LOUISIANA TRANSPORTATION RESEARCH CENTER

TECHSUMMARY September 2011

SIO No. 30000144 / LTRC Project No. 08-1P

Cost Effective Prevention of Reflective Cracking of Composite Pavement

INTRODUCTION

Reflection of cracks in hot mix asphalt (HMA) overlays represents a serious challenge associated with pavement rehabilitation. Since the early 1930s, considerable resources and efforts have been spent to find new and relatively inexpensive techniques to delay reflection cracking. Different methods, including the use of interlayer systems, have been suggested for enhancing pavement resistance to reflection cracking. Experimental investigations in the early 1980s showed that interlayer systems might be used to delay or to prevent the reflection of cracks through a new overlay placed over an old cracked pavement. Louisiana experimented with various techniques and treatments to control reflection cracking since the 1970s; however, the performance and cost-effectiveness of these methods were not evaluated in many projects. Performance and economical assessments of these various treatment methods present a critical need to ensure successful control of this distress and effective use of available funds. Therefore, it is necessary to analyze various pavements across the state in which these treatments were used to establish the performance and cost effectiveness of these crack control methods.

OBJECTIVE

The objective of this study was to evaluate and compare different reflection cracking control treatments by evaluating the performance, constructability, and cost-effectiveness of pavements built with these methods across the state. Results of this analysis assessed the benefits of these crack control techniques in terms of performance, economic worthiness, constructability, and long-term benefits. Based on the findings and the results of this project, recommendations for cost-effective control of reflective cracking were made.

SCOPE

State practices for control of reflective cracking were identified through district surveys and by reviewing the Louisiana Department of Transportation and Research (LADOTD) databases and pavement management system (PMS) data. Projects built with different crack control treatment methods were identified. The treatment methods that are evaluated in this study were fiber-glass grid, saw and seal, asphaltic surface treatment (AST - chip seal) as a crack relief interlayer, stress absorbing membrane interlayer (SAMI), fabrics, and STRATA®. However, there were an insufficient number of projects for stress absorbing membrane interlayers, paving fabrics, and STRATA® interlayers to allow for drawing conclusions on the cost-effectiveness of these treatment methods.

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METHODOLOGY

Current practices used in Louisiana to delay reflection cracking in rehabilitated pavements were reviewed. This task was achieved by first surveying all the district offices in Louisiana. The Content Manager tool on the LADOTD Intranet Web site was also reviewed to identify other treatment methods, which were not reported in the district surveys. This step was followed by identifying the projects in which different treatment methods were used. The basic requirement for a treatment to be considered as a reflective crack prevention technique is that it should be applied over an existing concrete layer and below an asphaltic overlay. The performance and cost-effectiveness of the different treatment methods were assessed by analyzing performance data obtained from the LADOTD pavement management system for the period ranging from 1995 to 2009. The Reflective Cracking Index (RCI) and the Pavement Condition Index (PCI) were the two parameters used to assess the performance of the pavement sections. A simplified economic evaluation was then performed on all the projects that were selected for detailed analysis. The adopted economic approach calculated the total annual cost (TAC) per mile for each pavement section by dividing the total cost of the project, obtained from bid items, by the performance service life in years and the length of the section. Comparison was then established between the total annual cost of the treated and untreated segments to determine cost effectiveness.

Results

For saw and seal, the majority of the sites showed a positive improvement due to the use of saw and seal. About 40 percent of the sections showed an improvement from 1 to 3 years and 47 percent of the evaluated sections showed an improvement from 4 to 12 years. The average level of improvement to the pavement service life due to the use of saw and seal was 4 years. The vast majority of the sections (80 percent) indicated that saw and seal is cost-effective as compared to regular HMA overlays. The effectiveness of saw and seal treatment method depends on the success of the construction process to ensure that the treatment is applied at the exact locations of the joints.

For fiber-glass grid, the majority of the sites showed a negative contribution due to the use of fiber-glass grid. About 23 percent of the sections showed disimprovement from 1 to 3 years and 39 percent of the evaluated sections showed disimprovement from 3 to 9 years. However, 38 percent of the sections showed an improvement from 1 to 6 years. The vast majority of the sections (85 percent) indicate that fiber-glass grid is not cost-effective as compared to regular HMA overlays. The increase in cost of overlay due to the use of fiber-glass grid ranged from 1.6 to 128 percent. For the use of chip seal as a crack relief interlayer, the majority of the sites showed a positive improvement due to the use of chip seal. About 25 percent of the sections showed an improvement from 1 to 3 years and 33 percent of the evaluated sections showed an improvement from 4 to 10 years. The average level of improvement to the pavement service life due to the use of chip seal was 4 years. The vast majority of the sections (75 percent) indicated that chip seal is cost-effective as compared to regular HMA overlays. The increase in cost of overlay due to the use of chip seal treatment ranged from 10 to 71 percent.

CONCLUSIONS

Among the various treatments that were analyzed, saw and seal and chip seal as a crack relief interlayer showed the most promising results in terms of performance and economic worthiness. The cost-effectiveness of fiber-glass grid was not validated as compared to regular HMA overlays. Based on the findings and the results of this project, a reflective crack control policy was developed for the state.

RECOMMENDATIONS

A choice is recommended for the districts between two treatment methods that were determined to be cost-effective for the climatic and operating conditions encountered in the state:

- **System A.** System A consists of sawing the overlaid asphaltic concrete pavement to create transverse and longitudinal joints at the exact locations of underlying portland cement concrete (PCC) joints followed by sealing of those constructed joints.
- **System B.** System B consists of applying an asphaltic surface treatment (chip seal) as a crack relief interlayer prior to the HMA overlay. Typical AST interlayer used in Louisiana are known as Type D and Type E.

A second phase for this project is recommended to conduct a controlled field evaluation that would assess the conditions of the existing pavements prior to rehabilitation and application of the treatments. A designed experiment would also allow refining and modifying the proposed crack control policy based on the level of distresses prior to rehabilitation, load transfer efficiency, type of pavement structure, age, climate, and traffic. Future research activities will also identify the design and operating factors that control the performance of crack control treatment methods including fiber-glass grid, SAMI, and STRATA®.