Texas I-35

Paving the Way for Free Trade

When the road that would become Interstate 35 between Dallas and Waco was built in September 1941, the "highway" consisted of one lane in each direction. The Texas Department of Transportation (TxDOT) used a 6-inch-thick jointed plain concrete pavement (JPCP) over 8 inches of compacted roadbed to accommodate the relatively light traffic.

Over the years, numerous rehabilitations were constructed to accommodate increased traffic growth. Since 1994, when I-35 was designated a primary corridor for overland NAFTA (North American Free Trade Agreement) trade between the U.S. and Mexico, ever-increasing truck traffic has necessitated upgrading to a super-high-performance, low-maintenance pavement solution. TxDOT chose continuously reinforced concrete pavement (CRCP) for the upgrade.

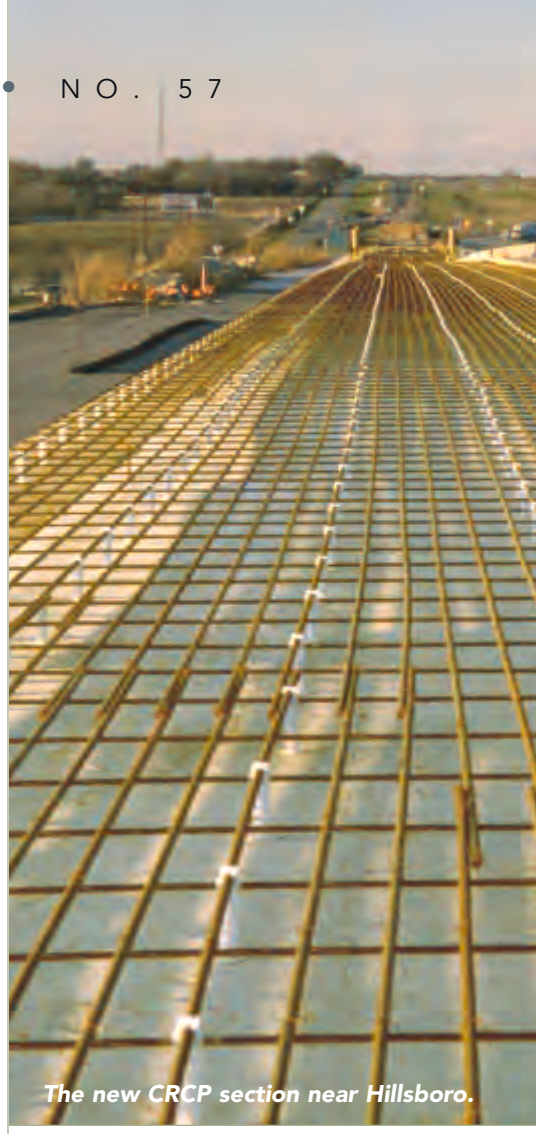
Checkered Pavement History

In 1951, the 5.1 mile segment of I-35 just south of Hillsboro was widened from 22 to 24 feet and crowned with asphalt. In 1955, TxDOT upgraded to a divided 4-lane highway by building a new 24-foot-wide southbound pavement that consisted of a cross-section of 2.5 inches of hot mix asphalt (HMA) over 12.5 inches of flexible asphalt base, over 9 inches of foundation course.

Starting in 1957, various sections of the roadway required major rehabilitation to maintain and extend the level of service. The repairs consisted of placing additional layers of HMA. Since 1941, all totaled, 12.25 inches of HMA have been added to the northbound lanes, and 9.25 inches have been added to the southbound lanes.

In 1997, this portion of I-35 was visually surveyed to assess the pavement's physical condition. On the southbound section, the HMA pavement had rutted to a depth of as much as one inch.

Rutting was not a problem on the northbound lane, possibly due to the 6-inch-thick JPCP underneath, although reflection cracking from the joints was prevalent. For both sections, the overall ride quality was good with an average Present Serviceability Index of 4.1 for the northbound lanes and 3.9 for the southbound lanes.



The new CRCP section near Hillsboro.

Ever-increasing truck traffic between the U.S. and Mexico has necessitated upgrading to a super-high-performance, low-maintenance pavement solution.

Customized CRCP Thickness Design

To design the CRCP, TxDOT used American Association of State Highway and Transportation Officials' *1993 Guide for the Design of Pavement Structures*, with modifications based on TxDOT's experience. For I-35, the CRCP had to be designed to account for three different support conditions: the northbound lanes, the southbound lanes, and the soon-to-be-paved median which added a third lane in each direction.

Between 1987 and 1996, the average daily traffic on this section of I-35 grew on average by 4.7 percent per year. Forecasting this traffic growth into the future led to predictions of **127 million** 18-kip ESALs (equivalent single-axle loads) for a 30-year design period and **222 million** ESALs for a 40-year design.

For a 30-year design, the northbound lanes required the thinnest CRCP thickness (13 inches) due to the underlying support from the JPCP. The CRCP pavement thickness for the full-depth construction in the median was thicker, at 14 inches.

Increasing the pavement design to 40 years increased the required pavement thickness by about 1.5 inches. The Waco District chose the 30-year design, but specified that the CRCP be 14-inches-thick throughout for construction expediency.

Unique materials and climatic conditions in the Hillsboro area led TxDOT to specify #7 longitudinal steel reinforcing bars be spaced at 6.5 inches.

Maximum Performance of Reinforcing Steel

The longitudinal steel reinforcing bars were specified based on the unique materials and climatic conditions in the Hillsboro area, rather than on a statewide or national standard. Experience and observations gathered from the Texas Rigid Pavement Database emphasizes that, for optimum pavement performance, the reinforcing bars need to be designed for three key requirements.

First, the crack width needs to be limited at freezing temperatures to prevent the infiltration of water. **Second**, the maximum steel stress needs to be less than 75 percent of the reinforcement's yield strength to ensure that it will not yield. And **third,** transverse crack spacing under three feet should be minimized to ensure adequate bond development between the steel and the concrete, and to reduce the likelihood of punchout formation.

For I-35, TxDOT specified that #7 reinforcing bars be spaced at 6.5 inches (0.7 percent steel).

TxDOT is counting on many years of solid, low-maintenance performance from the new CRCP section near Hillsboro

Paving for the Future

Because it is capable of sustaining high traffic volume and high ESALs with minimum maintenance, TxDOT is using CRCP throughout Texas. Given the extraordinary traffic loading on I-35, TxDOT is counting on many years of solid, low-maintenance performance from the new CRCP section near Hillsboro.

CRSI

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Design by Convey

Concrete Pavement CONTINUOUSLY REINFORCED