



# Fixing fault

## Concrete pavement restoration helps cure faulted pavement on I-44

**W**hile much has been written about the use of stimulus funds and the state of our nation's infrastructure, one project that has been in the works for years was recently completed, highlighting the effectiveness of the concrete pavement restoration (CPR) process.

In August, the last 22.4-lane-mile section on I-44—a highway that runs from the southern border of Texas to the Missouri border in the northeast corner of the state—was finally completed. This is the rehabilitated area between I-40 and I-35 in Oklahoma City, located 0.6 miles north of Reno Avenue and extending north 2.9 miles to 0.5 miles north of Northwest 36th Street. It is the culmination of five projects on the roadway since repairs began in 2004. Penhall Co. (Division 40) has served as the prime contractor for all five projects.

The highway is significant because it connects three of Oklahoma's largest cities and is a primary corridor through the Midwest. The Oklahoma City section of the highway ranges from six to eight lanes and overlaps I-35 for a short time. Approximately 125,000 to 135,000 vehicles travel this roadway each day.

According to Tom Hubbard, P.E., resident engineer, Oklahoma Department of Transportation (ODOT), a physical

survey revealed severe panel damage and faulted pavement. The road was in desperate need of repair as the transverse joint faulting was in the ¼-in. to ⅜-in. range with isolated ½-in. to ⅝-in. faults and variable ¼-in. to ¾-in. faulting at the longitudinal joints. Pavement replacement areas were quantified using a vehicle-mounted digital image collection system.

Given the high level of traffic and poor road conditions, a fast-track yet long-term solution was needed. As such, ODOT selected CPR because of previous success with this method. By selecting CPR, the state was able to extend the life of existing pavement and minimize disruption to the traveling public at a fraction of the cost of doing an asphalt overlay or total reconstruction.

CPR is a nonoverlay option used to repair areas of distress in concrete pavement without changing its grade. This preventive procedure restores the pavement to a like-new condition and reduces the need for major and more costly repairs. Furthermore, CPR also addresses the causes of pavement distress, minimizing further deterioration. In contrast, covering the area with an asphalt overlay does not correct the cause, and the problem will eventually appear again, resulting in a much more expensive solution. In fact, reports from the



In 2004, ODOT initiated repairs for all eastbound and westbound lanes, including auxiliary and ramp lanes, on I-44. The work was broken down into five phases and was completed in 2009. The total value of this final phase of the project was approximately \$2.9 million, and the repair is expected to offer another 15 years of service life.

Transportation Research Board state that for every dollar invested in appropriately timed preventive pavement maintenance, \$3 to \$4 in future rehabilitation costs are saved.

Benefits of CPR include:

- It addresses the causes of pavement distress, minimizing further deterioration;
- It costs less and lasts longer. The California Department of Transportation (Caltrans) has shown that diamond grinding, when used as a CPR strategy, typically lasts 16 to 17 years;
- It is quicker and causes less traffic disruption. Because CPR maintains the existing grade, features such as curbs, gutters, bridge clearances, approach slabs and roadside appurtenances do not need adjustment. In addition, CPR repairs only those areas that need improvement, such as the driving lane or the keel section of a runway;
- It preserves the safety of concrete pavement. Concrete does not ravel, washboard or shove. These defects can cause serious safety problems for asphalt pavements at intersections or other locations where traffic is starting, stopping and turning;
- It preserves the environmental benefits of concrete pavement. Concrete's light color reduces the number of streetlights needed to achieve the same illumination on a dark asphalt pavement. The light surface also can keep urban areas cool. Additionally, the hard concrete surface makes vehicles more fuel efficient. Given the fact that concrete pavements do not deflect like asphalt pavements, studies have shown that they can reduce truck fuel consumption significantly; and
- It can be used to repair a concrete pavement that has been previously overlaid with asphalt.

### The tricky approach

In 2004, ODOT initiated repairs for all eastbound and westbound lanes, including auxiliary and ramp lanes, on I-44, broken into the following five phases:

- In 2004, from the junction of S.H. 74 extending east to the

Burlington Northern Santa Fe Railroad, just west of I-235;

- In 2005, from west of Western Avenue, extending east to Lincoln Blvd.;
- In 2007, beginning at Lincoln Blvd., extending east to I-35;
- In 2008, beginning at the Oklahoma River, extending north to the Burlington Northern Santa Fe Bridge; and
- In 2009, repair of four lanes, eastbound and westbound, beginning at the Burlington Northern Santa Fe Bridge to the Junction of S.H. 74.

Dowel-bar retrofit (DBR), diamond grinding, joint sealing, selective panel replacement and base repair were used on the project for all lanes in both directions. DBR restores load transfer across the pavement joints to prevent future roughness from occurring, and then the entire surface is diamond ground, which produces a smooth and quiet ride. According to Hubbard, DBR and diamond-grinding projects are extremely effective in extending pavement service lives.

"In the past decade, many dowel-bar retrofit and diamond-grinding projects have been completed in the Oklahoma City metro area. In each case, user costs were minimized by performing the work during nighttime hours. The cost-effective nature and minimized user costs are key in the success of pavement restoration," said Hubbard.

