AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

COMMITTEE CORRESPONDENCE

Address Reply to

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MEMORANDUM

TO: All Interested Reviewers

FROM: Gary W. Sharpe, P.E.
Chairperson
AASHTO Joint Task Force on Pavements

DATE: June 23, 2004

SUBJECT: Distribution of the Recommended Mechanistic-Empirical Pavement Design Guide (NCHRP Project 1-37A)

Starting in 1996, the AASHTO Joint Task Force on Pavements (JTFP) sponsored development of a mechanistic-empirical design guide for new and rehabilitated pavements. National Cooperative Highway Research Program (NCHRP) Project 1-37A, the largest project in the over 40-year history of the program, was recently concluded with the successful delivery of a recommended mechanistic-empirical (M-E) pavement design guide by the research team of ERES Consultants, its subcontractors Arizona State University and Fugro Consultants LP, and numerous individual consultants.

The initial distribution of the M-E pavement design guide and the software accompanying this memorandum makes a research version available for testing and evaluation to interested users in the public and private sectors of the United States and worldwide—in the form of a CD-ROM or a download from the Internet.

The 1993 *AASHTO Guide for Design of Pavement Structures* was based on empirical equations derived from the AASHO Road Test. That test was conducted between 1958 and 1960, with limited structural sections at one location, Ottawa, Illinois, and with modest traffic levels compared with those of the present day. As such, designs accomplished with the 1993 AASHTO guide are projected far beyond the inference space of the original data. The JTFP in the mid-1990s proposed a research program to develop a pavement design guide based on mechanistic-empirical principles with numerical models calibrated with pavement-performance data from the LTPP program. The decision was further made to use only validated state-of-the-art technologies in this development program. The research was conducted as NCHRP Project 1-37A under the oversight of an NCHRP technical panel with membership drawn from state DOTs representing the JTFP, the hot mix asphalt (HMA) and portland cement concrete paving industries, academia, and FHWA.

The M-E pavement design guide developed in Project 1-37A includes (1) a Guide for Mechanistic-Empirical Design and Analysis, (2) companion software with documentation and a user manual, and (3) implementation and training materials. The M-E pavement design guide uses mechanistic-empirical numerical models to analyze input data for traffic, climate, materials, and proposed structure and to estimate damage accumulation over service life. It is applicable to designs for new, reconstructed, and rehabilitated flexible, rigid, and semi-rigid pavements. Performance predictions are made in terms of distress and smoothness. The predicted distresses for flexible pavement designs are longitudinal cracking, alligator cracking, transverse cracking, and rutting, and for rigid pavement designs, faulting, cracking, and continuously reinforced concrete pavement (CRCP) punch-outs. Design performance values can be compared with threshold values, or comparisons of performance may be made for alternate designs with varying traffic, structure, and materials.

This M-E pavement design guide provides significant potential benefits over the 1993 AASHTO guide in achieving cost-effective pavement designs and rehabilitation strategies. Most importantly, its user-oriented computational software implements an integrated analysis approach for predicting pavement condition over time that accounts for the interaction of traffic, climate, and pavement structure; allows consideration of special loadings with multiple tires or axles; and provides a means for evaluating design variability and reliability. The M-E pavement design guide will allow pavement designers to make better-informed decisions and take cost-effective advantage of new materials and features. The software can also serve as a forensic tool for analyzing the condition of existing pavements and pinpointing deficiencies in past designs.

The JTFP has established a road map for implementation and ultimate adoption of the M-E pavement design guide by AASHTO. It has endorsed the guide as an appropriate framework for mechanistic-empirical pavement design and recommended its immediate distribution by NCHRP for testing and evaluation by the pavement design and engineering community.

In the next several years, the task force will work with FHWA to introduce the guide to the user community through workshops, conferences, and training courses. In this same time period, it will coordinate the continued technical development of the guide, for example, by incorporating reflection and top-down HMA cracking models as they become available through NCHRP research projects. The ultimate objective of these implementation activities is two-fold: (1) to prepare for approval of a provisional or interim mechanistic-empirical design guide as a future edition of the AASHTO design guide and (2) to advance the guide and software to a routine-use AASHTOWare product.

The task force has identified a full program of technical, training, and marketing activities to advance the guide to a final product worthy of AASHTO adoption. NCHRP Project 1-40 will (1) conduct an independent, third-party review to test the guide's underlying assumptions, evaluate its engineering reasonableness and design reliability, and identify opportunities for its implementation in day-to-day design production work; (2) provide long-term technical support to users for software installation and in the design process; and (3) consider developing a metric (SI)-unit version of the guide and software. This project will also develop guidance for state DOTs and local agencies to tailor the guide for regional and local use.

It must be understood that because the software is a tool for pavement *analysis* it does not provide structural thickness as an output. Nor, in its present form, does the M-E pavement design guide lend itself directly to use as a tool for routine, day-to-day production work. The flexible design component does not specifically address recycled materials in HMA or special mix designs such as SMA, although the software does allow for analysis of a broad range of HMA mix design types. Similarly, the rigid design component considers only jointed plain concrete pavement (JPCP) and CRCP, but not jointed reinforced concrete pavement (JRCP), nor does it address all aspects of rehabilitation of JRCP. Neither the interlocking concrete pavements concept nor geosynthetic applications are specifically covered in the guide, and the M-E pavement design guide and software are available only in U.S. customary units at this time.

Comments on the M-E pavement design guide and software, suggestions for their further improvement, and specific instances of software "bugs" may be sent to NCHRP, by e-mail to pavement-guide@nas.edu or by fax to E. Harrigan at (202) 334-2006. The NCHRP 1-37A (Mechanistic-Empirical) Design Guide Community of Practice website[1] operated by the Federal Highway Administration's (FHWA) Design Guide Implementation Team provides a central forum for user dialogue on the M-E pavement design guide and software; it will also be regularly reviewed by FHWA, NCHRP, its technical support contractors, and the AASHTO JTFP.

GWS:EH:JAD

[1] The URL address of the NCHRP 1-37A (Mechanistic-Empirical) Design Guide Community of Practice website is http://knowledge.fhwa.dot.gov/cops/hcx.nsf/home?openform&Group=NCHRP%201-37A%20(Mechanistic-Empirical)%20Pavement%20Design%20Guide.