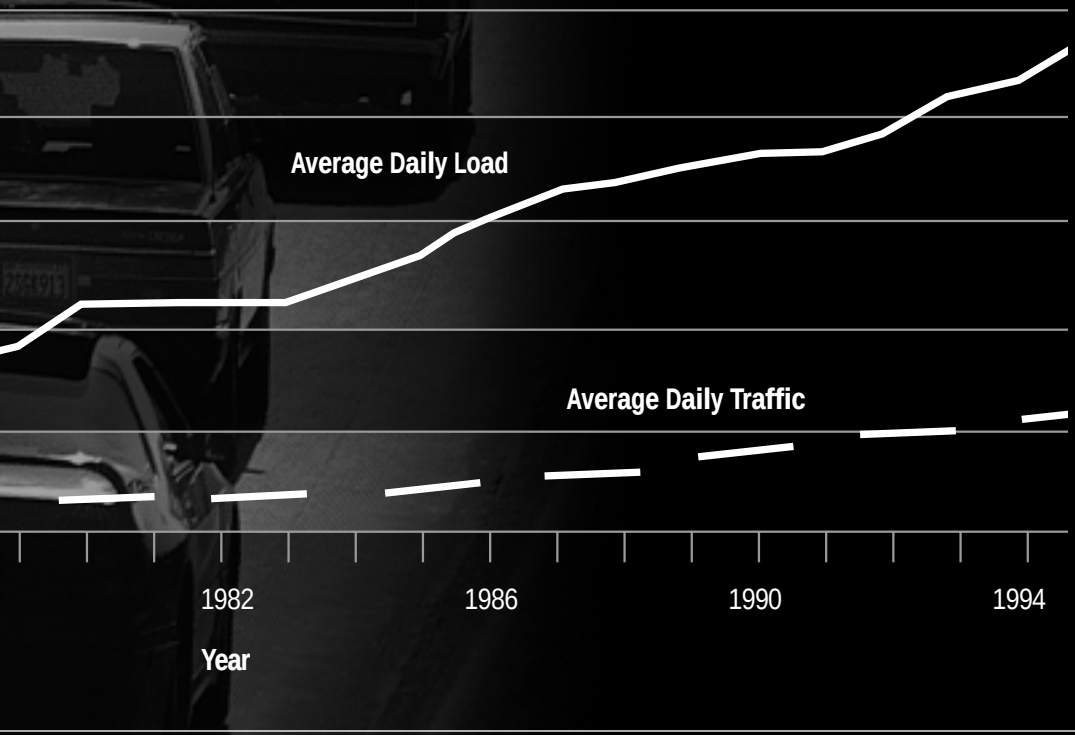
Superpave is a system of asphalt mix design tools, materials requirements, and performance analysis. It was not intended to address skid resistance of asphalt mixtures. Superpave mixes that pass under the restricted zone have a coarser texture. Typically, coarser pavement textures using the same polish-resistant aggregates result in better skid resistance.

Until a standard lab mixture skid test is developed, states may want to keep their polish-resistant requirements in place while superimposing the new Superpave criteria. Contractors may have to re-examine the aggregates they are using and re-screen their stockpiles or purchase different size aggregates in order to meet the new Superpave aggregate gradation limits in addition to the polish-resistant requirements.

Performance Related Mixture Testing

It is important that we understand how asphalt and aggregate interact in a mix to provide specifying agencies with high quality performance. While it is arguable how much aggregate and asphalt individually contribute to mix performance, we know that the final performance is determined from the mixture, not individual properties. The Superpave Shear Tester (SST) and Indirect Tension Tester (IDT) provide us with fundamental engineering measurements of asphalt mixture properties that relate to performance.

In addition to these performance tests, some states are experimenting with wheel tracking devices. These devices provide performance estimates for rutting, stripping, and even fatigue. While wheel tracking devices such as the Georgia Loaded Wheel, LCPC (French) Wheel Tracking device, and Hamburg Wheel Tracking device do not measure fundamental properties, they have been used successfully



as proof tests. The goal of a proof test is to quickly fail a specimen in the lab that would fail in the field, and likewise pass a specimen in the lab that would perform well in the field.

Colorado Department of Transportation found a correlation between Hamburg Wheel Tracking rutting measurements and pavement stripping performance. They use the Hamburg device to rank pavements as to good performance, high maintenance, complete rehabilitation, and disintegrator mixtures. CO DOT runs the specimens submerged at various temperatures based on the high temperature Performance Grade (PG). CO DOT has also experimented with giving the contractor an incentive of $1.50 per mix ton if the contractor meets the wheel tracking criteria.

