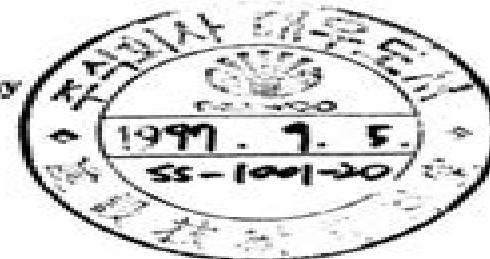


# **AASHTO® Guide for Design of Pavement Structures 1993**



Published by the  
American Association of State Highway  
and Transportation Officials

444 N. Capitol Street, N.W., Suite 249  
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# Aashto 1993 Pavement Design Guide

**Yan Bai**

## **Aashto 1993 Pavement Design Guide:**

*AASHTO Guide for Design of Pavement Structures, 1993* American Association of State Highway and Transportation Officials, 1993 Design related project level pavement management Economic evaluation of alternative pavement design strategies Reliability Pavement design procedures for new construction or reconstruction Design requirements Highway pavement structural design Low volume road design Pavement design procedures for rehabilitation of existing pavements Rehabilitation concepts Guides for field data collection Rehabilitation methods other than overlay Rehabilitation methods with overlays Mechanistic empirical design procedures

**Guideline and Recommended Standard for Geofoam Applications in Highway Embankments** Timothy D. Stark, National Cooperative Highway Research Program, 2004

## **Development of Flexible Pavement Design Parameters for Use with the 1993 AASHTO Pavement Design Guidelines**

**The Handbook of Highway Engineering** T.F. Fwa, 2005-09-28 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 **Pavement Engineering** Rajib B. Mallick, Tahar El-Korchi, 2022-12-30 Pavement Engineering Principles and Practice examines a wide range of topics in asphalt and concrete pavements from soil preparation and structural design to life cycle costing and economic analysis. This updated Fourth Edition covers all concepts and practices of pavement engineering in terms of materials design and construction methods for both flexible and rigid pavements and includes the latest developments in recycling sustainable pavement materials and resilient infrastructure. New and updated topics include material characterization concepts and tests, pavement management concepts, probabilistic examples of life cycle cost analysis, end of life considerations, waste plastic in asphalt, pervious concrete, pavement monitoring instrumentation, and data acquisition, and more. The latest updated references, state of the art reviews, and online resources have also been included

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

Ali Qays Abdullah, 2015 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 1960s. 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 *Bearing Capacity of Roads, Railways and Airfields* Andreas Loizos,Imad Al-Qadi,Tom Scarpas,2017-07-20 Bearing Capacity of Roads Railways and Airfields includes the contributions to the 10th International Conference on the Bearing Capacity of Roads Railways and Airfields BCRRRA 2017 28 30 June 2017 Athens Greece The papers cover aspects related to materials laboratory testing design construction maintenance and management systems of transport infrastructure and focus on roads railways and airfields Additional aspects that concern new materials and characterization alternative rehabilitation techniques technological advances as well as pavement and railway track substructure sustainability are included The contributions discuss new concepts and innovative solutions and are concentrated but not limited on the following topics Unbound aggregate materials and soil properties Bound materials characteristics mechanical properties and testing Effect of traffic loading In situ measurements techniques and monitoring Structural evaluation Pavement serviceability condition

Rehabilitation and maintenance issues Geophysical assessment Stabilization and reinforcement Performance modeling Environmental challenges Life cycle assessment and sustainability Bearing Capacity of Roads Railways and Airfields is essential reading for academics and professionals involved or interested in transport infrastructure systems in particular roads railways and airfields *Introduction to Modern Infrastructure Construction* George Wang,Don Chen,Jennifer Brandenburg,2024-12-30 Introduction to Modern Infrastructure Construction serves as a pivotal resource for construction management education focusing primarily on heavy civil construction and the latest technological innovations in the field This essential textbook is designed for both academic and professional use thoroughly covering critical topics including earthwork highway planning design asphalt production paving recycling technology and transportation asset management Additionally it explores various aspects of infrastructure such as bridges railways airports and pipelines offering comprehensive insights beneficial to project management in these areas Each chapter is supplemented with discussion questions or assignments to enhance educational value and the text includes lab practice appendices to reinforce practical application Authored by leading experts in the field George Wang Jennifer Brandenburg and Don Chen *Introduction to Modern Infrastructure Construction* draws on their extensive experience in academic teaching research and practical application Their expertise provides readers with a unique blend of theoretical knowledge and real world perspective making this book an indispensable guide for anyone aspiring to excel in the field of infrastructure construction **Pavement**

