Placing the steel basket in the concrete.

MISSISSIPPI Mississippi Concrete Warranty Project: Simple as A+B

At first glance, the concrete repaving of a seven-mile stretch of Interstate 55 in rural Carroll County, Mississippi appears to be a relatively simple project. But the State's trailblazing use of a 10-year maintenance warranty – in which the contractor guaranteed the quality and performance of the new highway – and its savings of time and money for stakeholders, vaulted the project into the national spotlight and attracted the attention of the Federal Highway Administration (FHWA) as an embodiment of the principles of FHWA's new Highways for LIFE program.

That stretch of Interstate 55 – seven miles of four-lane highway that sees only 14,000 motorists a day – had presented a multitude of problems and challenges to those who traveled its worn pavements. There were countless potholes and threatening thermal cracks that presaged more. Pothole patches produced washboarding and generated safety problems in inclement weather.

District 2 of the Mississippi Department of Transportation (MDOT) reviewed the situation, deciding that "teamwork" would be the watchword in implementing a new approach to the work ahead.

The value of teamwork quickly became clear: in the early stages of the project's development, no bidders emerged from the hot mix asphalt paving industry to support what had been projected as MDOT's first hot mix warranty "maintained pavement" project.

"We called on Alfred Crawley, P.E., of the Southeast Chapter of the American Concrete Pavement Association (ACPA) to determine the willingness of the concrete paving industry to do a warranty project," said Randy Battey, P.E., State Research Engineer.

Within 60 days, he recalled, a one-day workshop was held at the MDOT headquarters where MDOT personnel, four ACPA member contractors, two ACPA promoters, and FHWA representatives brainstormed about how to make a warranty concrete pavement project move from the drawing board onto the road.

The next 12 months were busy ones as ACPA provided a first draft of a warranty specification for MDOT's review, worked with the Department to develop performance goals for just such a warranty project, and provided a promising pavement design that MDOT adopted.

Then came the test: Would any contractor be willing to bid such a project, considering the stringent requirement to provide smooth pavement while saving construction time and public money? By February, 2001 three bids were received, with the low bidder's price coming in below the engineer's estimate.

Traffic Control and Safety

The project was located on an Interstate highway with two roadways separated by a median whose minimum width was 88 feet. With optimum traffic control and public (and worker) safety in mind, MDOT, with input from ACPA, shifted all traffic onto one side of the Interstate, using a concrete median barrier meeting NCHRP 350 standards to separate opposing traffic. Traffic would then be switched from one side to the other by the use of crossovers at each end.

The contractor accessed the project through an interchange just north of the project, allowing trucks to enter the work zone through a haul road on the outside shoulder of the interchange ramps at the project's north end. "A flagger was continuously stationed at the junction of the haul road at the interchange ramp and the local roads running from the contractor's concrete plant to ensure safe traffic flow at the point where construction traffic crossed the interchange ramps," said Alfred Crawley. He added that this was the only project location in which work zone activity shared the same area as general traffic.

To ensure job site safety, according to Jesse Stewart, District Construction Engineer, considerations included yield signs placed at the end of the southbound on-ramp (the acceleration lane was unavailable during construction); lowering the speed limit through the work zone to 60 mph; and closure of the highway rest area – located off the southbound lanes and about one mile from the project's north end – for the duration of the work.

Stewart added that off-site safety initiatives for the traveling public included signage at the interchanges at both ends of the project, directing wide loads to an alternate route. The low ADT – 14,000 vehicles – precluded traffic queues developing due to the two-lane, two-way traffic configuration. In addition, with the nearest urban areas some 70 miles to the south and 130 miles to the north, MDOT decided that a specific public information campaign was unnecessary.

A+B

To keep construction time and traffic problems to a minimum, MDOT let the project through what is known as the "A+B" process, whereby each bidder chooses his own contract time. The low bidder and eventual winner (APAC-Mississippi) allotted 102 calendar days for the troublesome two-lane, two-way traffic.

"A+B" might be thought of as "A" being the sum of contract bid terms and "B" as the contract time bid by the contractor, multiplied by the daily user cost specified by MDOT. Moreover, the "B" element actually was split into two timelines. One was the number of days of two-way, two-lane traffic. The other was total construction time minus all those days of "Two by Two." The cost to the taxpayer – the user cost – for the days of Two by Two was established by MDOT at $5,000 a day with $825 a day set for the remainder of construction time. The amount that contract winner APAC-Mississippi had specified was almost one-third less Two by Two traffic – 102 days versus 160 days – reducing by almost two months the construction timeframe.

