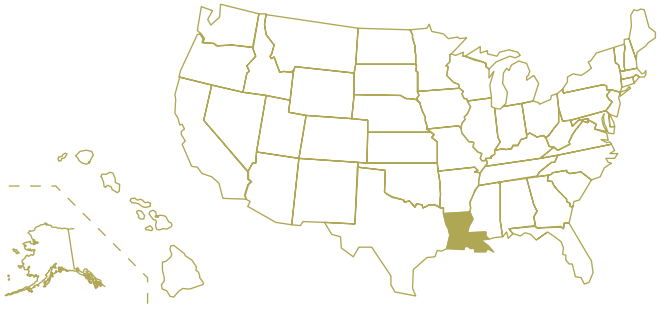
PERFORMANCE OBSERVED:

CRCP in Louisiana–Then and Now



Louisiana has some of the worst pavement subgrades in the nation: coastal marsh and river delta deposits—chiefly silty mud and organic matter locally known as "gumbo"—cover over half of the state. Louisiana Department of Transportation and Development (DOTD) engineers are constantly grappling with construction and performance issues associated with wet, soft pavement subgrades.

Extensive research has shown that the quality of the subgrade below a pavement section has a significant influence on pavement performance. A strong subgrade provides a solid foundation to support the pavement structure. Conversely, a weak subgrade allows settlement that can cause damage to the pavement.

Louisiana's Early Experience

In designing and constructing the Interstate system in the 1960s and 70s, the Louisiana DOTD experimented with a number of pavement types, including continuously reinforced concrete pavement (CRCP). CRCP is, simply, concrete pavement that is reinforced with steel bars. No transverse joints are needed. The reinforcing bars control the width of the transverse cracks that form and hold them closed. The transverse cracks do not impair the structural integrity of the pavement.

A number of highways in Louisiana were originally paved with CRCP. After a 25-year hiatus, the Louisiana DOTD used CRCP again, this time on US 190.

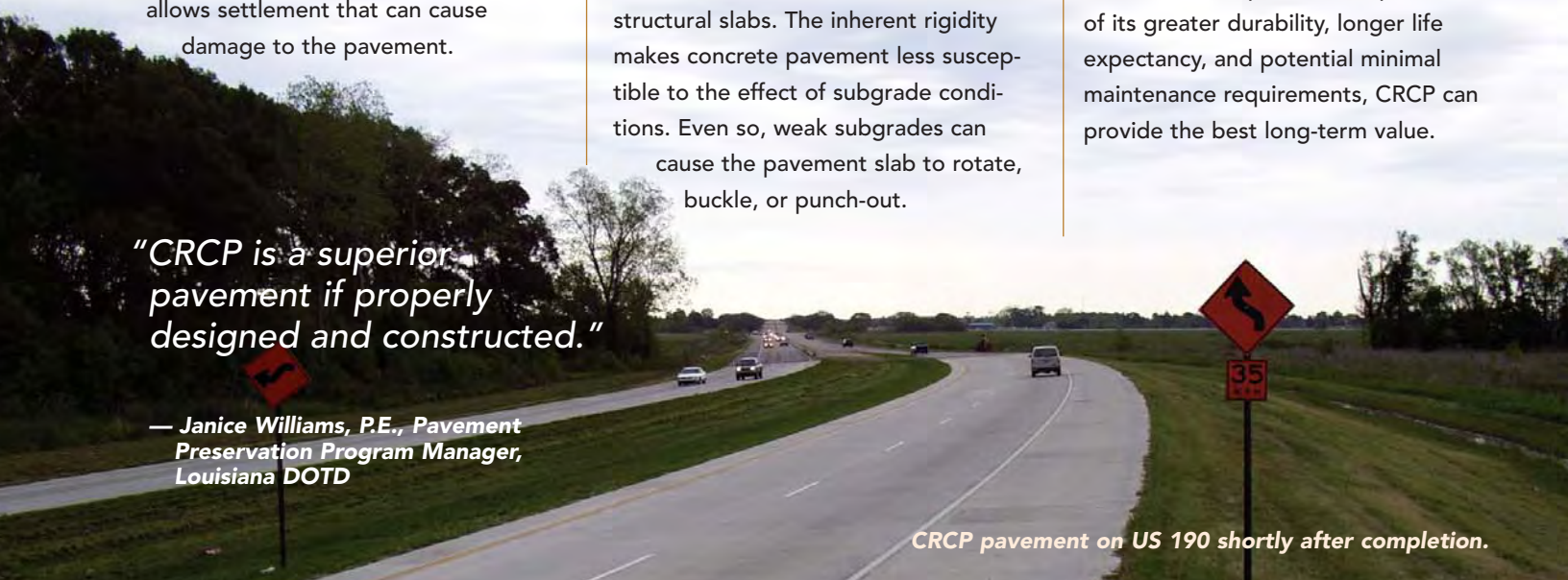
Photo courtesy of Louisiana Contractor, a McGraw-Hill Cos. publication