**Design: Materials, Analysis, and Highways** M. Rashad Islam,Rafiqul Tarefder,2021-02-05 Master the principles analysis and design in pavement engineering This student friendly textbook offers comprehensive coverage of pavement design and highways Written by two seasoned civil engineering educators the book contains precise explanations of traditional and computerized mechanistic design methods along with detailed examples of real world pavement and highway projects *Pavement Design Materials Analysis and Highways* shows step by step how to apply the latest software based AASHTOWare Pavement Mechanistic Empirical Design method Each design topic is covered in separate modular chapters enabling you to tailor a course of study Fundamentals of Engineering FE sample questions are also provided in each chapter Coverage includes Stress strain in pavement Soils aggregates asphalt and portland cement concrete Traffic analysis for pavement design Distresses and distress prediction models in flexible and rigid pavement Flexible and rigid pavement design by AASHTO 1993 and AASHTOWare Overlay and drainage design Sustainable and rehabilitation pavement design pavement management and recycling Geometric design of highways [Development of a Simplified Flexible Pavement Design Protocol for New York State Department of Transportation Based on the AASHTO Mechanistic-empirical Pavement Design Guide](#) Stefan Anton Romanoschi,Ali Q. Abdullah,2017 The 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 two decades The AASHTO 1993 Guide is based on the empirical design equations developed from the data collected in the AASHO Road Test in the

early 1960s A newer pavement design method called the Mechanistic Empirical Pavement Design Guide MEPDG was developed by the National Cooperative Highway Research Program NCHRP to provide a more efficient and accurate design method that is based on sound engineering principles The MEPDG models have been incorporated in the AASHTOWare Pavement ME Design 2 1 software program 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 This report summarizes the local calibration of the distress models for the Northeast NE region of the United States and the development of new design tables for new flexible pavement structures Design performance and traffic data collected on the 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 Design 2 1 with global calibration factors was used to compare the predicted and measured distress values The local bias was assessed for all distress 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 inaccurate measured data The calibration improved the prediction capability of the rutting fatigue cracking and smoothness prediction models The calibrated AASHTOWare software was used to run design cases for combinations of traffic volume and subgrade soil stiffness resilient modulus  $M_r$  for 24 locations in the state of New York The runs were performed for a road classified as Principal Arterial Interstate 90% design reliability level and 15 and 20 year design periods State wide average traffic volume parameters and axle load spectra were used to define the traffic The configuration specified in the current design table used by NYSDOT which is included in the Comprehensive Pavement Design Manual CPDM was followed for the 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 the 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 the thinnest asphalt layer for which the predicted distress was less than 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 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 Annual Average Daily Truck Traffic AADTT and thicker asphalt layers at high AADTT than the corresponding designs in the CPDM table

