Case Study

U.S. Department of Transportation
Federal Highway Administration

INTRODUCTION

Every two years, the Federal Highway Administration (FHWA) works with State transportation departments, local governments, tribes, private industry, and other stakeholders to identify and champion a new collection of innovations that merit accelerated deployment through the Every Day Counts (EDC) program.

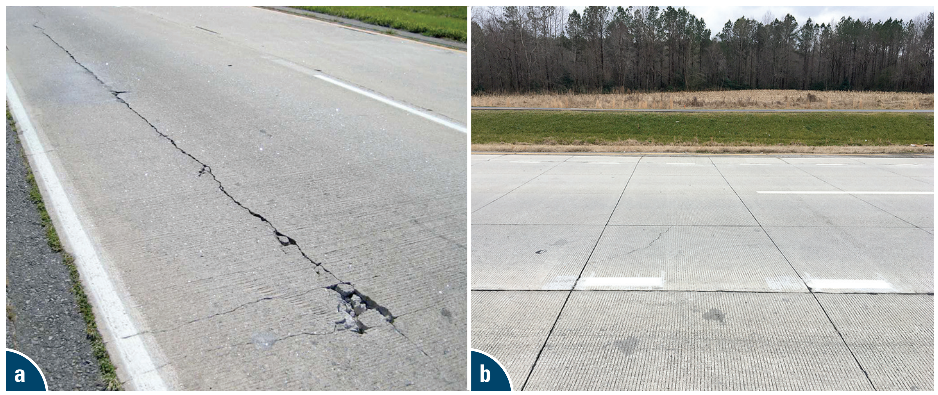
The EDC-6 program launched on September 23, 2020. One of the innovation areas is Targeted Overlay Pavement Solutions (TOPS).

Many pavements in the highway system have reached or are nearing the end of their design life while carrying traffic that exceeds their initial design criteria. TOPS can help agencies retain their investment in the engineered layers of existing pavement structures while creating longer-lasting, safer roadways. Concrete overlays can extend the service life of existing asphalt, concrete, and composite pavements without reconstruction, thereby improving safety for workers and roadway users. Finally, concrete overlays can help to reduce the life-cycle cost of pavement ownership.

TOPS
Targeted Overlay Pavement Solutions

CONCRETE OVERLAY
VIRGINIA US 58
Concrete on Continuously Reinforced Concrete (CRC)–Bonded and Unbonded

Concrete overlays leverage the investment already made in the existing pavement structure while potentially reducing the need for significant preservation activities and reducing lane closure durations. This case study summarizes the design, construction, and performance of bonded and unbonded concrete overlays on existing continuously reinforced concrete pavement (CRCP).



VDOT

Figure 1. Westbound US 58 in Southampton County: (a) condition of the existing CRCP before overlay construction and (b) close-up view of the unbonded concrete overlay in January 2021

PROJECT BACKGROUND

In 2012, the Virginia Department of Transportation (VDOT) constructed bonded and unbonded concrete overlays along a section of westbound US 58 in Southampton County. The goal was to explore strategies to extend the service life of the state's many miles of older CRCP without resorting to reconstruction or the use of short-life asphalt concrete (AC) overlays.

The existing CRCP on this section of US 58 was constructed in 1988 and was exhibiting cracking distress that was affecting rideability (see Figure 1). As a result, VDOT had identified this section for repair.

The existing pavement consisted of 8 inches of CRCP with AC shoulders over 6 inches of cement-treated aggregate base. In 2008 the roadway was carrying 8,300 vehicles per day, with trucks accounting for 14 percent of the traffic volume. The International Roughness Index (IRI) values in 2012 were 110 to 122 and 146 to 162 inches per mile for the sections to receive the bonded and unbonded overlays, respectively.

VDOT hoped to evaluate the effectiveness of each overlay type in both (1) preserving the original pavement structure while potentially reducing the need for significant preservation activities and (2) reducing lane closure durations.

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FHWA CONTRACTING OFFICER'S REPRESENTATIVE
Sam Tyson, Concrete Pavement Engineer
Federal Highway Administration
1200 New Jersey Avenue, S.E.
Washington, DC 20590
202-366-1326, sam.tyson@dot.gov

AUTHOR
Shiraz Tayabji
Advanced Concrete Pavement
Consultancy, LLC

DISTRIBUTION AND AVAILABILITY
This case study is available for free download on FHWA's website.

KEY WORDS
concrete overlay, continuously reinforced concrete

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PROJECT DETAILS

The demonstration project on US 58 included a 2.6-mile-long bonded overlay section with AC shoulders and a 2.2-mile-long unbonded overlay section with concrete shoulders, with transition sections between the test sections and the existing CRCP.

The bonded overlay was 4 inches thick, with no longitudinal steel or tie bars used. The unbonded overlay was 7 inches thick with slab dimensions of 6 feet by 6 feet and was placed over a 1-inch-thick porous AC friction course that served as a drainage layer and a separation layer. The inside and outside concrete shoulders alongside the unbonded overlay were 4 and 8 feet wide, respectively. Along the centerline and shoulder joints, 30-inch-long No. 4 bars were used at a spacing of 30 inches.

Both overlay types used the same concrete mixture.

Each overlay section was constructed separately during the summer of 2012, the unbonded section between late May and late July and the bonded section between late July and late September. During construction, westbound traffic was routed over the inside eastbound lane.

For the construction of the bonded overlay, distressed areas in the existing CRCP were replaced with full-depth and lane-width concrete repairs before shotblasting the surface, as shown in Figure 2.

VDOT

Figure 2. Shotblasting of existing CRCP surface

For the construction of the unbonded overlay, some minor repairs were performed to the CRCP before the 1-inch-thick porous AC friction course was placed. The AC course was placed 36 feet wide in a single pass and met VDOT's tight smoothness requirement to ensure a proper grade for the overlay concrete. Joints in the travel lanes were sawed in a 6-foot by 6-foot pattern.

Both sections were re-opened to traffic in October 2012.

PROJECT PERFORMANCE

According to VDOT, the two overlay sections showed significant improvement in ride quality compared to the existing CRCP. In 2019, the IRI values were 89 to 106 and 82 to 88 inches per mile for the bonded and unbonded overlay sections, respectively. A visual survey conducted by VDOT after four months of traffic showed many reflected transverse cracks in the bonded concrete overlay section. The unbonded concrete overlay did not show any reflected cracks.

Another visual survey performed by VDOT in January 2021 identified a significant amount of cracking in the bonded overlay, including Y-cracking and cluster cracking, along with several temporary AC patches and 16 concrete patches. The same survey found the unbonded concrete overlay to be in good to excellent condition, with only one sawed joint location experiencing minor spalling. A section of the unbonded concrete overlay is shown in Figure 1.

VDOT considered the concrete overlay demonstration project a success. The project showed that a bonded overlay of CRCP is not applicable when the existing CRCP is in poor condition and in need of repair over more than 10 percent of the pavement area. Rather, in such cases an unbonded overlay with short panels is preferred. The unbonded overlay continues to perform well in 2021 after nine years in service.