TECHSUMMARY January 2015

SIO No. 30000120 / LTRC Project No. 12-4P

Development of DARWin-ME Design Guideline for Louisiana Pavement Design

INTRODUCTION

The AASHTOWare® Pavement ME™ Design is the next generation of the American Association of State Highway and Transportation Officials' (AASHTO) pavement design software, which builds upon the newly developed Mechanistic-Empirical Pavement Design Guide (MEPDG) by the National Cooperative Highway Research Program (NCHRP). Pavement ME™ reflects a major change in the methods and procedures engineers use to design pavement structure and represents the most current advancements in pavement design. In preparation for Louisiana Department of Transportation and Development (DOTD) to adopt the new design guide, there is an urgent need to evaluate the MEPDG pavement design software based on typical Louisiana pavement structures and local conditions.

OBJECTIVE & SCOPE

The objectives of this research study were:

1. to evaluate the mechanistic-empirical pavement design guide using the latest software Pavement ME™ based on typical Louisiana traffic, materials and environmental information;
2. to assess the short and long-term performance of typical Louisiana pavement structures using Pavement ME's nationally calibrated performance models; and
3. to develop implementation guidelines (including a recommended input strategy) for future assessment and adoption of Pavement ME™ in Louisiana.

Due to the lack of project-level data, this study was mainly based on comparing predicted performance from Pavement ME with measured performance from Louisiana pavement management system (LA-PMS) which is considered as network-level data.

LTRC Report 551

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FUNDING:
SPR: TT-Fed/TT-Reg

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METHODOLOGY

This study selected a total of 162 projects (pavement sections), as shown in Figure 1, from the existing DOTD highway network for the evaluation, local calibration and validation of Pavement ME in Louisiana. The selected projects consisted of flexible pavements with five types of base (asphalt concrete base, rubblized Portland cement concrete [PCC] base, crushed stone or recycled PCC base, soil cement base, and stabilized base with a stone interlayer), rigid pavements with three types of base (unbound granular base, stabilized base, and stabilized base with a HMA or stone blanket layer), and HMA overlay on top of existing flexible pavements. Pavement design information including structure, materials and traffic were retrieved from multiple network-level data sources at DOTD. A Louisiana default input strategy of Pavement ME that reflects Louisiana's condition and practice was developed. In addition, based on a consensus survey and LA-PMS distress triggers, the design reliability and performance criteria were established for different highway classes in Louisiana. The predicted performance from Pavement ME was then compared with the corresponding measured performance retrieved from LA-PMS.

CONCLUSIONS

- For flexible pavements, Pavement ME in general under-predicted fatigue cracking but over-predicted rutting. After local calibration, results showed that the recommended thickness from Pavement ME was comparable with the 1993 Design with a difference ranging from -1 in. to 1 in. and an average of -0.3 in. (ME requires thinner).
- For rigid pavements, Pavement ME significantly over-predicted slab cracking. One probable reason is that the 20-ft. joint spacing used in Louisiana is different from the normal value 15 ft. Joint faulting however was under-predicted. Field measured faulting were at minimal less than 0.1 in. except for a few projects in which the longitudinal cracking was not saw cut.
- Using field-measured cracking and faulting data, local calibration was conducted. Pavement ME with calibrated models recommended on average 0.7 in. thinner PCC surface than the 1993 Design.
- For pavement rehabilitation, similar results as for new flexible pavement were found – the national model under-predicted fatigue cracking and over-predicted rutting.
- Reflective cracking was over-predicted and hence calibrated based on estimated field measurements.
- The difference of recommended overlay thickness by Pavement ME is within ±0.5 in. for most projects evaluated in this study with an average of 0.3 in. thinner than the 1993 Design.

RECOMMENDATIONS

Based on the results of this study, an implementation guideline document was prepared. The Implementation Guidelines contain all necessary design input information and calibration coefficients for DOTD to use the latest MEPDG software (Pavement ME) on a day-to-day basis for design and analysis of new and rehabilitated pavement structures in Louisiana. Table 1 lists the local calibration coefficients developed.

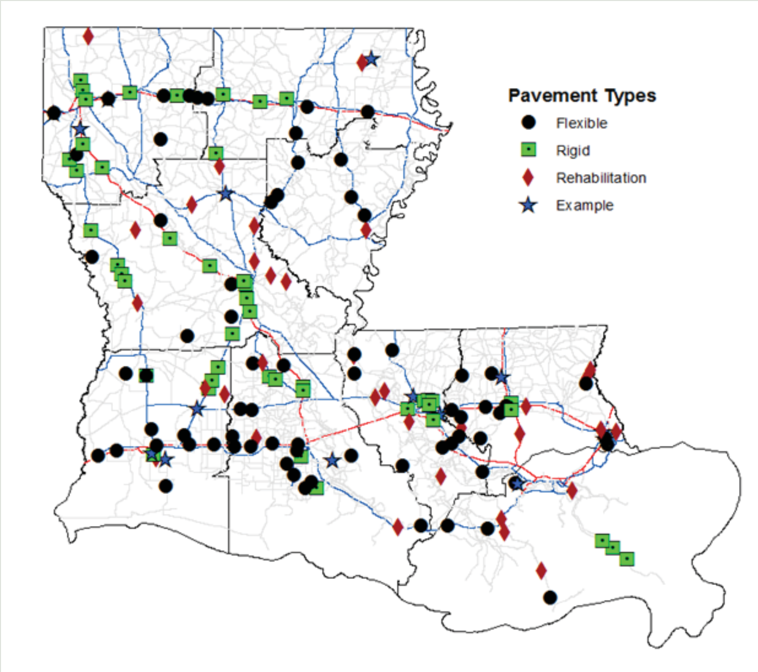

Figure 1
Pavement sections to evaluate and calibrate Pavement ME for Louisiana

Table 1
Local calibration coefficients

Pavement Type	Distress	Calibration Factor	Calibration Coefficient
New flexible and AC overlays	AC bottom-up cracking	β_{f3}	1.05
		C_1	0.892
		C_2	0.892
	AC rutting	β_{r1}	0.80
		β_{r3}	0.85
	Subgrade rutting	β_{s1}	0.40
	Reflective cracking	c	0.72
		d	0.30
New rigid	Fatigue Cracking	C_1	2.75
		C_4	1.16
		C_5	-1.73
	Joint faulting	C_1	1.5276
		C_3	0.00262
		C_6	0.55