Once the contract, on that basis, was set, one of the contractor's top challenges in expediting construction was the need to mill and remove eight inches of the existing asphalt pavement – from a total of 94,000 tons of such existing pavement – before concrete paving could begin. According to Crawley, the milling was indicated due to the existence of stripping at depths of five to six inches in the existing asphalt. Thus, the decision to build the road down instead of up (more on this aspect to follow) was based on the projected costs and extended construction time required for bridge clearance and raising the shoulders of the roadway.

The engineers found that the existing pavement was full-depth, hot-mix asphalt, approximately 15 inches in thickness, which had reached low levels of serviceability because of the many pothole patches necessitated from stripping in the asphalt. There were, in addition, numerous thermal cracks throughout the pavement. The project was situated between highway interchanges with fully controlled access, had two overpasses where local roads crossed over I-55, and included three bridge structures, two over streams and one over a local road.

The final pavement design, said Stewart, called for "removing eight inches of the existing asphalt pavement for a width of 326 feet in each roadway," which allowed for an extra width of one foot on each side to install retrofit edge drains. The new concrete pavement was 10 inches jointed plain with doweled transverse contraction joints on 16-foot spacing. After installing the edge drains, a two-inch asphalt overlay was placed on the existing asphalt shoulders to complete the paving.

"If there was one thing we would have done differently," said Stewart, "it would have been to wait until the entire project was finished before installing the retrofit edge drains. The settling that occurred meant that we had to redo some of the asphalt shoulder overlay."

Getting Somewhere

"In summary," said Battey, "the project incorporated the contract innovation of warranted pavement and incentives for smoothness and reduced construction time. And the contractor responded with a short construction schedule and one of the smoothest pavements on the MDOT system."

Liquid membrane as it is sprayed on the new concrete surface, helping seal the pavement and ensure a smooth ride for years to come.

That success, given the requirements for new paving to be maintained at specific levels for a full ten years, was due to MDOT's recognition of the need to allow APAC-Mississippi, the general contractor, as much latitude and initiative as possible, waiving standard specifications to encourage innovative thinking on the contractor's part.

Another factor was the contractor's response to the challenge by using the same grade line for both cold milling and concrete paving. The team also saw the opportunity to save significant time by utilizing the existing roadbed for a haul road.

Even after milling eight inches of the existing asphalt pavement, APAC found at least five good inches that could serve as a usable base. "Stringent grade line checks," in Battey's words, along with quality paving practices, resulted in an "excellent ride quality" with few areas needing grinding. The bottom line: APAC's quality control program worked, resulting in concrete that met or even exceeded MDOT's standard specifications, with 72 percent of the finished pavement qualifying the contractor for the maximum bonus for ride quality, while another 21 percent enabled him to collect the intermediate bonus.

How to Build a Road *Down*

Faced with the date of June 15, 2001 for the $11,698,796 project to begin construction, the contractor needed to work quickly. But challenging that goal was the eight inch-thick layer of existing asphalt pavement – or 94,500 tons of old asphalt – that had to be removed or somehow dealt with before the new, smooth concrete surface could be installed. After thoroughly inspecting and analyzing the asphalt, he found that the best solution was to mill it away, considering that lurking far down in the asphalt, five to six inches below the surface, was a good deal of stripping.

The discovery led to a decision to build the new road down, instead of up, because, the planners and contractor found that, to build it up in conventional fashion, after all the milling, would have resulted in a raised road surface with numerous bridge clearance problems and the possibility of having to raise shoulders on the entire roadway.

The next immediate task: developing the grade for the concrete paving. To assure a quality pavement, said Stewart, the first critical step was to establish a high quality string line to control both the asphalt milling and concrete paving operations. The milling equipment featured a grade control system, automatically regulating the longitudinal profile and cross slope of the milled surface using electronic sensors, guiding from a stringline to a tolerance of plus-or-minus 20 inches from the difference of the finish grade for the paving, minus the 10-inch pavement thickness. In addition, the use of a high-strength steel cable for the stringline, combined with frequent checks by a construction surveyor, ensured "a reliable and true grade line."

