Mepdg Manual

Development of a Simplified Flexible Pavement Design Protocol for New York State Department of Transportation Based on AASHTO ME Pavement Design GuideSustainable Concrete PavementsHandbook of Transportation Engineering Volume II, 2eMechanistic-empirical Pavement Design GuidePavement Asset ManagementMinnesota Department of Transportation Research Services Annual ReportAASHTO Guide for Design of Pavement Structures, 1993Advances in Unsaturated SoilsGuidelines for Implementing NCHRP 1-37A M-E Design Procedures: MEPDG models validation & recalibrationConcrete Pavement Design, Construction, and Performance, Second EditionSpecification Criteria for Simple Performance Tests for RuttingMix Design Practices for Warm Mix AsphaltCalibration of Rutting Models for Structural and Mix DesignPavement Design and MaterialsA Performance-related Specification for Hot-mixed AsphaltImplementation of the Mechanistic-empirical Pavement Design Guide in UtahDevelopment of FWD Procedures ManualCalibration of Rutting Models for Structural and Mix DesignLTPP Computed ParameterShell Bitumen HandbookImplementation Plan for the New Mechanistic-empirical Pavement Design GuideRecent Developments in Pavement Design, Modeling and PerformancePavement AnalysisLong-Term Pavement Performance Pavement Loading User Guide (LTPP PLUG)Independent Review of the "Mechanistic-empirical Pavement Design Guide" and SoftwareSummary of Progress - National Cooperative Highway Research ProgramA National Database of Subgrade Soil-water Characteristic Curves and Selected Soil Properties for Use with the MEPDG.Pavements and the EnvironmentA Manual for Design of Hot Mix Asphalt with CommentaryThe Asphalt HandbookThe Handbook of Highway EngineeringDevelopment of Field Data for Effective Implementation of Mechanistic Empirical Pavement Design ProcedureGuide for the Local Calibration of the Mechanistic-empirical Pavement Design GuideGuidelines for Dowel Alignment in Concrete PavementsPavement EngineeringGuidelines for Implementing NCHRP 1-37A M-E Design Procedures: Summary of findings, implementation plan, and next stepsImplementation of the AASHTO Mechanistic-empirical Pavement Design Guide and SoftwareMechanistic-empirical Pavement Design Guide Implementation PlanThe Modern Asphalt PavementTowards an Integrated Pavement Design Approach

Development of a Simplified Flexible Pavement Design Protocol for New York State Department of Transportation Based on AASHTO ME Pavement Design Guide

Sustainable Concrete Pavements

TRB's National Cooperative Highway Research Program (NCHRP) Report 691: Mix Design Practices for Warm-Mix Asphalt explores a mix design method tailored to the unique material properties of warm mix asphalt technologies. Warm mix

asphalt (WMA) refers to asphalt concrete mixtures that are produced at temperatures approximately 50°F (28°C) or more cooler than typically used in the production of hot mix asphalt (HMA). The goal of WMA is to produce mixtures with similar strength, durability, and performance characteristics as HMA using substantially reduced production temperatures. There are important environmental and health benefits associated with reduced production temperatures including lower greenhouse gas emissions, lower fuel consumption, and reduced exposure of workers to asphalt fumes. Lower production temperatures can also potentially improve pavement performance by reducing binder aging, providing added time for mixture compaction, and allowing improved compaction during cold weather paving. Appendices to NCHRP Report 691 include the following. Appendices A, B, and D are included in the printed and PDF version of the report. Appendices C and E are available only online.

