

Project Information

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Research Administration

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DEVELOPMENT OF PAVEMENT DESIGN AND INVESTIGATION STRATEGIES FOR NON-INTERSTATE ROUTES

This project investigated the state-of-the-practice on conducting field investigation (i.e., visual inspection, cores, FWD tests) for rehabilitation of non-interstate routes and whether field investigation is cost effective for the SCDOT. Using data from 31 primary routes, the life-cycle cost (LCC) over a 50-year analysis period of the design with field investigation is compared against the LCC of the design without field investigation. The Equivalent Uniform Annual Cost (EUAC) over a 15-year analysis period was also used to evaluate the two designs. Both cost analyses indicated that performing field investigation is cost-effective for primary routes, which are roadways that carry between 5,000 to 10,000 vehicles per day. It is recommended that the SCDOT perform field investigation for primary routes that are in fair or poor condition.



Without field investigation, the extent of pavement structural damage is unknown (top picture). Without this knowledge, the rehabilitation design may not adequately address existing distresses (bottom picture).

Problem

The SCDOT's current rehabilitation design procedure for non-interstates is focused primarily on efficiency of contract preparation and does not typically include a detailed field investigation. However, the SCDOT recognizes that the design choices may affect the future performance and maintenance cost of a pavement if the existing distresses are not adequately addressed. Field investigation is labor intensive and costly. On the other hand, the rehabilitation design guided by field investigation results could make the pavement last longer, and therefore, save money for the SCDOT in the long run. This project investigated the cost-effectiveness of performing field investigation for primary routes at the design stage of pavement rehabilitation.

Research

The cost-effectiveness of performing field investigation for primary routes was determined by comparing the LCC and EUAC of two different rehabilitation design options, one with field investigation and one without field investigation. The design with field investigation used results from visual assessment of pavement surface condition, core samples, and falling weight deflectometer tests on roadways prior to their rehabilitation. The design without field investigation represents the current design being used by SCDOT district engineers. A total of 31 primary routes located throughout the state of South Carolina was used in this study. PSI was utilized to determine when rehabilitation should be applied for good, fair, and poor pavements. Pavements with $PSI \geq 3.0$ are referred to as "good" pavements.

Similarly, pavements with $PSI \geq 2.0$ are referred to as "fair" pavements and "Poor" pavements are those with $PSI \geq 1.0$. The life-cycle cost analysis used FHWA's RealCost Excel-based tool, and the pavement service life was determined using AASHTO's pavement design guide.

Results

The results of the analysis indicated that:

- 1) a properly designed pavement will require fewer maintenance cycles. Since designs with field investigation are more likely to provide the required pavement structure (i.e., SN), they prolong the time when the first maintenance treatment is needed, and
- 2) the total LCC of designs with field investigation is lower than the LCC of designs without field investigation.

The EUAC analysis was performed for 30 primary routes that are to be kept in fair pavement condition. The service life of these pavements was determined using threshold values based on MAP-21 criteria (terminal IRI = 120, fatigue cracking = 10%) and using Pavement M-E Design software. The results indicated that the EUAC for the 10-year design with field investigation is lower compared to designs without field investigation.

Recommendations

Based on this project's findings, it is recommended that the SCDOT consider the following:

- Have the SCDOT district engineers conduct field investigation for primary routes that are candidates for

rehabilitation and are in fair or poor condition.

- Have the State Pavement Engineer hold annual or bi-annual workshops to review and discuss the procedure for identifying which project requires field investigation with all DCMS.
- Develop a pavement design decision support system (DSS) that integrates all of the SCDOT's pavement design tools and roadway maintenance history to eliminate guesswork regarding existing pavement condition and to facilitate the development of an appropriate reconstruction, rehabilitation or preservation treatment.

Value & Benefit

The SCDOT rehabilitated about 280 centerline miles of primary routes in 2020; these pavement sections required at least 150 PSY of surface type B or C. Assuming 50% of these pavements were in poor condition and 50% in fair condition, the expected annual cost savings to the SCDOT would have been \$138,790 if field investigation had been performed and the design with investigation had been used.

The rehabilitation design with field investigation defers the maintenance cycles. This is particularly important for the SCDOT not only in terms of cost savings, but also reducing the number of concurrent resurfacing projects since there is a high demand for contractors in South Carolina.