Steward adds that the transverse cross slope was checked from a taut t-string supported from the longitudinal string line.

The smoothness of the milled surface – a crucial element in the warranty contract – was measured by a computerized Profilograph in each travel lane in accordance with MDOT specifications. Those lots with a profile index of greater than five inches per mile were corrected before placement of the new concrete pavement. "These smoothness details for the milled surface provided an excellent track line, contributing to the high degree of smoothness exhibited in the concrete pavement," said Crawley.

In addition, the milled asphalt pavement was used for the haul road; haul trucks dumped the concrete directly onto the grade ahead of the paver; dowel baskets were installed just ahead of the paver (using paint marks for alignment); and a loader with a long boom was used to help distribute the concrete evenly across the width of the roadway. Sixteen-foot straight edges, directly behind the paver, were employed to enhance the smoothness.

To achieve final smoothness, corrective measures, such as grinding, were used only at construction joints.

The new concrete paving, made of native Mississippi aggregates, was on a 10-inch jointed plain with doweled transverse contraction joints on 16-foot space. As a final step, after installing the edge drains, a two-inch asphalt overlay covered the existing asphalt shoulders.

The paving was complete and the roadway ready and open to traffic on May 16, 2002.

Quality, Job One

Under MDOT's challenge to APAC-Mississippi, Randy Battey recalled, the contractor's quality control program "relied heavily on the basics of quality," dovetailing with the quality tenets of the FHWA Highways for LIFE program. Battey defined the Mississippi project's basics of quality as consistent product characteristics that, more than anything else, passed the "excellent ride quality" test.

Thus, the smoothness of the finished product came from high quality track line, true and stable string line, and consistent concrete.

In fact, after examining the performance of jointed concrete on the entire MDOT system built over the last half century, the MDOT engineers found that native Mississippi aggregates, combined with short joint spacing and load transfer and the stable sub base that this project presented, could actually meet or exceed all performance criteria and thresholds. Moreover, the contractor, relying on the standard specifications of MDOT's long experience with concrete pavements, knew what concrete mix parameters to follow to produce the performance that MDOT was looking for.

Innovations Used

It was the kind of project that called for creative, pioneering approaches all down the line, said Battey. Outside-the-box thinking was employed in materials, such as using a steel cable for the string line to control both the milling and the paving. The contract innovations of warranted pavements, as well as incentives for smoothness and reduced construction time, added to the environment of innovation encouraged by the Highways for LIFE program.

The contractor's team noticed how well the jointed concrete on the MDOT system had performed, year in and year out, over half a century, and recognized that the standard MDOT specifications reflected the "keys to quality pavement performance." Thus, they hewed to exactly those standards as construction got underway.

"You can see this as sort of an innovation-in-reverse," said Battey, where the contractor, given the opportunity to use or factor in just about any mixture or process he wanted, discovered that the state-of-the-art conformed to MDOT specs and designs all along.

The true innovation, said Crawley, was the Department's decision to construct a long-life concrete pavement when no such work had been done in the state for nine years. Other breakthroughs, he said, comprised the joint MDOT/ACPA effort to develop a realistic, workable warranty specification that produced a smooth, new concrete pavement in cost-effective, time-saving ways.

Thus, by emphasizing the need to expedite construction, and drawing the contractor directly into the planning process to determine how that might be accomplished, MDOT was able to rebuild the entire seven-mile, four-lane section of I-55 while inconveniencing the traveling public for only 110 calendar days.

Lessons Learned

In the end, the Mississippi Department of Transportation and its contractor had the satisfaction of seeing their plans and judgments validated, not only with a top quality, new concrete pavement, but with the project's recognition by the American Concrete Pavement Association as a finalist in the 2003 Excellence in Concrete Pavement Awards.

"This project is an excellent example of the value of concrete paving—where conditions justify it—and for the warrantied approach," said James Q. Dickerson, III, MDOT District 2 Engineer. "The contractor is responsible for maintaining the pavement to indicated distress levels for a full 10 years. It's cost-effective, long-lasting, and keeps the user in mind at all times."

Dickerson concludes, "It was our first experience with the concrete highway reconstruction, and we will be looking for other such opportunities."

The finished concrete surface of the I-55 Warranted Highway work in rural Carroll County, Mississippi.