Case Study

U.S. Department of Transportation
Federal Highway Administration

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CONCRETE OVERLAY

COLORADO SH-13

Concrete on Asphalt–Bonded

Bonded concrete overlays rely on the underlying pavement to provide support and load carrying capacity. For bonded concrete overlays of asphalt pavement, the strength and thickness of the concrete slab and the bond between the new concrete surface and the existing asphalt essentially establishes a monolithic pavement structure. This case study summarizes the design and performance of a 6- inch-thick, 131,000 square yard bonded concrete overlay project utilizing pilot car traffic control.

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.

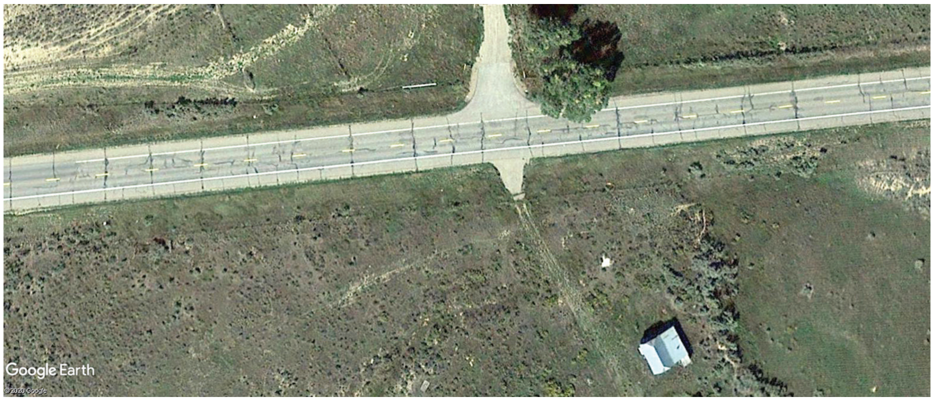

Figure 1. Existing asphalt pavement condition prior to concrete overlay

PROJECT DETAILS

This project is located in northeastern Colorado on SH-13 (milepost 98 to 104), a simple two-way highway located approximately 10 miles north of the city of Craig. The existing asphalt pavement exhibited severe transverse cracking (Figure 1). Due to the high probability of reflective cracking with an asphalt overlay, in 2016 the Colorado Department of Transportation (CDOT) executed an alternate bid contract for construction of either a 6-inch concrete overlay or a 6-inch asphalt overlay with full-depth reclamation. Using CDOT-specified values for future rehabilitation and maintenance costs and user costs, bids were evaluated in consideration of the life-cycle cost of the proposed structural pavement section. According to CDOT, the concrete overlay option was determined to have the lowest life-cycle cost and was therefore selected. The successful bid was 14 percent below the engineer's estimate.

OVERLAY INFORMATION

The CDOT thickness design method for a thin concrete overlay requires the overlay to be placed on asphalt with a minimum thickness of 3 inches. The asphalt is milled at the discretion of the contractor so that the amount of milling needed to remove existing rutting is balanced against the cost of additional concrete.

For the SH-13 project, the contractor opted to mill the existing asphalt pavement to maintain a consistent concrete overlay thickness. The existing roadway was surveyed to develop a milling plan, and areas identified as requiring deep cuts were cored to ensure that the remaining asphalt maintained the minimum thickness. After milling, a minimum depth of 7 inches of asphalt pavement remained. Asphalt millings were placed on the shoulder to create a stable track pad for the concrete paver (Figure 2).

CDOT

Figure 2. Asphalt millings placed on the shoulder

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KEY WORDS

concrete overlay bonded

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Contract specifications required the contractor to sweep the milled asphalt surface using a mechanical broom; pressure clean the surface using air or water to remove all dust, grit, and foreign materials; and spray a light mist of water prior to placement of the overlay. The concrete paving mixture had an optimized aggregate gradation that permitted a reduction in cementitious content, improved workability, and enhanced performance. Traffic control included a single lane closure using a pilot car to detour traffic to one lane.

The pavement was placed 19 feet wide to accommodate a 12-foot lane and 7-foot shoulder in each direction. Longitudinal joints were sawed in the middle of the travel lane and at the shoulder, and transverse joints were sawed every 6 feet to create nominally 6-foot by 6-foot panels. (The contract allowed the use of early entry saw-cutting.) The entire surface and exposed sides of the concrete overlay were cured using a Type 2 curing compound specified in ASTM C309. Rumble strips were placed in the fresh concrete with a drum behind the paver.

As a final step, the contract specifications required the contractor to diamond grind the concrete surface to remove depressions or slope misalignments (not to exceed ⅛ inch in 12 feet). The completed overlay is shown in Figure 3.

CDOT

Figure 3. Completed concrete on asphalt–bonded overlay

TRAFFIC CONDITIONS

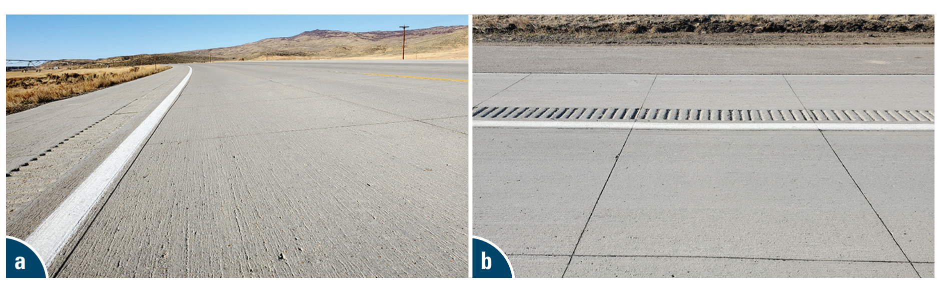
In 2019, the traffic volume was 1,300 vehicles per day with 20 percent trucks. The estimated equivalent single axle loads (ESALs) from the time of construction to 2020 were approximately 550,000 (assuming 2 percent growth and 1.5 ESALs per truck).

PERFORMANCE

The average International Roughness Index (IRI) value measured immediately after construction was 44 inches per mile. As of 2020, the IRI value remained low, with minimal cracking and no measured faulting (Table 1). Figure 4 shows the current condition of the roadway.

Table 1. Overlay characteristics reported by CDOT in 2020

IRI (in./mi)	Faulting (in.)	Transverse Cracking (ft)	Longitudinal Cracking (ft)	Corner Breaks (count)	Total Cracked Slabs (%)
52	0	40	50	1	0



CDOT

Figure 4. Current condition of the overlay: (a) close-up of pavement surface and edgeline and (b) edgeline, shoulder, and rumble strips