

Quarterly Project Report

Center for Transportation Studies

Project Title: TPF-5(149) Composite Pavements

Quarter: January 01 - March 31, 2011

CTS Project # : 2008036

Contract # : 89261

Work Order # : 90

Project Authorization Date : 10/1/2007

Project Expiration Date: 7/31/2012

Principal Investigator

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Funding Source(s):

State Pooled Funds

AL: Nelson Cruz

TL: Tim Clyne

Task Update:

1 Development of Information on Composite Pavements

The project team will assess the state of practice and knowledge for the design and construction of composite pavement systems. The literature review will include projects and studies within the U.S. and foreign countries. The review of the state of practice will focus on two main issues: summarizing design and construction guidelines and identifying test sections or field projects to determine performance histories. It will include the design and construction of AC overlays of old PCC pavements and new composite pavement systems. The team will start with a review of the procedures that have been used to design composite pavement systems. The design/analysis procedures for composite pavements will be reviewed to determine those that are believed to have application and those that are considered inappropriate for use on further subtask activities.

The other focus of the literature review will be to develop a database of pavement sections to be used for validation/verification of the design guidelines developed in this study. Although the main focus of this study will be new composite pavements, the literature review will cover asphalt overlays of old concrete pavements as well. Based on the literature review, the research team will identify where the design and construction guidelines can be improved.

Deliverables : A task report summarizing the literature review for new composite pavements and asphalt overlays of old concrete pavements.

Task Budget : \$43,898.00

Task Due Date : 6/30/2009 (Calculated)

Date Delivered : 7/7/2009 (Reported by PI)

Date Approved : 7/24/2009 (CTS received task approval)

Task Approved : Yes

Progress:

2 Perform Initial Life-Cycle Analysis

In this task a life cycle analysis will be performed, taking into account agency and user costs as well as environmental and sustainability aspects. This analysis will compare several hypothetical TICPs and overlays with conventional asphalt and concrete pavements to determine economically viable solutions and relative environmental costs. The research team will collect the most recent information on construction cost of individual design features for California, Washington and Minnesota conditions. After that, a life cycle analysis will be performed to determine under what conditions use of composite pavement may be viable. This life cycle analysis will include a life cycle cost analysis and an PaLATE (Pavement Life Cycle Assessment Tool for Environmental and Economic Effects).

The results of this task will be a thorough understanding and documentation of the absolute and relative costs of designing and

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constructing TICPs versus conventional pavements.

Deliverables : Letter-report containing detailed description of the analysis and a summary of the economically viable design solution and corresponding required design lives.

Task Budget : \$43,898.00

Task Due Date : 1/31/2011 (*Calculated*)

Date Delivered : (*Reported by PI*)

Date Approved : (*CTS received task approval*)

Task Approved : No

Progress:

A memo summarizing a LCCA procedure and the corresponding MS Excel spreadsheet had been developed by Dr. Harvey and Mr. Santero and presented to the TAP in January. An additional example of the analysis accounting for reduction in unit cost of concrete layer of the composite pavement compared to unit cost of a new concrete pavement will be added to the memo and the revised document will be submitted to the TAP in April.

% Task Complete: 90

3 EICM Validation and Analysis

Although the construction of new composite pavements is relatively rare, over the past 35 years there exists a useful body of knowledge and experience for both AC/PCC and PCC/PCC materials, designs and construction. The MEPDG also provides useful prediction models, analysis methodologies, and a design procedure that, with further improvements and calibrations can be made to provide reasonable capabilities for new composite pavements.

In this task, the research team will conduct extensive validation of the EICM. An extensive sensitivity analysis will be conducted to ensure that the predicted temperature distributions are reasonable for a wide range of the input parameters that might be expected for composite pavements. The temperature distributions predicted with the EICM will be carefully evaluated. After that, the comparison of the predicted and measured temperatures distributions will be made. This will be followed by an extensive analytical investigation of the effect of various TICP designs on the reduction of PCC slab curling and joint movements due to presence of the HMA layer.

Deliverables : A letter-report summarizing validation of the EICM model and analytical investigation of the effect of various TICP designs on the reduction of PCC slab curling and joint movements.

Task Budget : \$70,237.00

Task Due Date : 12/31/2010 (*Calculated*)

Date Delivered : (*Reported by PI*)

Date Approved : 12/20/2010 (*CTS received task approval*)

Task Approved : Yes

Progress:

4 Evaluation of Pavement Response Models

In this task, the research team will use the information collected at the MnROAD test sections to evaluate and adapt available computer models capable of predicting pavement response to load and environmental effects. The responses of the MEPDG structural models, ISLAB2000, will be compared with the measured responses from the test sections. In addition to the analysis of the responses from the composite pavement section, the responses from the adjacent pavement sections will be compared with the correspondent responses of the composite sections.

