JANUARY/FEBRUARY 2010

VOLUME 15, NUMBER 1

HMAT

Hot Mix Asphalt Technology

PUBLISHED BY THE NATIONAL ASPHALT PAVEMENT ASSOCIATION

WWW.HOTMIX.ORG

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How Alabama

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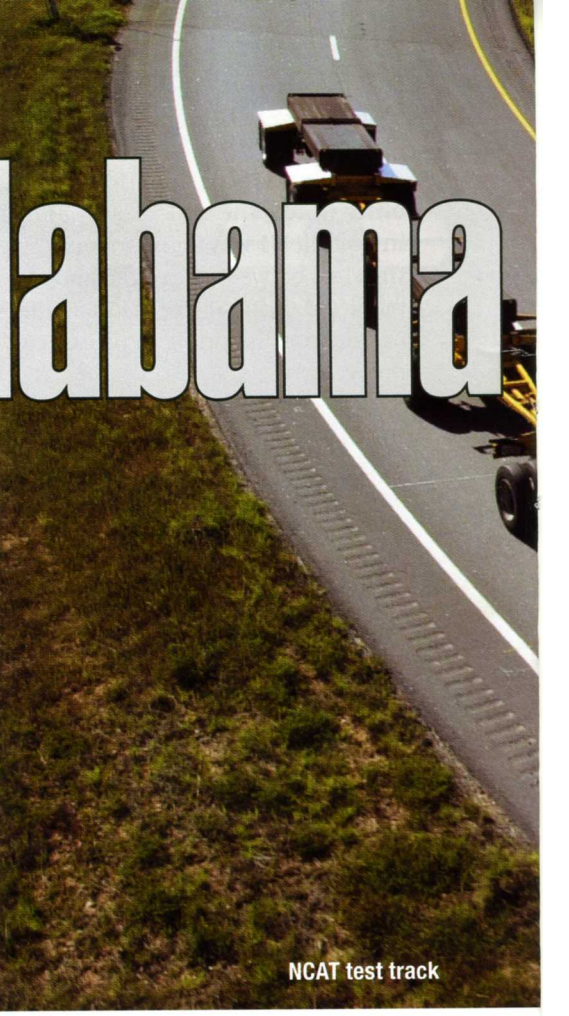
Former Alabama DOT asphalt layer structural coefficient of 0.44 was based on AASHO Road Test held from 1958-1960 at Ottawa, Ill.

A field-tested refinement of the asphalt layer coefficient allows Alabama DOT to achieve the same structural requirements with thinner pavements.

By Tom Kuennen



NCAT test track

New research refining or "recalibrating" the structural coefficient of asphalt layers is letting the Alabama Department of Transportation decrease its hot-mix asphalt pavement thicknesses by nearly 19 percent.

The new data enable the DOT to meet structural requirements with thinner asphalt pavements, allowing more square yards of asphalt pavement to be placed within the same budget beginning in 2010.

The new research from the National Center for Asphalt Technology (NCAT) at Auburn University in Alabama, *Recalibration of the Asphalt Layer Coefficient*, by Kendra Peters-Davis and Dr. David H. Timm, P.E., was published in August and establishes that in the age of Superpave and other advanced pavement designs, today's asphalt layers are stronger structurally than layers used during the AASHO Road Tests of 1958-1960.

One of the main parameters in an asphalt pavement design system is the asphalt layer structural coefficient. The structural coefficient is an index that expresses the structural contribution of the asphalt layer(s) relative to all the other layers.

Based on research from the 1956 AASHO Road Tests, the existing asphalt layer structural layer coefficient value used by Alabama and many other states has been 0.44. The new research incorporates actual performance of modern materials and designs at the NCAT Test Track at Auburn University, and has resulted in a new structural layer coefficient value of 0.54.

From a practical standpoint, this permits a thinning of a pavement by about 18.5 percent while still getting the same load-bearing performance as before. Beginning next year, the resulting savings will

Gets More Bang for Its Asphalt Buck

be used to expand Alabama's overlay program by a like amount.

