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funding levels. The current funding level would only permit completion of about three projects per year—not enough to do the program. AHTD felt that the motoring public would endure a reconstruction program of five years but no longer.

costs for each of the rehabilitation methods but do not include other construction costs.

Two of these projects, number 20138 and number 001765, also provided examples of traffic control methods and speedy construction time. Project number 20138's original pavement consisted of approximately

Rubblizing I-30 and



In June 2001 the Arkansas Highway Transportation Department (AHTD) together with the Federal Highway Administration (FHWA) and the Arkansas Asphalt Pavement Association (AAPA) held a rubblization reconstruction demonstration on I-40 near Russellville, Arkansas, to show how the AHTD is implementing its \$952 million rehabilitation program on Interstates 30 and 40. More than 240 highway engineers and officials from 17 states attended.

Before reconstruction planning began, AHTD was fully aware that 60 percent of its system, approximately 360 miles, was in fair to poor condition and in serious need of rehabilitation. *Truckers Magazine* had recently rated I-30 and I-40 through Arkansas as the worst roads in the country due to the faulting that occurred at most transverse joints in the existing PCC.

Can We Do It?

The challenge was how to complete such a massive rehabilitation project in a reasonable time within

In order to properly rehabilitate the entire 360 miles as planned, AHTD would have to increase the rate of rehabilitation from 15 miles per year to about 75 miles per year.

AHTD had previously tried various forms of concrete rehabilitation but had found that they were costly, slow, and provided relatively short-term improvements.

Rubblize and Overlay

Rubblizing the faulted Portland Cement Concrete (PCC) pavements together with a Superpave asphalt overlay offered the most economic and efficient means of correcting the faulted PCC and giving the motoring public a new, smooth pavement designed to last a minimum of 20 years. A series of test rubblization projects with Hot Mix Asphalt (HMA) overlays demonstrated the effectiveness of the process. Table 1 is a cost summary of the test projects used to justify the rubblization/HMA process. The costs in the table represent the relative material

5.5 miles of 9-inch jointed reinforced concrete pavement (JRCP) over 6 inches of cement-treated base within the southbound lanes of U.S. 65 south of Little Rock. It was reconstructed successfully by rubblization and HMA overlay in the fall of 1996 in 70 working days during head-to-head traffic.

Big Savings

Project number 001765 consisted of 5.06 miles of I-40 west of Little Rock with very heavy traffic—60,000 average daily traffic (ADT) with 40 percent heavy trucks. Its original pavement was 9 inches of JRCP on natural subgrade. It was reconstructed during 1997 in approximately 70 working days under traffic with no lane closures during rush hour periods. The rubblization/HMA overlay reconstruction method saved \$4.41 million compared to the estimated cost of reconstruction with PCC.

The success of these projects gave the AHTD confidence that rubblization plus HMA overlay provided the means

of handling traffic through construction zones—head-to-head, under traffic, or with temporary lane removal.

Also, the successful completion of the projects showed AHTD that *lane rental fees* could be used to ensure that projects would be completed with a minimum amount of lane closures. Lane rental fees are implemented in

specification that were antiquated and cumbersome; and (3) making changes to allow a turn-around time for the review of contract documents that would not exceed seven days.

FHWA then agreed to allow AHTD's annual budget of \$65 million to be used for the project as part of the interstate maintenance program.

Pavement sections west of Little Rock consist of 4 inches of 25mm-sized mix for the base course, 3 inches of 19mm nominal-sized mix for the intermediate course, and two 2-inch layers of 12.5mm nominal-sized mix for the surface course. Pavement sections east of Little Rock will consist of 5 inches of 1-inch nominal-sized mix

d I-40 in Arkansas



bond program projects using A + B contracts. Under this program, a set number of days are established for construction between AHTD and the contractor. If the project is completed in less than the allotted time, the contractor receives a bonus. If the project period is exceeded, however, the contractor is assessed a penalty—typically \$5,000 per day. AHTD believed they would be able to complete the \$952.5 million rehabilitation program within the estimated 5-year time frame.

