Try the un-overlay

Va. tests technology of the unbonded concrete overlay

By Allen Zeyher
Managing Editor

Virginia transportation officials looked for a suitable project to try an unbonded concrete overlay for several years.

When they found a deteriorated segment of U.S. Rte. 58 in Southampton County, the National Concrete Pavement Technology Center at Iowa State University recommended it as a good candidate for an unbonded overlay.

"Concrete overlays are a relatively new technology to Virginia," Robert Long Jr., executive director of the Mid-Atlantic Chapter of the American Concrete Pavement Association, told ROADS & BRIDGES. "This is the first full-blown concrete overlay construction project in the state of Virginia and certainly the first unbonded overlay . . . that they'd ever done."

The Virginia Department of Transportation (VDOT) liked the idea. In fact, VDOT decided to use the project as a chance to evaluate an unbonded concrete overlay side-by-side with a bonded concrete overlay, and since a nearby pavement was being treated with an asphalt overlay, they could evaluate a nonconcrete overlay in the same neighborhood.

The section of Rte. 58 in the project was originally built some 60 years ago and widened from two lanes to four 25 years ago, so the pavement being overlaid had 25 years of deterioration.

The bonded overlay is the first section a driver encounters heading west on Rte. 58. The section is 2.6 miles of a 4-in. bonded concrete overlay with asphalt shoulders. Next comes 2.2 miles of a 7-in. unbonded overlay cut into 6- x 6-ft panels with tied concrete shoulders. Then comes 0.3 miles of full-depth, 11-in. concrete reconstruction of the original 60-year-old pavement.

Gradual transitions

Because each of the sections had a different depth, it was necessary to pave transitions from one to the next.

"Heading westbound, you transition from the old roadway up 4 in. onto the 4-in. overlay," Long said. Then it transitions up another 4 in. to the unbonded overlay. "Then you transition back down 8 in. There are geometrical requirements that needed to be met for that transition. In any of those areas where we increased the thickness, we had to build the shoulders and tie into entrances and crossovers, etc."

As far as the materials used in the pavement, the mix was a traditional A3 concrete,

according to Bobby Baker, project inspector for NXL Consulting, VDOT's consultant inspector. "There was no reinforcing steel placed in the bonded section," Baker told Roads & Bridges. In the unbonded section, they used tie bars to tie the two lanes together and tie the shoulders to the lanes but no reinforcing steel was used. "The reconstructed section was done with dowel assemblies on 15-ft centers," Baker said, "but no reinforcing steel between the jointed sections, just the dowel assemblies to hold the joints together."

Any area of broken pavement had to be repaired before the bonded overlay could go on, so the initial cost of this particular bonded concrete overlay was a bit higher than ideal.

Since the bonded overlay was going over a continuously reinforced concrete pavement, the contractor could leave the small, regularly spaced cracks that function as joints. Those cracks will be allowed to propagate up through the overlay and continue to function as joints, with the existing pavement and the overlay acting as a unit.

"It was a learning process for us also with the bonded overlay," Lowell Jensen, project manager for Hi-Way Paving Inc. of Hilliard, Ohio, which performed all of the concrete work, told Roads & Bridges.

Ups and downs

"There was a tremendous amount of abrupt changes in the old pavement just from wear and fatigue," Jensen said. "We had to basically build a new grade on top of that and try to maintain a good ride."

Hi-Way Paving used a stringless, laser-guided Leica system and a Gomaco GP 2800 paving machine with a Gomaco belt placer to keep the bonding surface clean. The laser-guided system measured the profile of the existing road down the centerline and every 25 ft out to the edges and constructed a rough 3-D model.

"We built that into our file," Jensen said, "and the paver basically went along and hovered over that existing pavement and filled in the bottom, so to speak."

