TECHSUMMARY July 2009

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Mechanistic Flexible Pavement Overlay Design Program

INTRODUCTION

The Louisiana Department of Transportation and Development (LADOTD) currently follows the 1993 AASHTO pavement design guide's "component analysis" method in its flexible pavement overlay thickness design. Such an overlay design method, however, does not require performing any field or laboratory tests to assess existing pavement structural conditions. Instead, pavement engineers have to use a pre-assigned, parish-based subgrade resilient modulus value and a set of assumed structural layer coefficients in an overlay thickness design. Obviously, such an overlay thickness design procedure could potentially lead to an over- or under-designed overlay thickness since none of the design parameters represent actual field conditions.

OBJECTIVE

The objective of this research was to develop an overlay design method/procedure that is used for a structural overlay thickness design of flexible pavement in Louisiana based upon (1) in-situ pavement conditions and (2) non-destructive test (NDT) methods, specifically the falling weight deflectometer (FWD) and/or Dynaflect.

SCOPE

Fifteen flexible pavement overlay rehabilitation projects were selected for this study. Field testing consisted of conducting NDT deflection tests (FWD and Dynaflect) along both traffic directions on each selected project. Among them, four projects were selected for the Phase I study and the rest were used in Phase II. For Phase I projects only, in-situ layer thicknesses of existing pavements were measured through auguring, and the mid-depth temperatures of asphalt concrete layers were continuously monitored during NDT testing. The overlay thickness design analysis was performed based on six selected NDT-based overlay design procedures as well as the Mechanistic-Empirical Pavement Design Guide (MEPDG) software and the current DOTD component analysis method. Construction cost and life-cycle cost analyses were also included in this study.

METHODOLOGY

To achieve the objective of this research study, the following tasks were performed:

- Selected 15 overlay rehabilitation projects from DOTD's overlay letting list based on different subgrade types and three (low-, medium- , and high-volume) traffic levels. Performed NDT (FWD and Dynaflect) deflection tests on each selected project.

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- Conducted a comprehensive literature review and an e-mail survey among other state DOTs to find out whether NDT testing is being incorporated into their overlay thickness design procedures. Six NDT-based overlay design procedures (or software) were identified, which include: (1) Louisiana 1980 Dynaflect deflection-based procedure, (2) EVERPAVE, (3) ROADHOG, (4) AI MS-17 deflection approach, (5) the 1993 AASHTO NDT procedure, and (6) ELMOD.
- Performed overlay thickness design for the four Phase I rehabilitation projects based upon (1) the NDT deflections and (2) the six selected NDT overlay design procedures. Analyzed the overlay thickness results and compared to those obtained from the DOTD component analysis method as well as those obtained from the newly developed MEPDG software.
- Evaluated the Dynaflect deflection-based Louisiana Pavement Evaluation Chart and developed a FWD deflection-based overlay thickness design procedure for flexible pavement overlay thickness design in Louisiana.
- Developed a visual basic computer program for automating the proposed FWD based overlay design procedure.
- Performed cost-benefit analyses on Phase II rehabilitation projects.
- Prepared a final report that documented and summarized the study results.

CONCLUSIONS

A FWD deflection-based overlay thickness design procedure was developed in this study for selecting an overlay thickness of pavements requiring structural rehabilitation. Based on the results of this study, the following specific observations and conclusions may be drawn:

- The 1993 AASHTO NDT procedure generally over-estimated the effective structural number for the existing flexible pavements in Louisiana, which would result in an under-designed overlay thickness.
- Without further modification or calibration, none of the six-selected NDT procedures or software could be directly applied in an overlay thickness design in Louisiana since none represent a Louisiana pavement condition.
- The Louisiana Pavement Evaluation Chart, originally developed by Kinchen and Temple, has been proved not only applicable to the Louisiana flexible pavement conditions, but is also based on the elastic multi-layered pavement theory. Therefore, it can be further used in the evaluation of existing pavement strengths of Louisiana flexible pavements.
- A strong correlation between FWD and Dynaflect determined structural numbers were obtained. Such a correlation is deemed useful since it builds a link between the layered elastic theory applied in a flexible pavement structure and Louisiana in-situ pavement conditions.
- The cost-benefit analysis indicated that, in lieu of the current LADOTD component analysis overlay design method, a significant amount of cost savings ($74,419 per mile) would result in applying the proposed FWD-based overlay design method developed from this study.

RECOMMENDATIONS

The developed FWD-based overlay design procedure is recommended to be used for Louisiana flexible pavements' structural overlay thickness design until implementation of the new MEPDG method can be studied and deployed. For low-volume roads where a higher probability of functional instead of structural overlays is required, this proposed overlay design process would be of little use except to validate that a structural overlay is not required.