Planning

Early in the planning stages, AHTD realized that the success of its proposed program depended on developing a strong partnership with the FHWA. The two organizations worked closely to identify issues that would target contract problems and minimize future changes. These issues consisted of (1) standardizing pavement designs so that successive projects didn't require redesign; (2) modifying parts of the

Under this agreement, a total of \$164 million in bond projects were let during fiscal year 2000 and a total of \$365 million of bond projects were let in 2001.

Design

The pavement thickness—based on Equivalent Single Axle Loads (ESALs)—is based on 75 million ESALs generated by 43 percent trucks west of Little Rock and 122 million ESALs produced by 54 percent trucks east of Little Rock.

Base materials over the stiff soils west of Little Rock consist of unstabilized aggregate while the soft, alluvial clay east of Little Rock require a cement-treated base. A structural coefficient of 0.29 was used for subgrade material west of Little Rock in the 1993 AASHTO pavement design equation to determine the proper HMA overlay thickness. This result was a required overlay thickness of 11 inches for sections of I-40 west of Little Rock and a 12-inch pavement thickness for sections east of Little Rock.

for the base course, 3 inches of 3/4-inch nominal-sized for intermediate mix, and two 2-inch layers of 1/2-inch nominal-sized for the surface mix. A PG 76-22 modified asphalt binder is used in all of the lifts.

Smoothness

The International Roughness Index (IRI) on the existing PCC indicated a rough ride. Information obtained from AHTD's roughness measuring vehicle over the last several years shows that a significant portion of the I-30/I-40 system had IRI values from 170 to 300 inches per mile.

According to FHWA, pavement ratings between 95 and 170 have acceptable ride quality. Design for the rehabilitated road system targets optimum smoothness.

Underdrain System

AHTD decided that a well-designed underdrain system to remove water

and moisture trapped beneath the concrete slabs was a key part of the rehabilitation process. If moisture is not removed from the subgrade, there may not be sufficient resistance to achieve the required minimum particle size.

Where the low side of the pavement is located on the inside driving lane, as typically occurs with super elevated curves, underdrains are installed adjacent to the inside edge of the JRCF just before rubblization. AHTD specified

heavy-duty, high stiffness polyethylene pipe and rigid PVC elbows for these underdrains. Outlet laterals for the underdrains were provided at regular 250-foot intervals.

Construction

Construction for the five-year program is following a bell-shaped curve. It began in 1999 and will end some-

time in the 2005 with an average base of approximately 125 miles of construction per year. But in 2002, the miles of pavement under construction is anticipated to swell to 300 miles.

The completed program will contain 276 four-lane miles of rubblized PCC with HMA overlay. Approximately 64 miles of existing asphalt pavement will be milled and replaced with the new HMA Superpave mix. The remaining 40 miles of PCC will be removed and replaced with HMA Superpave mixes.

In areas with high traffic counts that do not require bridgework and median crossovers, the existing outside shoulder is replaced with a Full-Depth 5-inch thick, 10-foot-wide HMA shoulder. Underdrains are installed as part of this first step. Two lanes of traffic are then diverted onto the new shoulder and existing JRCF of the outside lane.

Tight Interlock

The inside lane of JRCF is then rubblized with the resonant frequency breaker (RMI), including approximately 12 inches across the centerline joint beginning at the inside edge of the panel. Both the Antigo multiple head breaker and the RMI resonance frequency breaker were used in test sections, but AHTD has specified the RMI for the total program.

To demonstrate the degree of interlock in the rubblized surface, a small breaker bar was driven beneath the base of the rubblized PCC and lifted upward. The dislodged pavement section resembled a tightly interlocked jigsaw puzzle.

A backhoe was then used to excavate a test pit of the rubblized surface. The teeth on the backhoe's bucket could barely penetrate the tight interlock of the rubblized surface.