To form a good bond between the existing pavement and the overlay, Hi-Way Paving first repaired the broken concrete in the existing pavement. Then Shot Blast Inc. of Marcus Hook, Pa., shot-blasted using self-propeled, ridable shot-blasting machines to expose a fresh concrete surface. Then they dampened the surface and laid the overlay. No bonding agent was used.

VDOT's researchers performed a number of bond-strength tests on the overlay, according to Long, and were very happy with what they found.

For the unbonded overlay, VDOT laid a 1-in. layer of a porous friction course asphalt mix over the existing concrete without doing any significant repairs to it. Then they laid 7 in. of concrete over the asphalt.

The asphalt interlayer acts as a bond breaker to separate the overlay from the pavement underneath. It will provide support for the overlay but will not function integrally with it. The second function of the interlayer is to help with drainage.

"We make it a relatively open material so that any water that gets in there can be gathered in that interlayer and then drained off to the outer edges of the pavement," Long said.

"The asphalt layer was put down to pretty high standards to make sure things were level," he continued. "When the concrete was placed on that smooth interlayer with that good track line for the paver, the ride was absolutely fantastic."

Staying level-headed

"The 4 in. [bonded overlay] didn't ride quite as well as the 7 in. [unbonded], but that 1-in. bond breaker that they placed on there, even though it was a bond breaker, to us it really was a leveling course," Jensen said. "It took out 80% to 90% of the sharp imperfections in the old pavement. It made it much easier for us to pave on."

They still got a pretty good pavement on the bonded section, Jensen said, with international roughness index numbers in the mid-70s, but not as smooth as the unbonded overlay, because it lacked the asphalt leveling course.

Hi-Way Paving was able to lay the asphalt leveling course 36 ft wide in one pass—both westbound lanes plus a 4-ft inside shoulder and an 8-ft outside shoulder—because VDOT decided to reroute westbound traffic to one of the eastbound lanes.

Uber traffic control

The result of rerouting traffic was a more complicated traffic-control task. In fact the phasing and traffic control were the toughest challenge of the project, according to Long. After first considering doing the whole project one lane at a time, under traffic, VDOT decided to reroute westbound traffic to the northern lane of eastbound Rte. 58 for phases 2 (unbonded) and 3 (bonded) and perform Phase 1 (reconstructed) one lane at a time, under traffic.

Hi-Way Paving completed Phase 2 first, between the end of May and the end of July 2012. Both westbound lanes

In the unbonded section, they used tie bars to tie the two lanes together and tie the shoulders to the lanes but no reinforcing steel was used.

were merged and diverted into the northern eastbound lane. Hi-Way built a temporary road along the northern side of Rte. 58 for local traffic.

The contractor then performed phases 1 and 3 concurrently between late July and late September.

To separate directions of traffic sharing the eastbound roadway, the maintenance-of-traffic contractor pinned concrete barrier in place between the lanes.

For example, for the unbonded section (Phase 2), it took around 30 days for Spivey Corp. of Chesapeake, Va., to set up the crossover, make the transitions of traffic and install the barrier. Spivey was in charge of traffic control. All that work was prelude to doing 11 days of paving. Then the whole assemblage had to be rearranged to work on the bonded section (Phase 3) and the reconstructed section (Phase 1).

"We had 5.2 miles of barrier wall we installed and dowel-pinned it to the existing pavement," Baker said. "Then once it was no longer needed, we removed it and had to fill in all the dowel holes in the existing pavement on the eastbound side."

After repairing any broken concrete, the contractor used a stringless, laser-guided system to measure the profile of the old pavement and place the bonded overlay.

"The reason the barrier had to be used was the speed limit was not reduced to 45 mph," Long said. In the future, they might recommend to VDOT to reduce the traffic speed to 45 and use traffic separaters that are less expensive and easier to move and reconfigure.

Construction was completed and the westbound lanes were reopened to traffic in early October. The project also updated the signs, road markings and guardrails. R&B

For more information about this topic, check out the Concrete Channel at www.roadsbridges.com.