Handbook of Transportation Engineering Volume II, 2e

Mechanistic-empirical Pavement Design Guide

New York State Department of Transportation (NYSDOT) has used the AASHTO 1993 Design Guide for the design of new flexible pavement structures for more than three decades. The AASHTO 1993 Guide is based on the empirical relationships developed for the data collected in the AASHO Road Test in the early 1960's. A newer pavement design method, called the Mechanistic-Empirical Pavement Design Guide (MEPDG) was developed by the National Cooperative Highway Research Program to provide a more efficient and accurate design method and based on sound engineering principles. The MEPDG models have been incorporated in the AASHTOWare Pavement ME 2.1 software program that can be purchased from AASHTO. Due to the advanced principles and design capabilities of the AASHTOWare program, NYSDOT decided to implement the MEPDG and calibrate the distress models included in the software for the conditions in the state. The work conducted in this research included the local calibration of the distress models for the North East (NE) region of the United States. Design, performance and traffic data collected on Long Term Pavement Performance (LTPP) sites in the NE region of the United States were used to calibrate the distress models. First, the AASHTOWare Pavement ME 2.1 with global calibration factors was used to compare the predicted and measured distresses, values that were used for model calibration. The local bias was assessed for all distresses models except for the longitudinal cracking model; it was found the bias existed for this model even after calibration. The thermal cracking model was not calibrated because of erroneous measured data. The calibration improved the prediction accuracy for the rutting, fatigue cracking and smoothness prediction models. The AASHTOWare software was used to run design cases for combinations of traffic volume and subgrade soil stiffness (Mr) for twenty-four locations in New York State. The runs were performed for a road classified as Principal Arterial Interstate, the 90% design reliability level and 15 years design period. State-wide average traffic volume

parameters and axle load spectra were used to define the traffic. The NYSDOT's Comprehensive Pavement Design Manual (CPDM) was initially used to obtain pavement design solutions. The thicknesses for the select granular subgrade materials and the asphalt layer thicknesses were varied to include several values higher and lower than the thickness recommended by CPDM. The thicknesses of asphalt surface and binder layers were kept constant; only the thickness of the asphalt base layer was changed. For each design combination, the design case with thinnest asphalt layer for which the predicted distress was less the performance criteria was selected as the design solution. The design solutions for each of the 24 locations were assembled in design tables. The comparison of the design tables showed that some variation in the design thickness for the asphalt layers exists even, with thicker asphalt layers being needed for the locations in the Upper part of the New York State. The comparison between the new design tables and the table included in the CPDM proved that the new design tables require thinner asphalt layers at low AADTT and thicker asphalt layers at high AADTT than the corresponding design in the CPDM table. For stiff subgrade soil and low AADTT, the design thicknesses are almost the same in the new design tables and in the CPDM table.

Pavement Asset Management

Minnesota Department of Transportation Research Services Annual Report

TRB’s National Cooperative Highway Research Program (NCHRP) Report 719: Calibration of Rutting Models for Structural and Mix Design highlights proposed revisions to the Mechanistic–Empirical Pavement Design Guide (MEPDG) and software to incorporate three alternative rut-depth prediction models that rely on repeated load (triaxial) permanent deformation or constant height testing to provide the requisite input data.

AASHTO Guide for Design of Pavement Structures, 1993

Developed as a more detailed follow-up to a 2009 briefing document, Building Sustainable Pavement with Concrete, this guide provides a clear, concise, and cohesive discussion of pavement sustainability concepts and of recommended practices for maximizing the sustainability of concrete pavements. The intended audience includes decision makers and practitioners in both owner-agencies and supply, manufacturing, consulting, and contractor businesses. Readers will find individual chapters with the most recent technical information and best practices related to concrete pavement design, materials, construction, use/operations, renewal, and recycling. In addition, they will find chapters addressing issues specific to pavement sustainability in the urban environment and to the evaluation of pavement sustainability. Development of this guide satisfies a critical need identified in the Sustainability Track (Track 12) of the Long-Term Plan for

Concrete Pavement Research and Technology (CP Road Map). The CP Road Map is a national research plan jointly developed by the concrete pavement stakeholder community, including Federal Highway Administration, academic institutions, state departments of transportation, and concrete pavement-related industries. It outlines 12 tracks of priority research needs related to concrete pavements. CP Road Map publications and other operations support services are provided by the National Concrete Pavement Technology Center at Iowa State University. For details about the CP Road Map, see www.cproadmap.org/index.cfm.