From an industry perspective, the greatest improvements that Superpave mixtures have provided are increased durability and better aggregate interlock.

Improved Quality Control Tools

Even with the new tools that Superpave has provided to the asphalt industry, engineers are asking, "Are we building what we design?" Superpave may make its greatest contribution in the area of quality control and quality assurance (QC/QA).

For instance, one way to increase pavement performance is to improve QC. The winter 1997 Asphalt Magazine noted QC/QA implementation in the mid-to-late 1980s contributed to a 20 percent increase in pavement performance. The new Superpave tools are useless if the mix is not properly placed and controlled in the field.

As Superpave is implemented, these design tools can be taken to the field for quality control. Dynamic Shear Rheometers (DSR) are being installed as QC devices in asphalt terminals and at some contractors' hot-mix plants. In Indiana and other states, contractors are using the SGC to control their mixes.

Typically, a contractor must wait two to three hours to measure the bulk specific gravity to calculate volumetric criteria. The SGC will allow monitoring of the densification throughout the compaction process. You can also use the SGC to estimate volumetric properties when the specimen has completed the gyratory process. In other words, you can estimate the air voids, VMA, and VFA after six to eight minutes from the time the mix is put into the gyratory mold. This means you can estimate volumetric properties before the mix reaches the job site.

Conclusion

From an industry perspective, the greatest improvements that Superpave mixtures have provided are increased durability and better aggregate interlock. Superpave has also provided us with a better understanding of asphalt mix performance. We hope to see local and state agencies experiment with Superpave to increase their pavement performance.

Superpave has given us tools and measurements that have changed the way we do business. This has not been an easy change, and we are still working through areas of difficulty, but we have come a long way since 1993. As an industry, we are moving toward a better understanding of how to build durable, high performing asphalt pavements.▲

Asphaltnews from page 15

The Arizona DOT has scheduled 40 Superpave projects over the next 18 months. Most of the projects are overlays and all of them will be covered by QC/QA specifications. AzDOT let 17 Superpave projects in 1996.

"Aircraft/Pavement Technology: In the Midst of Change" is the theme of the 1997 ASCE Airfield Pavement Conference to be held August 17-20, 1997 in Seattle, Washington. The theme reflects the continuing challenges faced by the airfield pavement industry. For more information and registration materials, contact ASCE at 1-800-548-2723.

Responding to a concern of the Utah Department of Environmental Quality, the Utah DOT has collaborated with the Utah Water Research Laboratory to evaluate their asphalt-lined salt detention basins. In environmentally sensitive areas, UDOT uses basins constructed of dense-graded asphalt with zero air voids. Utah DEQ was concerned about the intrusion of salt into ground water. Core samples taken from UDOT's asphalt basins showed that the permeability values were lower than those required by EPA for landfill liners.

The Railroad Transportation Research Center at Pueblo, Colorado, will include a 6-inch thick section of asphalt pavement as an underlayment in their test track. The Asphalt Institute, which has recommended asphalt underlayments and overlayments to the Research Center, will provide specifications and construction procedures to assist with the project.

Superpave Corner

At the request of FHWA, as part of the National Asphalt Training Center II contract on Superpave Training and Field Assistance, the Asphalt Institute has developed a two-day Superpave course for the National Highway Institute. NHI has titled this course, Subject 13152ó Superpave for the Generalist and Project Staff. In brief, this course was put together to provide a good overall perspective on the entire Superpave system and how it is being implemented. The pilot course has been thoroughly reviewed and evaluated. The course materials have been delivered and the five Superpave Regional Centers soon will be scheduling courses based on demand.

Superpave for the Generalist will highlight the following topics: PG binders, aggregate properties, mixture properties, volumetric determinations, example mix design calculations, impact on construction, and available assistance with Superpave implementation. The course is intended for engineers, managers, inspectors, and contractor personnel who want to learn about the issues and concepts of Superpave and its differences from conventional mixtures rather than the details of test procedures.

The Asphalt Institute is helping Arkansas contractors develop mix design forms that comply with the Arkansas Highway & Transportation Department's new standards for Superpave mix designs. AHTD mix designs require three trial blends and analysis for the basis of blend selection. Design asphalt contents are selected in accordance with Superpave guidelines.