Concrete pavements, by virtue of their rigidity, tend to spread the wheel loads evenly over the entire slab, even though they are not designed as structural slabs. The inherent rigidity makes concrete pavement less susceptible to the effect of subgrade conditions. Even so, weak subgrades can cause the pavement slab to rotate, buckle, or punch-out.

When designed and constructed properly, CRCP provides one of the smoothest and highest quality ride surfaces of any pavement type. Because of its greater durability, longer life expectancy, and potential minimal maintenance requirements, CRCP can provide the best long-term value.

"CRCP is a superior pavement if properly designed and constructed."

— Janice Williams, P.E., Pavement Preservation Program Manager, Louisiana DOTD



CRCP pavement on US 190 shortly after completion.

In the early 1970s, sections of CRCP were built in Louisiana on Interstates I-10, I-12, and I-20, and on US 90 and LA 3132. At the time, DOTD's design standards called for an 8-inch-thick concrete slab. "Although some sections have shown amazing long-term performance, other sections had remarkable failures," says Janice Williams, P.E., Pavement Preservation Program Manager with the Louisiana DOTD.

Performance Observed

Segments of CRCP pavement on I-20 in the Mississippi Delta and a segment of I-10 between Baton Rouge and New Orleans have performed extremely well. Although traffic loads have far exceeded the original design plan, the CRCP road segments have far outlived the designed original service life

The Louisiana DOTD has observed some interesting pavement behavior on those segments of I-10 underlain by hydraulically placed sand fill. "The pavement has experienced differential settlement and dips due to the soft subgrade, but it has not buckled," notes Williams. "We see embankment settlement at the cross drains on the order of 2 inches over 100 feet. The CRCP has developed some vertical curvature, but the cracking pattern is generally within the normal range for CRCP. Jointed concrete pavement would have never survived."

Other pavement segments have not fared as well. The Louisiana DOTD attributed the premature failures of some of the CRCP segments to insufficient thickness of the concrete slab, poor base, rounded aggregate, and/or poor construction technique, in addition to poor subgrade conditions. Pavements constructed when the Louisiana summer sun was at its hottest were particularly susceptible to early failure.

A Return to CRCP

Louisiana discontinued the use of CRCP in the mid-1970s until additional research could be performed on the factors that would improve pavement performance. Then, in 1996, the DOTD conducted a study to develop the most cost-effective design for reconstruction of a six-mile segment of US 190 in West Baton Rouge Parish.

Several alternative pavement sections were analyzed. The life-cycle cost analysis (considering a 30-year design life) concluded that CRCP would have the highest performance and the lowest cost over the life of the project. Construction of the CRCP on US 190 was completed in 2003.

Shortly thereafter, the Louisiana DOTD decided to use CRCP at two other locations: the Greenwood Weigh Station ramps on I-20 and a short segment of I-10 mainline near the Sabine River Bridge. At the weigh station ramps, the DOTD used 14-inch-thick concrete and a single mat of reinforcing bars to handle the heavy truck traffic.

Why did the Louisiana DOTD return to CRCP? Learning from other states' research and success with CRCP was a primary factor. "We were able to make the case, based on the successful application of CRCP in other states, that CRCP is a superior pavement if properly designed and constructed," states Williams. "In our life-cycle cost analysis for the US 190 project, CRCP was the obvious winner."

Overlay Extends Service Life

The original CRCP constructed on Interstate 10 between Baton Rouge and New Orleans in the early 1970s performed extremely well, despite carrying far more traffic and heavier loads than anticipated in the original design.

Fibers were added to strengthen the concrete because the overlay thickness precluded the use of steel reinforcing bars.

Between 1990 and 1997, the Louisiana DOTD resurfaced a 22-mile-long section of I-10 with a 4-inch-thick bonded concrete overlay.

The overlay is predicted to extend the pavement service life by another 20-plus years.

"The thin bonded concrete overlays have enabled the Louisiana DOTD to increase the existing CRCP's structural capacity by 50 percent and increase the service life by another 20 years."

— Masood Rasoulian, P.E., Senior Pavement Research Engineer, Louisiana DOTD

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CRCP
continuously reinforced concrete pavement

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