Advances in Unsaturated Soils

This book provides some simple methods for the analysis of pavements in order to describe their present condition and to predict their future condition. Functional and structural conditions of flexible and rigid highway and airfield pavements are treated. The book has been designed to assist the engineer in answering such questions as: What is the bearing capacity of a pavement structure? How good is the ''ride'' quality? How quickly will the pavement deteriorate? What will be the effects of a particular maintenance or rehabilitation measure? How much should be invested in maintaining road networks in order to obtain the highest rate of return on the investment? The analytical-empirical (or mechanistic-empirical) method has long been recognized as a proper engineering method for pavement evaluation. Its more widespread use has been hindered by the difficulties of determining the fundamental input parameters, but recent developments like the Falling Weight Deflectometer are rapidly changing this situation. The book discusses all important aspects of structural as well as functional evaluation and presents a number of useful mathematical models that are easily programmed on a microcomputer or incorporated in a spreadsheet. The book is written primarily for engineers involved in the design or maintenance of pavement structures and for engineering students interested in this subject. Some of the more advanced methods for computer simulation of pavement performance will be of interest to engineers engaged in pavement research, and the description of pavement management systems will also be of interest to those in airport administration, highway agencies etc.

Guidelines for Implementing NCHRP 1-37A M-E Design Procedures: MEPDG models validation & recalibration

Concrete Pavement Design, Construction, and Performance, Second Edition

This research study focuses on analyzing two techniques for observing the variability of mix production and its effects on pavement performance. First, this study focuses on using the Mechanistic-Empirical Pavement Design Guide (MEPDG) to

analyze and predict the effect of the variability of HMA production on rutting in the asphalt layer. Then, this study makes an attempt to compare the results produced by the MEPDG with the results produced by the Hamburg Wheel Tracking Device (HWTD). In order to effectively establish correlations between the two techniques, an experiment was conducted during this research. This experiment focused on using volumetric data from a previous research project. The data from this project was used to model asphalt mixes and pavement structures in the MEPDG and the performance results were then compared to actual data obtained in the laboratory from the Hamburg Wheel Tracking Device (HWTD).

Specification Criteria for Simple Performance Tests for Rutting

This second edition of Concrete Pavement Design, Construction, and Performance provides a solid foundation for pavement engineers seeking relevant and applicable design and construction instruction. It relies on general principles instead of specific ones, and incorporates illustrative case studies and prime design examples to highlight the material. It presents a thorough understanding of materials selection, mixture proportioning, design and detailing, drainage, construction techniques, and pavement performance. It also offers insight into the theoretical framework underlying commonly used design procedures as well as the limits of the applicability of the procedures. All chapters have been updated to reflect recent developments, including some alternative and emerging design technologies that improve sustainability. What's New in the Second Edition: The second edition of this book contains a new chapter on sustainability, and coverage of mechanistic-empirical design and pervious concrete pavements. RCC pavements are now given a new chapter. The text also expands the industrial pavement design chapter. Outlines alternatives for concrete pavement solutions Identifies desired performance and behavior parameters Establishes appropriate materials and desired concrete proportions Presents steps for translating the design into a durable facility The book highlights significant innovations such as one is two-lift concrete pavements, precast concrete pavement systems, RCC pavement, interlocking concrete pavers, thin concrete pavement design, and pervious concrete. This text also addresses pavement management, maintenance, rehabilitation, and overlays.

Mix Design Practices for Warm Mix Asphalt

Introduction -- Mechanistic-Empirical Pavement Design Guide and AASHTOWare Pavement ME Design (TM) Software Overview -- Survey of Agency Pavement Design Practices -- Common Elements of Agency Implementation Plans -- Case Examples of Agency Implementation -- Conclusions.

Calibration of Rutting Models for Structural and Mix Design

New theories and testing techniques related with Unsaturated Soil Mechanics have proven to be valuable tools to study a broad spectrum of geo-materials which includes rocks, rock fills, frozen soils and domiciliary solid wastes. These new theories and testing techniques have permitted the analysis of several traditional problems from a new perspect

Pavement Design and Materials

This publication provides a guide to the Minnesota Department of Transportation's current research activities.