Boost to Alabama Program

"In our recent NCAT test sections we evaluated the structural layer coefficient that we used in our existing design procedure," said Mike Harper, P.E., assistant chief engineer for operations, Alabama DOT. "The result of the study was the recommendation that we could comfortably go from 0.44 to 0.54 with our structural layer coefficient in our design procedure. That means, for most of our new pavements, an 18 percent reduction in the total build-up, and an 18 percent reduction in overlay thickness for existing asphalt pavements, which is a tremendous savings for us. We will use that savings to pave more miles."

The Alabama DOT will implement the new pavement value in its road program in its 2010 budget. As the new fiscal year started Oct. 1, this means that the state will benefit from the road cost savings almost immediately.

"Our resurfacing budget is approved each year," said Larry Lockett, P.E., state materials and tests engineer, Alabama DOT. "This means that our resurfacing budget will go 18 percent farther than it has in the past. We will be able to pave more roads, more lanes, more miles, because of this 18 percent saving."

As the economic stimulus package—the *American Recovery and Reinvestment Act of 2009*—provided an approximately 40 to 50 percent increase in Alabama's resurfacing program over two years, this 18 percent savings will further leverage those funds to benefit Alabama's roads and economy.

"For a number of reasons, Alabama has been building fewer and fewer new lanes, but doing more and more resurfacing and reconstruction," Harper said. "We use the falling weight deflectometer (FWD) to determine what the depth of our overlay should be, and we will be using the 0.54 value in overlay thickness design for 2010's resurfacing program. We will use 0.54 for both overlays and new construction."

Changes in pavement designs—like other changes in how government bodies go about their work—aren't necessarily welcomed by government agencies, DOTs included. In many agencies there is a built-in reluctance to change specifications or procedures, as a change introduces the chance of failure, compared to no chance if things are left alone. Yet Alabama DOT administration has been supportive of the new asphalt layer value. "Our management was very impressed with the research, and our ability to expand our program," Lockett said.

Certainly the DOT operations side is confident that the new value will work for its road patrons. "The new 0.54 layer coefficient is on the conservative side," Harper said. In September the new structural layer coefficient got the go-ahead from FHWA's Alabama Division for use

on federally funded projects, he added.

Field testing at the NCAT test track assures that the new-design pavements will perform just as well as before.

"Because the research comes from the National Center for Asphalt Technology and NCAT's use of an actual test track, we have great confidence in the new number," said Mel Monk, P.E., executive director of the Alabama Asphalt Pavement Association (AAPA).

"The AASHO Road Test put 2 million ESALs on the pavements, but the Auburn test track is putting 10 million ESALs on different pavement designs over two years," Monk said. "The design sections were exposed to environmental conditions, and because Alabama is a warm state, at NCAT we have the perfect rutting test conditions. The sections also were heavily instrumented with strain gauges, pressure gauges and transducers, everything you could use to monitor a pavement. Because of all that I have total confidence that the new value is valid."

Plugged into DARWin Software

For pavement designs, Alabama uses the AASHTOWare *DARWin 3.1 Pavement Design and Analysis System*, a computerized version of the *1993 AASHTO Guide for Design of Pavement Structures*. "DARWin still is based on the AASHO Road Tests, which have worked extremely well for a long time," Harper said. "But we found that for our Interstate system, we were getting some thick pavements, lots of layers of asphalt."

The first Alabama sections placed at the NCAT Test Track in 2000 led the state to believe these pavements were indeed overdesigned. "In the real world, when we went through the Superpave transition, we saw that we had improved the quality of our aggregates, with more crushed materials and with polymers added to binder in our mixes for higher ESAL-range roads," Harper said. "We found our roads were more durable, and that the structural coefficient we had been using from the AASHO Road Tests of the 1950s was not representative of what we are doing today."