One of the largest Superpave projects in the east is underway on I-695 north of Baltimore. Total tonnage includes 142,000 tons of 37.5 mm nominal size mix using PG 64-22; 27,000 tons of 25 mm mix using PG 70-22; and 78,000 tons of SMA using PG 76-22. The initial 37.5 mm mix design called for 2.5 percent asphalt content, but the Maryland DOT lowered the number of design gyrations because of concerns about low asphalt content.

Ohio DOT has adopted a policy for 1997 projects that requires the addition of SBR and SBS polymers to heavy-duty hot-mix asphalt surface courses. The use of polymers, recommended by Flexible Pavements, Inc. (Ohio), is designed to increase the durability and longevity of the ODOT Type 1-H heavy-duty surface mix. ODOT has put together a team to implement the policy that includes representatives from the asphalt suppliers, hot-mix asphalt industry, and polymer-modified suppliers.

FHWA says highway agencies and contractors comparing Superpave gyratory compactors should review AASHTO Provisional Specification TP4-93 and ask vendors whether their products comply with the specification and has undergone sufficient testing to satisfy a testing protocol. The agency recommends that prospective buyers also talk with current customers who have bought an SGC. The Provisional Specifications are available from AASHTO at 202-624-5800.▲

'97-'98 Seminars *and* Training Courses

Fall 1997 Educational Seminars

Protecting Your Pavement Investment: *The Importance of Proper Pavement Maintenance and Rehabilitation*

This 2 1/2-day seminar provides proven and timely maintenance procedures that are essential to assure long-term pavement performance. Participants will receive practical information on topics such as how to analyze pavement maintenance needs, preventative and corrective maintenance procedures, rehabilitation techniques, and quality control of overlay construction.

Savannah, GA . . . . . October 14-16, 1997	Salt Lake City, UT . . . . . November 12-14, 1997
Nashville, TN . . . . . October 21-23, 1997	San Francisco, CA . . . . . November 18-20, 1997
Oklahoma City, OK. . . . . October 21-23, 1997	Atlantic City, NJ . . . . . November 18-20, 1997
Albuquerque, NM . . . . . October 21-23, 1997	Brownsville, TX. . . . . November 18-20, 1997
Biloxi, MS . . . . . November 4-6, 1997	Detroit (Livonia), MI . . . . . December 1-3, 1997
Newport Beach, CA . . . . . November 5-7, 1997	West Springfield, MA . . . . . December 16-18, 1997
	Reno, NV . . . . . December 16-18, 1997

Registration Fee is $419 for each participant. Discount of $50 per each registration given to agencies sending three or more participants.

Superpave Laboratory Training Courses

Superpave Mix Design Analysis Course

This hands-on training course is modeled after the Asphalt Institute's acclaimed Superpave laboratory-training courses that were developed as part of the FHWA's National Asphalt Training Center (NATC). The four-day course consists of laboratory training and lectures on test procedures, calculations and criteria involved with the Superpave asphalt mix design system. The course provides the student opportunity to study all phases of performing a Superpave mix design, including hands-on sample preparation and compaction using the Superpave Gyratory Compactor. Courses will be held at Asphalt Institute's International Headquarters and Laboratories.

Lexington, KY . . . . . October 7-10, 1997	Lexington, KY. . . . . November 4-7, 1997

Registration Fee: $750 for each participant.

Spring 1998 Educational Seminars

Constructing Quality Pavements Using Superpave Technology

This 2 1/2-day seminar is designed to provide the technology that will help you achieve the high quality asphalt pavements that Superpave promises. The subjects covered include new binder designations, mix design procedures, grading bands, mix types, placing, compaction, and overviews for field control testing.

Indianapolis, IN . . . . . February 10-12, 1998	Las Vegas, NV . . . . . April 7-9, 1998
Orlando, FL . . . . . February 24-26, 1998	Woodbridge, NJ . . . . . April 14-16, 1998
Portland, OR . . . . . March 3-5, 1998	Cincinnati, OH. . . . . April 28-30, 1998
Denver, CO. . . . . March 17-19, 1998	Phoenix, AZ . . . . . May 5-7, 1998
Charleston, SC. . . . . March 24-26, 1998	Raleigh, NC. . . . . May 5-7, 1998
Newport Beach, CA . . . . . March 31-April 2, 1998	Sacramento, CA . . . . . May 5-7, 1998

Registration Fee is $439 for each participant. Discount of $50 per each registration given to agencies sending three or more participants.