### **Implementation of the AASHTO**

**Mechanistic-empirical Pavement Design Guide and Software** ,2014 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

### **Comparison**

**of Ontario Pavement Designs Using the AASHTO 1993 Empirical Method and the Mechanistic-empirical Pavement Design Guide Method** Jonathan Boone, University of Waterloo, Department of Civil Engineering, 2013 The AASHTO 1993 Guide for Design of Pavement Structures is the most widely used pavement design method in both Canada and the United States and is currently used by the Ministry of Transportation of Ontario MTO for both flexible and rigid pavement design. Despite its widespread use the AASHTO 1993 pavement design method has significant limitations stemming primarily from the limited range of conditions observed at the AASHTO Road Test from which its empirical relationships were derived. The Mechanistic Empirical Pavement Design Guide MEPDG was developed to address the perceived limitations of the AASHTO 1993 Guide. Although the MEPDG provides a rational pavement design procedure with a solid foundation in engineering mechanics a considerable amount of work is required to adapt and validate the MEPDG to Ontario conditions. The purpose of this research was to conduct a comparative analysis of Ontario structural pavement designs using the AASHTO 1993 Guide for Design of Pavement Structures and the Mechanistic Empirical Pavement Design Guide. Historical flexible, rigid and asphalt overlay pavement designs completed using the AASHTO 1993 pavement design method for the MTO were evaluated using a two stage procedure. First the nationally calibrated MEPDG pavement distress models were used to predict the performance of the pavements designed using the AASHTO 1993 method. The purpose of this stage of the analysis was to determine whether the two methods predicted pavement performance in a consistent manner across a range of design conditions typical of Ontario. Finally the AASHTO 1993 and MEPDG methods were compared based on the thickness of the asphalt, concrete or Portland cement concrete layers required to satisfy their respective design criteria. The results of the comparative analysis demonstrate that the AASHTO 1993 method generally over predicted pavement performance relative to the MEPDG for new flexible pavements and asphalt overlays of flexible pavements. The MEPDG predicted that most of the new flexible pavements and asphalt overlays of flexible pavements designed using the AASHTO 1993 method would fail primarily due to permanent deformation and/or roughness. The asphalt layer thicknesses obtained using the MEPDG exceeded the asphalt layer thicknesses obtained using the AASHTO 1993 method and a poor correlation was observed between the asphalt layer thicknesses obtained using the two methods. Many of the new flexible pavements and asphalt overlays of existing flexible pavements could not be redesigned to meet the MEPDG performance criteria by increasing the asphalt layer thickness. The results of the comparative analysis showed that the AASHTO 1993 method generally under predicted rigid pavement performance relative to the MEPDG although the results varied widely between alternative rigid pavement designs. The AASHTO 1993 rigid pavement designs that the MEPDG predicted would not meet the rigid pavement performance criteria generally failed due to pavement roughness. A very poor correlation was observed between the Portland cement concrete layer thicknesses obtained using the MEPDG and AASHTO 1993 design methods. The MEPDG predicted thinner Portland cement concrete layer thicknesses than the AASHTO 1993 design method for most of the rigid pavement designs.

designs **Pavement Design and Analysis**, 1995 Papers presented at the 1995 TRB Annual Meeting Airfield and Highway Pavements Imad L. Al-Qadi, 2006 This collection contains 87 papers presented at the 2006 Airfield and Highway Pavements Specialty Conference held in Atlanta Georgia April 30 May 3 2006 *IMPROVED Guidance for Users of the 1993 AASHTO Flexible Pavement Design Procedures*, 1997 **Pavement Design Manual** Colorado. Department of Transportation, 2011 The purpose of the Manual is to provide the Colorado Department of Transportation CDOT and consultant pavement designers with a uniform and detailed procedure for designing pavements on CDOT projects