Deliverables : A letter-report and a PowerPoint presentation.

Task Budget : \$61,457.00

Task Due Date : 1/31/2011 (*Calculated*)

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Date Delivered : (Reported by PI)
Date Approved : (CTS received task approval)
Task Approved : No
Progress:

A finite element program accounting for the effect of loading time dependency has been developed and the procedure development of rapid solutions to be implemented into the distress calculation procedure has been derived. Documentation of the process will be submitted in April.

% Task Complete: 90

5 Develop Design Guidelines

In this task, the research team will develop guidelines for the design of composite pavements. The main focus of this task will be adaptation of the MEPDG procedure for the JPCP cracking model and supplementing it by the CalME procedure for AC rutting. It is anticipated that the information obtained in Tasks 4 and 5 will enable the research team to validate and adopt the PCC cracking model for design of AC/PCC pavements. A comprehensive sensitivity analysis using the MEPDG software will be conducted to evaluate the effect of various design features on the predicted cracking of the PCC layer. Most attention will be paid to the combination of the design features identified in Task 2 as economically feasible to check if those combinations can provide acceptable performance.

Deliverables : A letter-report documenting adaptation of the MEPDG procedure for the JPCP cracking model and supplementing it by the CalME procedure for AC rutting.

Task Budget : \$125,548.00

Task Due Date : 5/31/2011 (Calculated)
Date Delivered : (Reported by PI)
Date Approved : (CTS received task approval)
Task Approved : No
Progress:

The work on the modification of the MEPDG JPCP cracking model and CalME rutting model is under way.

% Task Complete: 79

6 Develop Construction Guidelines

Once the general ideas of composite pavement design have been solidified, a group of experts in materials and construction will be convened to determine constructibility of composite pavements. This panel will evaluate materials, methods, sequencing and value engineering. The use of CA4PRS pavement construction schedule estimating software for TICP alternatives will be investigated. The software will be used to develop estimated construction schedules for construction of alternative structures. Recommendations for any updates to the software to handle this type of construction will be developed based on the experience of this part of the investigation.

Deliverables : A letter-report documenting development of the construction guidelines.

Task Budget : \$21,949.00

Task Due Date : 5/31/2011 (Calculated)
Date Delivered : (Reported by PI)
Date Approved : (CTS received task approval)
Task Approved : No
Progress:

The work on this task has been initiated.

% Task Complete: 20

7 Develop Synthesis

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Task Update:

A synthesis will be prepared.

Deliverables : Synthesis of practices.

Task Budget : \$14,925.00

Task Due Date : 9/30/2011 (*Calculated*)

Date Delivered : (*Reported by PI*)

Date Approved : (*CTS received task approval*)

Task Approved : No

Progress:

8 Draft Final Report

The research team will prepare a final report that contains the following:

- 1) Summary of experience to date based on the literature review
- 2) A description of the MnROAD test sections
- 3) A detailed description of the data that has been collected, where the data is stored, and how it can be accessed
- 4) A detailed description of the environment, structural, and performance model and their predictive capabilities
- 5) Summary of the pavement designs considered, the expected performance based on the sensitivity analyzes, expected construction schedule, and approximate life cycle cost over a common analysis period. This will provide a recommendation for the best structures for the different conditions considered in the analysis
- 6) Recommendations for best practices for each condition considered in the sensitivity analysis factorial
- 7) Identification of issues that need further research and development to further improve this technology
- 8) Address relevant issues to advise the participating state departments of transportation on possible changes in the design and construction specification to accelerate the implementation of the results of this study

Deliverables : Draft final report.

Task Budget : \$28,534.00

Task Due Date : 11/30/2011 (*Calculated*)

Date Delivered : (*Reported by PI*)

Date Approved : (*CTS received task approval*)

Task Approved : No

Progress:

9 Final Report

The research team will address the panel's comments on the final report.

Deliverables : Final written report.

Task Budget : \$28,534.00

Task Due Date : 5/31/2012 (*Calculated*)

Date Delivered : (*Reported by PI*)

Date Approved : (*CTS received task approval*)

Task Approved : No

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Task Update:

Progress:

Future Plans:

Problems Encountered/Actions Taken:

Students:

Name

E-Mail

Degree Program

Degrees

Graduation Date