For more information detach and mail this form to:

Attn: Seminar Coordinator,
Asphalt Institute, P.O. Box 14052,
Lexington, KY 40512-4052
Phone: (606) 288-4964
Fax: (606) 288-4999
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Architectural Splendor with StreetPrint

by Tim Murphy, Asphalt Institute District Engineer

For years architects have been trying to find a way to produce a laid-brick street without actually laying the bricks. They tried a variety of materials, but with limited success. Then Integrated Paving Concepts, Inc. (IPC) of Victoria, British Columbia, developed StreetPrint, a revolutionary asphalt texturing system that replicates the appearance of hand-laid brick.

The IPC system works because its licensed applicators ensure a good foundation to build on and around 92 percent compaction prior to placing the template on the hot-mix asphalt. IPC ensures that the colored acrylic emulsion is properly applied to the surface of the compacted asphalt for both beauty and to prevent oxidation.

No Joints, No Water

Unlike a brick pavement, StreetPrint has no joints where weeds can grow or water can infiltrate, and you can build it for approximately 50 percent less than you can lay the bricks. Since StreetPrint came on the market in 1993, over 8 million square feet of finished product has been placed worldwide by 270 authorized applicators.

The Asphalt Institute got involved with the product after several large cities inquired about it. Most cities plant grass or install hand-laid bricks in parkways, the space between curbs and sidewalks. Maintenance for both grass and bricks is expensive. Public Works engineers were looking for a less costly alternative. They asked the Institute if placing asphalt in parkways would be a feasible maintenance solution.

Gallagher Asphalt of Thornton, Illinois, quickly saw the potential market for StreetPrint. Charlie Gallagher envisioned StreetPrint capturing the lucrative driveway market and filling the need for a decorative material in parkways when he first saw it demonstrated at ConExpo in 1993. Realizing the product could open a potential niche market, Gallagher Asphalt quickly signed on with IPC to be a distributor of StreetPrint throughout the central U.S. Gallagher began marketing the product to many small contractors, who, in turn, brought it to municipalities of all sizes in the central and midwestern states.

Variety of Uses

"The market seems to be unlimited," says Gallagher. "Not only can we use it for streets in historic areas of Chicago, but we can also use it for ornamental biking and walking paths, and to beautify business districts—especially in the parkways. We can use it for new or overlaid driveways. We have seen business double since we began aggressively marketing the process to more contractors."

The process is not just an anomaly, it has an infinite number of uses. Word about this new look is spreading quickly, according to Tom Scholl, president of Scholl Paving, an authorized applicator of the StreetPrint process. The product is creating interest around the world.

Scholl was invited to spend several days in Tel Aviv, Israel, last summer to demonstrate the process. The largest StreetPrint project ever done, 150,000 square feet of paving, took place there with Scholl in charge. The project included several major streets and intersections and was done in 110-degree heat. The Israeli government was pleased with the results. To show their appreciation, they gave Scholl a private tour of Jerusalem on his final day in Israel.

McDonald's and The Bulls

The StreetPrint process involves rolling a welded steel cord template into the pavement surface after the hot-mix asphalt has been completely compacted but before it has cooled.

Dozens of templates currently exist and many more are being developed for today's customers. Templates can even be personalized so that customers have their family or company name imprinted on the StreetPrint surface in heavily traveled areas. Some current users include McDonald's; Texas Department of Transportation; Chicago Bulls' players; various Ford Dealerships; Dayton, Ohio; Pittsburgh, Pennsylvania and White Plains, New York. The ability to compliment the many existing patterns has been accomplished by IPC through the continued refinement of the coating system.

The product has been used in a variety of climates and continues to perform well under wide ranges of temperature.

The coating system uses prescribed amounts of acrylic, epoxy, portland cement and silica sands and a new sealing membrane product. There are dozens of colors to choose from. Applicators now foresee five-year resealing cycles as the norm for lightly traveled uses and a longer resealing cycle for walking paths and no-traffic areas. The product has been used in a variety of climates and continues to perform well under wide ranges of temperature.

Many municipalities and architects that desire to cut costs, reduce maintenance efforts and provide an aesthetically pleasing look to their communities will use StreetPrint. Applicators believe that StreetPrint's lower cost coupled with the public's desire for beauty will lead more communities to specify the product. That opens another viable market for asphalt.▲

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Research Park Drive
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