A Performance-related Specification for Hot-mixed Asphalt

Modern highway engineering reflects an integrated view of a road system's entire lifecycle, including any potential environmental impacts, and seeks to develop a sustainable infrastructure through careful planning and active management. This trend is not limited to developed nations, but is recognized across the globe. Edited by renowned authority

Implementation of the Mechanistic-empirical Pavement Design Guide in Utah

Development of FWD Procedures Manual

Calibration of Rutting Models for Structural and Mix Design

TRB's National Cooperative Highway Research Program (NCHRP) Report 704: A Performance-Related Specification for Hot-Mixed Asphalt provides a proposed performance-related specification (PRS) for hot-mix asphalt (HMA) in the form of the Microsoft Windows-based Quality-Related Specification Software (QRSS). The QRSS is a stand-alone program for Microsoft Windows (versions XP and 7) that employs a database of pre-solved solutions of the Mechanistic-Empirical Pavement Design Guide. The program is capable of (1) calculating the predicted rutting, fatigue cracking, and low-temperature (thermal) cracking of an HMA pavement from the mix volumetric and binder and aggregate properties of the as-designed HMA (typically the job mix formula) and (2) comparing them with predictions calculated from the contractor's lot or sub-lot quality assurance data for the same properties.

LTPP Computed Parameter

This guide addresses the selection and use of axle loading defaults for Mechanistic-Empirical Pavement Design Guide (MEPDG) applications. The defaults were developed based on weigh-in-motion (WIM) data from the Long-Term Pavement Performance (LTPP) Special Pavement Study (SPS) Transportation Pooled Fund Study (TPF). The guide consists of two parts. The first part provides guidelines for selecting and using LTPP SPS TPF axle loading defaults with the MEPDG and DARWin-ME software. These defaults provide a source of axle loading information for pavement analysis for locations where site-specific axle load spectra are not available. The second part of the guide provides practical guidelines that States and LTPP can use to generate additional MEPDG traffic loading defaults based on their own WIM data or for specific analysis purposes. In addition, this guide contains an operator's manual that supports the use of the LTPP PLUG software. This software helps users select site-specific or default axle loading conditions from its traffic loading library and produces axle load distribution input files for use with the MEPDG or DARWin-ME software. The software can be used to store, view, and group multiple normalized axle load spectra (NALS) and to develop MEPDG inputs and defaults using agency-provided data.

Shell Bitumen Handbook

"This digest summarizes key findings from NCHRP Project 1-40A Part I was prepared by Stephen F. Brown, Scott Wilson Pavement Engineering, Ltd.; Part II was prepared by Michael M. Darter . Applied Research Associates, Inc. [et al.]"--P. [1].

Implementation Plan for the New Mechanistic-empirical Pavement Design Guide

Recent Developments in Pavement Design, Modeling and Performance

Pavement Analysis

TRB’s National Cooperative Highway Research Program (NCHRP) Report 719: Calibration of Rutting Models for Structural and Mix Design highlights proposed revisions to the Mechanistic–Empirical Pavement Design Guide (MEPDG) and software to incorporate three alternative rut-depth prediction models that rely on repeated load (triaxial) permanent deformation or constant height testing to provide the requisite input data.

Long-Term Pavement Performance Pavement Loading User Guide (LTPP PLUG)

This guide provides guidance to calibrate the Mechanistic-Empirical Pavement Design Guide (MEPDG) software to local conditions, policies, and materials. It provides the highway community with a state-of-the-practice tool for the design of new and rehabilitated pavement structures, based on mechanistic-empirical (M-E) principles. The design 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.

