Case Study

U.S. Department of Transportation
Federal Highway Administration

APRIL 2022
FHWA-HIF-22-028

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

RICHLAND COUNTY, ILLINOIS, HIGHWAY 9

Concrete on Asphalt–Unbonded

Unbonded concrete overlays do not rely on composite behavior between the overlay and the underlying pavement for structural capacity. In the case of concrete on asphalt–unbonded (COA–U) overlays, the strength and thickness of the concrete slab are typically enough to prevent cracks in the existing pavement from reflecting through to the new concrete surface. This case study summarizes the design and performance of an unbonded concrete overlay on an existing bituminous seal coat-surfaced pavement.

PROJECT DETAILS

This project is located on County Highway 9 in Richland County, Illinois, just north of the village of Noble. With a total length of 8.23 miles, the project begins at E. Colborn Camp Lane and ends at County Road 1800 N. County Highway 9 consists of a simple two-way roadway with a total width of 22 feet and narrow unpaved shoulders.

Several factors contributed to Richland County's decision to place a thin concrete overlay on County Highway 9:

1. Thin unbonded concrete overlays have been successfully placed in both Clay and Cumberland Counties.
2. A limited number of asphalt pavement contractors were available, with only one contractor typically bidding on asphalt projects for the county.
3. Multiple concrete contractors were available.
4. The county had previous experience with premature oxidation of asphalt overlays.

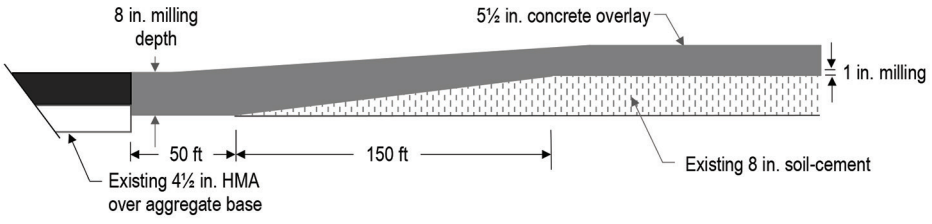
The existing roadway consisted of a double-application bituminous seal coat over 8 inches of soil-cement stabilized base. Placed in 2004, the seal coat was intended as a temporary surface until the county had enough funds for overlay construction.

In 2010, the existing pavement distress included transverse cracks due to shrinkage of the soil-cement base, with no rutting or ride issues. The pavement cross slope was somewhat inconsistent because a motor grader was used to construct the soil-cement base with no trimming after curing.

OVERLAY INFORMATION

Prior to placement of the overlay, the existing pavement was milled to a remaining depth of 1 inch. In some locations, the seal coat was completely removed, and the overlay was placed directly over the soil-cement base.

The concrete overlay thickness was 5.5 inches, and joints were sawcut to yield a slab size of 5.5 feet by 5.5 feet. Figure 1 shows the design detail for the transition from the existing pavement to the concrete overlay.



NCE, redrawn from Contract No. 95627, Illinois Department of Transportation

Figure 1. Design detail showing concrete overlay taper to existing asphalt pavement

FHWA CONTRACTING OFFICER'S REPRESENTATIVE
Robert Conway
Sr. Pavement & Materials Engineer
Federal Highway Administration
1200 New Jersey Avenue, S.E.
Washington, DC 20590
202-906-0536, robert.conway@dot.gov

AUTHORS
Linda M. Pierce, Principal
Tom Van Dam, Principal
Nichols Consulting Engineers, CHTD

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

KEY WORDS
asphalt pavement, concrete overlay unbonded

The county's contract specifications required the use of Class PV cement, a cement factor of 605 pounds per cubic yard, and a compressive strength of 3,000 psi or flexural strength of 550 psi at 14 days. Synthetic macrofibers conforming to Type III in ASTM C1116 were required at a maximum dosage rate of 5 pounds per cubic yard unless a field demonstration confirmed that a higher dosage would remain workable with no fiber clumping. The as-placed mixture used 4 pounds per cubic yard of synthetic macrofibers.

In total, 16,970 cubic yards of concrete were placed (Figure 2). The contractor set up a portable concrete batch plant on the north end of the project and used ready-mixed concrete trucks to transport the concrete to the paver. One 11-foot-wide lane was placed per pass using a string line. The concrete was hand-finished, and joints were sawcut using soft-cut early-entry saws. Transverse joints were sawcut to a minimum depth of 1.5 inches, and no reinforcement was placed at the longitudinal or transverse joints. Typical concrete compressive strengths were over 4,000 psi within 72 hours.

TRAFFIC CONDITIONS

This segment is a designated truck route that serves oil field and grain elevator traffic. As of 2021, the traffic volume was 485 vehicles per day with 13 percent trucks (50 single-unit and 15 multiple-unit). The estimated equivalent single axle loads (ESALs) from the time of construction to 2021 was approximately 420,000 (assuming 2 percent growth and 1.5 ESALs per truck).

PERFORMANCE

Two years after construction, the concrete overlay exhibited no cracked slabs. Spalling was noted at a few joint locations, but this was believed to be due to the sawcutting operation. There was no evidence of fiber balling. In 2021, the Richland County Engineer stated that the pavement is exhibiting "no failures and the ride quality is exceptional" (Table 1). Figure 3 shows the current condition of the pavement.

Table 1. Overlay pavement conditions reported by Richland County in 2021

Age (years)	Transverse Cracking (ft)	Longitudinal Cracking (ft)	Corner Breaks (Count)	Total Cracked Slabs (%)
11	0	0	0	0

ACPA, IL Chapter

Figure 2. Concrete overlay construction

Jeff Roesler

Figure 3. Current overlay condition