After rubblizing, the first lift of HMA Superpave is placed on the rubblized material. Once the lift is compacted, traffic is once again shifted back onto

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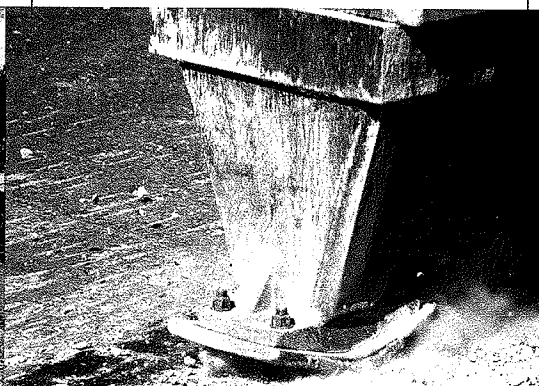
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the new pavement. The outside lane is then rubblized and overlaid with HMA. Each lift of HMA is then placed across the entire width of the rubblized lane and the new outside shoulder. After placing the HMA, the rehabilitated pavement section is opened to normal traffic flow. The process of constructing alternate lanes continues until each lane has been rehabilitated with the full base, intermediate or surface course thicknesses.

Traffic Handling

Traffic movement through the work zone during construction is handled in the same way on each project. As traffic approaches the work zone, it is directed to the left lane, then into either the driving lane or passing lane, as required. This pattern results in the motorist entering each work zone in a consistent fashion. The Highway Police, a Division of AHTD Weights

They placed large billboards near each major road entry into Arkansas proclaiming "There's a Whole Lot of Paving Goin' On Ahead" and suggesting that motorists obtain a copy of "Rebuilding Arkansas Interstates," a brochure describing the magnitude of the program. AHTD also used the internet, AM radio and billboards to explain special traffic regulations in work areas and encouraged motorists to "Think Ahead."



Volumetrics and Incentives

Mix designs in Arkansas were performed by the contractors or commercial testing labs in accordance with AASHTO MP-2 criteria. The percentage of voids in the total mix and in-place density (voids in the compacted mix) are used as incentive or disincentive pay items. Other volumetric properties are measured, recorded, and permitted to vary within established limits but are not generally used as pay items.

Incentives are awarded for a minimum of five consecutive tests on lots of 3000 tons, each meeting the volumetric criteria. To date, a total of \$1,442,595 of incentives have been paid out on 22 percent of the projects completed as a result of meeting the required volumetric properties.

In addition to pay items on volumetric criteria, incentives are awarded for maintaining consistency of gradation and pavement smoothness.

and Standards with the same authority as the State Police, patrol the construction zones.

Public Relations Program

With the huge amount of construction, AHTD realized that an important part of the success of the program is safety of the construction workers. As a key part of its safety and public relations program, AHTD created the slogan, "A safe driver is an informed driver."

Thinking ahead is what AHTD, FHWA and AAPA did when they developed and implemented the biggest—and most successful—highway rehabilitation program in Arkansas' history.▲

Tom Deddens is the Asphalt Institute's Field Engineer for Arkansas, Illinois, Kansas, Missouri, and Nebraska.

Table 1.
Cost
summary
of test
projects.

Job Number/Location	Rehabilitation Method	Material Cost
Job #060616 [I-30/U.S. 70 South]	PCC Removal and Replacement	\$45.99/S.Y.
Job #060591 [I-30 Malvern Co.]	PCC Removal and Replacement	\$40.56/S.Y.
Job #060592 [I-40/Morgan Co.]	Rubblize w/6-inch HMA overlay	\$18.91/S.Y.
Job #20138 [U.S. Pulaski Co. Line to Redfield Co.]	Rubblize w/5-inch HMA overlay	\$13.80/S.Y.
Job #0700181 [I-30/Clark Co.]	Rubblize w/12-inch overlay	\$21.65/S.Y.
Job #R10066 [I-40/Bayou Deview-Brinkley]	Rubblize w/10-inch overlay	\$21.95/S.Y.
Job #001765 [I-40 Mayflower-Morgan Co.]	Rubblize w/9-inch overlay	\$25.68/S.Y.