Independent Review of the "Mechanistic-empirical Pavement Design Guide" and Software

Summary of Progress - National Cooperative Highway Research Program

This volume includes a collection of research and practical papers from an international research and technology activities on recent developments in pavement design, modeling and performance, and effects on infrastructure, green energy, technology and integration. Sustainability is increasingly a key priority in engineering practices. With the aging transportation infrastructure and renewed emphasis on infrastructure renovation by transportation agencies, innovations are urgently needed to develop materials, designs, and practices to ensure the sustainability of transportation infrastructure. The volume is based on the best contributions to the 2nd GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures, Egypt 2018 – The official international congress of the Soil-Structure Interaction Group in Egypt (SSIGE).

A National Database of Subgrade Soil-water Characteristic Curves and Selected Soil Properties for Use with the MEPDG.

Pavement Engineering will cover the entire range of pavement construction, from soil preparation to structural design and life-cycle costing and analysis. It will link the concepts of mix and structural design, while also placing emphasis on pavement evaluation and rehabilitation techniques. State-of-the-art content will introduce the latest concepts and techniques, including ground-penetrating radar and seismic testing. This new edition will be fully updated, and add a new chapter on systems approaches to pavement engineering, with an emphasis on sustainability, as well as all new downloadable models and simulations.

Pavements and the Environment

The definitive transportation engineering resource--fully revised and updated The two-volume Handbook of Transportation

Engineering, Second Edition offers practical, comprehensive coverage of the entire transportation engineering field. Featuring 18 new chapters and contributions from nearly 70 leading experts, this authoritative work discusses all types of transportation systems--freight, passenger, air, rail, road, marine, and pipeline--and provides problem-solving engineering, planning, and design tools and techniques with examples of successful applications. Volume II focuses on applications in automobile and non-automobile transportation, and on safety and environmental issues. VOLUME II COVERS: Traffic engineering analysis Traffic origin-destination estimation Traffic congestion Highway capacity Traffic control systems: freeway management and communications Traffic signals Highway sign visibility Transportation lighting Geometric design of streets and highways Intersection and interchange design Pavement engineering: flexible and rigid pavements Pavement testing and evaluation Bridge engineering Tunnel engineering Pedestrians Bicycle transportation Spectrum of automated guideway transit (AGT) and its applications Railway vehicle engineering Railway track design Improvement of railroad yard operations Modern aircraft design techniques Airport design Air traffic control systems design Ship design Pipeline engineering Traffic safety Transportation hazards Hazardous materials transportation Incident management Network security and survivability Optimization of emergency evacuation plans Transportation noise issues Air quality issues in transportation Transportation and climate change

A Manual for Design of Hot Mix Asphalt with Commentary

The Asphalt Handbook

The Handbook of Highway Engineering

This respected Handbook has earned its reputation as the authoritative source of information on bitumens used in road pavements and other surfacing applications. This new edition has been up-dated to ensure The Shell Bitumen Handbook retains its excellent reputation.

Development of Field Data for Effective Implementation of Mechanistic Empirical Pavement Design Procedure

Guide for the Local Calibration of the Mechanistic-empirical Pavement Design Guide

As AASH is expected to eventually adopt the MEPDG at its primary pavement design method, it is critical that the SDDOT become familiar with the MEPGD documentation and associated design software. The research conducted under this project was a first step toward achieving this goal.

Guidelines for Dowel Alignment in Concrete Pavements

For more than 70 years, "MS-4" has served the asphalt industry as its primary reference manual. This new, expanded edition showcases the advances in asphalt technology, covering such topics as superpave courses, asphalt binder, quality control, and rehabilitation of concrete pavements with HMA.

