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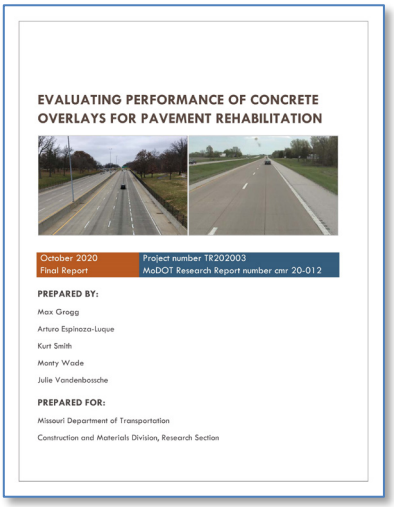
Research Summary

Evaluating Performance of Concrete Overlays for Pavement Rehabilitation


EVALUATING PERFORMANCE OF CONCRETE OVERLAYS FOR PAVEMENT REHABILITATION

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The Missouri Department of Transportation (MoDOT) has a long history of concrete overlay use dating back to at least the 1930s, and over the last 20 years has constructed approximately 40 concrete overlay projects in a range of applications. The goal of this study was to review and evaluate the performance of bonded and unbonded overlays constructed in Missouri as a first step in documenting their performance and working to improve MoDOT's overall concrete overlay selection, design, and construction procedures.

A database of important design, construction, and performance data for 41 concrete overlay projects built by the Missouri DOT from 1999 to 2019 was compiled. Three types of concrete overlays were included in this project:

- Unbonded overlays (UBOLs): concrete overlay with thicknesses of 8 in or greater, most with dowels, and conventional joint spacing placed on and separated from an existing concrete or asphalt pavement. A total of 26 UBOL projects were included.
- Big block overlays (BBOLs): an unbonded concrete overlay with typical 5-in thickness, no dowels, and short panel size (typically 6 ft by 6 ft) and placed on an existing concrete or asphalt pavement. A total of 9 BBOL projects were included.
- Bonded overlays (BOLs); a thin concrete overlay of typical 4-in thickness and 4 ft by 4 ft panel size bonded to the underlying asphalt or concrete pavement. A total of 6 BOL projects were included.

The UBOL projects exhibited excellent ride quality that was generally very stable over time .

Time-series smoothness data were available for all projects since the time of their construction while key distress data (cracking, spalling, faulting, patching) were available from 2018. These data were examined for all overlay types and general performance trends and observations were made to identify factors leading to improved performance. Although the presence of several confounding variables (e.g., slab thickness, interlayer type, slab width, shoulder type, and traffic loadings) often hindered performance comparisons, some of the key observations from a review of the performance data are listed below:

- The UBOL projects exhibited excellent ride quality that was generally very stable over time.
- The thickness of the overlay slab appeared to strongly affect the performance of the UBOL and BBOL projects. Where thicknesses were deficient of the design value, higher

incidences of cracking and patching were observed. An as-constructed thickness minus one standard deviation value greater than 8.6 in resulted in less cracked and patched slabs.

- UBOL projects with widened 14-ft slabs and HMA shoulders exhibited higher levels of longitudinal cracking.
- UBOL projects with geotextile interlayers exhibit less cracking than those using an existing or new HMA interlayer.
- The most common distresses for BBOL projects were longitudinal cracking and shattered slabs.
- BBOL projects with a 6 in design slab thickness exhibited less cracking than the 5 and 5.5 in thick designs. A 5.5 in minimum as-constructed thickness resulted in less cracking.
- BOL projects exhibited much higher IRI levels, but these were typically very short sections located at intersections.
- Predominant distresses for BOL projects were longitudinal and corner cracking. Essentially all the longitudinal, transverse, and corner cracking is contained in the right panel of the BOL projects.

Based on these findings, general recommendations to improve the performance of concrete overlays in Missouri were developed; these include:

- MoDOT should revise UBOL and BBOL design thickness procedures to be site specific, building on their mechanistic design procedure for pavements.
- MoDOT should revise UBOL and BBOL thickness construction quality control practices to better control minimum thickness due to the sensitivity of concrete overlays to as-constructed thickness.
- MoDOT should continue the use of geotextiles interlayers as they appear to provide better performance for UBOL projects.

Figure 1. Unbonded concrete overlay on I-64.

Project Information

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