According to Mike Miller, the Penhall superintendent responsible for the bridge approach work, the 10th Street bridge portion of the project, which consisted of 24 bridge approach panels, presented many challenges. Specifically, it was difficult to remove the approach, perform subgrade repair, as well as place the double-mat rebar reinforcement and high-early-strength concrete during a single night shift during live traffic even though it was diverted.

"Although we had done work like this before, we were very concerned because we had never completed it in a single night," said Miller. "We used all the tools in our toolbox. We had the best crew members, as well as extra equipment and

## CPR techniques include:

- Soil stabilization to support concrete slabs;
- Full-depth repairs that include removing a portion of the existing slab and replacing it with new concrete;
- Partial-depth repairs to correct surface distress and joint-crack deterioration in the upper third of the concrete slab;
- Dowel-bar retrofit (DBR) that consists of cutting slots in the pavement across the joint or crack, cleaning the slots, placing the dowel bars and backfilling the slots with new concrete. This provides load transfer at the joints, allowing for a longer life for plain-jointed concrete pavements;
- Cross-stitching longitudinal cracks or joints to add reinforcing steel to hold the crack together tightly;
- Diamond grinding, which removes faulting, slab warping, studded tire wear and unevenness resulting from patches. Diamond grinding also reduces noise and provides proper skid numbers to ensure safe travel; and
- Joint and crack resealing, which minimizes surface water and incompressible material infiltration into the joint system, minimizing long-term maintenance costs.

materials staged in case we had any problems. The removal went well, but we learned some lessons regarding the steel placement. The key to our success was being able to batch our own ready-mix. With the help of General Resource Technology, we were able to manufacture and place a high-strength concrete that kept us on schedule."

Safety also was a daily concern. According to Miller, Action Safety Supply did an outstanding job moving the traveling public through such a complicated area. The company had crews on the project during all hours of the work. The work area extended from three to five lanes with right-hand and left-hand on and off ramps.

"Action Safety Supply played a critical part in the success of the overall project," said Miller.

Brent Burwell, executive director of the Oklahoma/Arkansas Chapter of the American Concrete Pavement Association, noted that it was excellent to see this section of I-44 being restored using CPR instead of a costly asphalt overlay method.

"The original pavement, built in 1976, has served the public well over the years, and with the improvements made to the roadway through this project, we may see another decade or two of service," said Burwell. "The concrete pavement preservation techniques used in this project do more than just cover the problem for a few years. Combined with the long life of the original pavement, the work performed by the contractor, Penhall Co., will

give the taxpayers of Oklahoma a great value for their money."

The total value of this final phase of the project was approximately \$2.9 million, and the repair is expected to offer another 15 years of service life. The total cost of all five projects since 2004 was \$11.3 million.

Pete Lewis, Penhall's regional manager responsible for its CPR Division, said that his firm has been involved with the CPR industry through its Highway Services Division in Rogers, Minn., for approximately 20 years. He noted that they were pleased when ODOT started to ask questions regarding CPR.

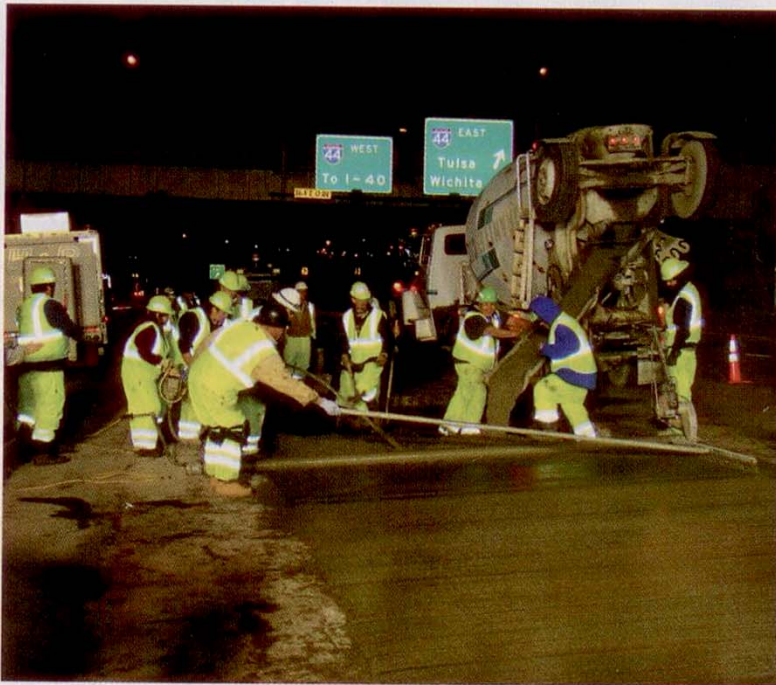
"We are pleased to have been a part of the reconstruction of the I-44 corridor in Oklahoma City," said Lewis. "ODOT has always had the best interest of the traveling public and the taxpayers of Oklahoma in mind during this complicated process. It was

with everyone's hard work and honest considerations that CPR had a chance to prove its value. CPR has proven that concrete pavements are renewable." ●

**Kaylor is president of Constructive Communications Inc., Dublin, Ohio.**

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