"The research was initiated by the Alabama DOT," said Dr. David Timm, P.E., Gottlieb associate professor of civil engineering, Auburn University. "They've been sponsoring NCAT Test Track research back to the year 2000, and from 2003 to 2009 sponsored test sections that looked at the performance of thinner HMA cross sections in which significant pavement deterioration occurred. As a result of the tests they were able to go back into Alabama's existing design system and recalibrate it to reflect current performance using modern asphalt

mixes plus today's heavy truck loads and ESALs. The resulting new asphalt layer coefficient was recalibrated to more accurately reflect HMA's performance in Alabama."

Unlike the AASHO tests, the NCAT sections used in the recalibration of the structural coefficient included standard, dense-graded Superpave mixtures, both modified and unmodified; SMA mixes; and mixes designed by Alabama, Florida, Oklahoma and Missouri DOTs. "There was a variety of materials and mixes, which resulted in a range of values," Timm said. "For all sections the average value was 0.54."

In essence, the NCAT research determined to what degree asphalt pavements were being overbuilt—based on the AASHO tests—and "shaving" that design down to one that will provide optimal use of HMA, but still within Alabama's design system and with the same structural performance. Now, all the DOT will have to do is insert the new value into its design software; nothing else changes.

"This work confirmed opinions that pavements were being overdesigned in the existing design system," Timm said. "With the existing system, you were stuck with the thickness you got. But we've known for a while through the work on Perpetual Pavements done by the Asphalt Pavement Alliance, that there is an upper limit to how thick the pavement needs to be, and beyond that upper-bound thickness you are throwing money away."

"We have come so far since the introduction of the old number following the AASHO Road Test," AAPA's Monk said. "We've introduced Superpave, better quality aggregate than ever before, and with PG-graded binders we've been able to specify more exactly the type of liquid asphalt to use for different traffic applications and climates. We've introduced stone-matrix asphalt (SMA), which for Alabama is our top-quality mix that we use for our highest levels of traffic loads. And we've brought in open-graded friction courses (OGFCs) for the top layers, which are safer because they reduce splash and spray while providing a superior friction course."

Now, he said, the time has come to give these improvements their due. "We'd done all these things, but still were using a structural number of 0.44," Monk said. "We were introducing all new improved mixes, but left behind the 'credit' for what we were doing. By using 0.54 we are recognizing—and putting a value on—the new quality asphalt binders and mixes we are using."

Transferring Technology Beyond Alabama

Alabama is looking forward to sharing this new technology with other states. "The research will be shared with any states that want to look at it," Harper said. But the data are so new that beyond the states that participated with Alabama in the test sections, the word is not yet out.

The Alabama research may be applicable to other states, but they will have to go carefully, Timm said. "Other states should read the report, look at what type of mixtures we used in our climate, and see how different their mixtures might be," he said.

"For example, Florida placed some sections in this research and certainly the results would transfer to their conditions," Timm said. "But if you were to go to a northern-tier state, they would want to look at the research much more closely. Many states have been using the 0.44 since the 1960s. If they haven't taken a critical look at it since then, this might be a good opportunity to re-examine that value, and this study might point them in the right direction. But the farther away you get from where we did the testing, the greater the need to scrutinize what differences exist between your mixtures and climate, and what we had at the test track."

In the meantime, at the NCAT Test Track, research will continue on the new asphalt layer coefficient. "At the test track we just finished reconstructing a number of sections, and left a number of sections in-place," Timm said. "We have two more years of traffic to apply, which just started in September. We will continue to monitor these sections to validate the 0.54 value. We rehabbed several of the existing sections and now we will be able to answer the question of whether this new value is good for rehabbed pavements."

Transfer of this new finding to the industry at large will accelerate, Timm said. A "webinar" on the 0.54 value has been conducted by NCAT and is available on demand from its Web site. A presentation was held in late summer at the Southeastern Association of State Highway & Transportation Officials (SASHTO) meeting in Biloxi, Miss. "We'll continue to speak and make presentations," Timm said. "And we prepared a paper for the American Society of Civil Engineers, which was submitted in September." HMAT

The NCAT report is available online to all. To download NCAT Report 09-03, Recalibration of the Asphalt Layer Coefficient, *visit http://www.eng.auburn.edu/center/ncat/reports/rep09-03.pdf.*