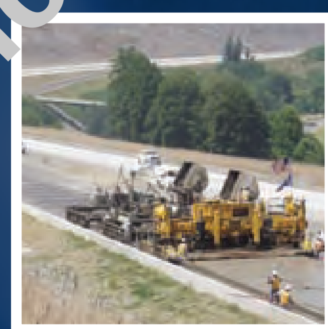
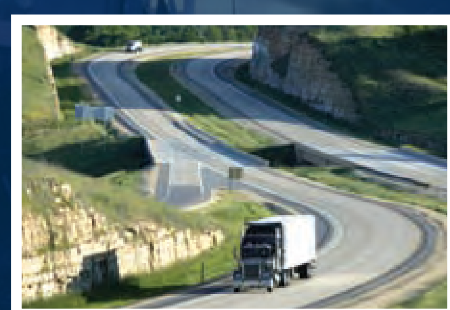
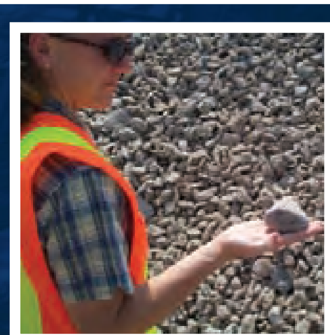
Mechanistic–Empirical Pavement Design Guide

A Manual of Practice

July 2008
Interim Edition







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PREFACE

This document describes a pavement design methodology that is based on engineering mechanics and has been validated with extensive road test performance data. This methodology is termed mechanistic-empirical (M-E) pavement design, and it represents a major change from the pavement design methods in practice today.

From the early 1960s through 1993, all versions of the American Association for State Highway and Transportation Officials (AASHTO) *Guide for Design of Pavement Structures* were based on limited empirical performance equations developed at the AASHO Road Test in the late 1950s. The need for and benefits of a mechanistically based pavement design procedure were recognized when the 1986 AASHTO *Guide for Design of Pavement Structures* was adopted. To meet that need, the AASHTO Joint Task Force on Pavements, in cooperation with the National Cooperative Highway Research Program (NCHRP) and the Federal Highway Administration (FHWA), sponsored the development of an M-E pavement design procedure under NCHRP Project 1-37A.

A key goal of NCHRP Project 1-37A, *Development of the 2002 Guide for Design of New and Rehabilitated Pavement Structures: Phase II* was the development of a design guide that utilized existing mechanistic-based models and data reflecting the current state-of-the-art in pavement design. This guide was to address all new (including lane reconstruction) and rehabilitation design issues, and provide an equitable design basis for all pavement types.

The *Mechanistic-Empirical Pavement Design Guide* (MEPDG), as it has now become known, was completed in 2004 and released to the public for review and evaluation. A formal review of the products from NCHRP Project 1-37A was conducted by the NCHRP under Project 1-40A. This review has resulted in a number of improvements, many of which have been incorporated into the MEPDG under NCHRP Project 1-40D. Project 1-40D has resulted in Version 1.0 of the MEPDG software and an updated design guide document.

Version 1.0 of the software was submitted in April 2007 to the NCHRP, FHWA, and AASHTO for further consideration as an AASHTO provisional standard and currently efforts are underway on Version 2.0 of the software. Simultaneously, a group of state agencies, termed lead states, was formed to share knowledge regarding the MEPDG and to expedite its implementation. The lead states and other interested agencies have already begun implementation activities in terms of staff training, collection of input data (materials library, traffic library, etc.), acquiring of test equipment, and setting up field sections for local calibration.

This manual presents the information necessary for pavement design engineers to begin to use the MEPDG design and analysis method. The FHWA has a web site for knowledge exchange for the MEPDG (http://knowledge.fhwa.dot.gov)

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CHAPTER 1

Introduction

The overall objective of the *Mechanistic-Empirical Pavement Design Guide* (MEPDG) is to provide the highway community with a state-of-the-practice tool for the design and analysis of new and rehabilitated pavement structures, based on mechanistic-empirical (M-E) principles. This means that the design and analysis procedure calculates pavement responses (stresses, strains, and deflections) and uses those responses to compute incremental damage over time. The procedure empirically relates the cumulative damage to observed pavement distresses. This M-E based procedure is shown in flowchart form in Figure 1-1. "MEPDG," as used in this manual, refers to the documentation and software package (NCHRP 2007.a).

The MEPDG represents a major change in the way pavement design is performed. The two fundamental differences between the *Guide for Design of Pavement Structures* (AASHTO, 1993) and the MEPDG are that the MEPDG predicts multiple performance indicators (refer to Figure 1-1) and it provides a direct tie between materials, structural design, construction, climate, traffic, and pavement management systems. Figures 1-2 and 1-3 are examples of the interrelationship between these activities for hot-mix asphalt (HMA) and Portland cement concrete (PCC) materials.

1.1 PURPOSE OF MANUAL

This manual of practice presents information to guide pavement design engineers in making decisions and using the MEPDG for new pavement and rehabilitation design. The manual does not provide guidance on developing regional or local calibration factors for predicting pavement distress and smoothness. A separate document, *Standard Practice for Conducting Local or Regional Calibration Parameters for the MEPDG*, provides guidance for determining the local calibration factors for both HMA and PCC pavement types (NCHRP, 2007.b).

1.2 OVERVIEW OF THE MEPDG DESIGN PROCEDURE

Pavement design using the MEPDG is an iterative process—the outputs from the procedure are pavement distresses and smoothness, not layer thicknesses. The designer first considers site conditions (i.e., traffic, climate, subgrade, existing pavement condition for rehabilitation) in proposing a trial design for a new pavement or rehabilitation strategy. The trial design is then evaluated for adequacy against user input, performance criteria, and reliability values through the prediction of distresses and smoothness. If