Pavement Engineering

A comprehensive, state-of-the-art guide to pavement design and materials With innovations ranging from the advent of SuperpaveTM, the data generated by the Long Term Pavement Performance (LTPP) project, to the recent release of the Mechanistic-Empirical pavement design guide developed under NCHRP Study 1-37A, the field of pavement engineering is experiencing significant development. Pavement Design and Materials is a practical reference for both students and practicing engineers that explores all the aspects of pavement engineering, including materials, analysis, design, evaluation, and economic analysis. Historically, numerous techniques have been applied by a multitude of jurisdictions dealing with roadway pavements. This book focuses on the best-established, currently applicable techniques available. Pavement Design and Materials offers complete coverage of: The characterization of traffic input The characterization of pavement bases/subgrades and aggregates Asphalt binder and asphalt concrete characterization Portland cement and concrete characterization Analysis of flexible and rigid pavements Pavement evaluation Environmental effects on pavements The design of flexible and rigid pavements Pavement rehabilitation Economic analysis of alternative pavement designs The coverage is accompanied by suggestions for software for implementing various analytical techniques described in these chapters. These tools are easily accessible through the book’s companion Web site, which is constantly updated to ensure that the reader finds the most up-to-date software available.

Guidelines for Implementing NCHRP 1-37A M-E Design Procedures: Summary of findings, implementation plan, and next steps

Implementation of the AASHTO Mechanistic-empirical Pavement Design Guide and Software

Comprehensive and practical, Pavement Asset Management provides an essential resource for educators, students and those in public agencies and consultancies who are directly responsible for managing road and airport pavements. The book is comprehensive in the integration of activities that go into having safe and cost-effective pavements using the best technologies and management processes available. This is accomplished in seven major parts, and 42 component chapters, ranging from the evolution of pavement management to date requirements to determining needs and priority programming of rehabilitation and maintenance, followed by structural design and economic analysis, implementation of pavement management systems, basic features of working systems and finally by a part on looking ahead. The most current methodologies and practical applications of managing pavements are described in this one-of-a-kind book. Real world up-to-date examples are provided, as well as an extensive list of references for each part.

Mechanistic-empirical Pavement Design Guide Implementation Plan

TRB's National Cooperative Highway Research Program (NCHRP) Research Results Digest 347: A National Database of Subgrade Soil-Water Characteristic Curves and Selected Soil Properties for Use with the MEPDG explores the creation of a national database of pedologic soil families that contains the soil properties for subgrade materials needed as input to the Mechanistic-Empirical Pavement Design Guide (MEPDG). The report focuses upon the parameters describing the soil-water characteristic curves and also includes measured soil index properties needed by the Enhanced Integrated Climate Model in all three hierarchical levels of pavement design. NCHRP Web-Only Document 153, which has the same title as NCHRP RRD 347 is the contractor's final report and Appendices A through D related to NCHRP Research Results Digest 347 of the same title.

The Modern Asphalt Pavement

Towards an Integrated Pavement Design Approach

"Highway agencies across the nation are moving towards implementation of the new AASHTO Mechanistic- Empirical Pavement Design Guide (MEPDG) for pavement design. The objective of this project was to implement the MEPDG into the daily operations of the Utah Department of Transportation (UDOT). The implementation of the MEPDG as a UDOT standard required modifications in some UDOT pavement design protocols (i.e., lab testing procedures, equipment, and protocols, traffic data reporting, software issues, design output interpretation, and others). A key requirement is validation of the MEPDG's nationally calibrated pavement distress and smoothness prediction models when applied under Utah conditions and performing local calibration if needed. This was accomplished using data from Long Term Pavement Performance

(LTPP) projects located in Utah and UDOT pavement management system (PMS) pavement sections. The nationally calibrated MEPDG models were evaluated. With the exception of the new hot-mix asphalt (HMA) pavement total rutting model, all other models were found to be reasonable. The rutting model was locally calibrated to increase goodness of fit and remove significant bias. Due to the nature of the data used in model validation, it is recommended that further MEPDG model validation be accomplished in the future using a database that contains HMA pavement and jointed plain concrete pavement (JPCP) exhibiting moderate to severe deterioration. This report represents Phase II of the UDOT MEPDG implementation study and builds on the Phase I study report completed in 2005 for UDOT. The Draft User's Guide for UDOT Mechanistic-Empirical Pavement Design (UDOT Research Report No. UT-09.11a, dated October 2009) incorporates the findings of this report as inputs and pavement design guidelines for Utah for use by UDOT's pavement design engineers during trial implementation of the MEPDG"--Technical report documentation page.