**Design Pamphlet for the Determination of Design Subgrade in Support of the 1993 AASHTO Guide for the Design of Pavement Structures** Harold L. Von Quintus, 1997 This design pamphlet details suggested procedures to determine the design resilient modulus of subgrade soils in support of the 1993 American Association of State Highway and Transportation Officials AASHTO Guide for the Design of Pavement Structures The design pamphlet includes recommendations for the subsurface characterization and exploration of subsurface soils laboratory test procedures and determination of design resilient modulus using relative damage coefficients based on serviceability criteria and the damage coefficients to minimize permanent deformations in the subgrade *Consideration of Preservation in Pavement Design and Analysis Procedures*, 2015 TRB's National Cooperative Highway Research Program NCHRP Report 810 Consideration of Preservation in Pavement Design and Analysis Procedures explores the effects of preservation on pavement performance and service life and describes three different approaches for considering these effects in pavement design and analysis procedures The report may serve as a basis for developing procedures for incorporating preservation in the American Association of State Highway and Transportation Officials AASHTO Mechanistic Empirical Pavement Design Guide A Manual of Practice MEPDG and the AASHTOWare Pavement ME Design software Initially the scope of this project intended to develop procedures for incorporating pavement preservation treatments into the MEPDG design analysis process that would become part of the MEPDG Manual of Practice However it was determined that sufficient data were not available to support the development of such procedures Appendices A through I are available online only *Design Pamphlet for the Determination of Layered Elastic Moduli for Flexible Pavement Design in Support of the 1993 AASHTO Guide for the Design of Pavement Structures* Harold L. Von Quintus, 1997 This design pamphlet details suggested procedures to determine the design resilient modulus of different pavement materials in support of the 1993 American Association of State Highway and Transportation Officials AASHTO Guide for the Design of Pavement Structures These suggested procedures do consider the seasonal variation of resilient moduli to estimate structural layer coefficients for flexible pavement design *Flexible Pavement Design* Ashraf Ayman Aguib, American University in Cairo. Department of Construction and Architectural Engineering, 2014 Abstract The new Mechanistic Empirical Pavement Design Guide MEPDG provides a state of the art and practice pavement design procedure that eradicates the AASHTO 1993 empirical design procedure deficiencies Huge

advancements with respect to traffic input material characterization and environmental impact are incorporated in the MEPDG. The AASHTO 1993 design procedure is based on empirical equations derived from the AASHO Road Test conducted in the late 1950's in a test track in Ottawa Illinois. The test provided very useful information for the design of pavement at that time. However with the present advancement in materials and dramatic increase in traffic volumes this empirical design procedure started to show massive drawbacks. The MEPDG is a more comprehensive design procedure that incorporates sophisticated models for pavement response calculation material properties variations with respect to environmental conditions and pavement performance predictions. The mechanistic part of the design procedure is the pavement response calculation and the empirical part of the method is the pavement performance prediction. Incorporating these models allows the MEPDG of producing pavement design sections that are cost effective and perform better than those designed using the AASHTO 1993 design procedure for a given life span. With the initial introduction of the MEPDG in 2004 almost every State Highway Agency SHA in the United States and several road authorities around the world exerted efforts to understand and plan to implement the MEPDG according to their own local conditions. It was hence found necessary to explore the new design procedure according to Egyptian local conditions. The objectives of the research is to prepare a body of accurate and readily usable environmental data for Egypt for MEPDG input compare the effectiveness of both design methods and assess the sensitivity of MEPDG predicted performance with respect to variations in inputs. Weather data files for major Egyptian cities were extracted from available data sources and prepared for direct input in the MEPDG. The preparation of data was done using a computer application especially developed in this research program to comprehensively and rationally complete this task. A comparative study was then done between the two design methods. Five pavement sections were designed using the AASHTO 1993 design procedure and then evaluated using the MEPDG for three traffic levels. These five sections were chosen to best represent the majority of Egypt. A sensitivity analysis was then conducted to investigate the predicted behavior of fatigue cracking and rutting with respect to variations in environmental conditions traffic levels AC layer thickness and properties granular base GB layer thickness and subgrade strength. Comparing both design methods revealed that pavements designed under the AASHTO 1993 do not perform equally at the end of their design life. Terminal Present Serviceability Index PSI values are different for different traffic levels and locations. Predicted fatigue cracking and rutting showed a similar trend to terminal PSI values. The AASHTO 1993 was also found to over estimate pavement layers thicknesses. Predicted fatigue cracking showed high sensitivity to design inputs under the scope of the study. Environmental conditions and traffic loading were also found to be the most influential input parameters on the selected pavement performance indices. Unexpected results for predicted rutting lead to further investigation and MEDPG rutting prediction model was evaluated with respect to an Egyptian rutting prediction model. Rutting prediction model adopted by MEPDG produced lower values for permanent strain compare to the Egyptian rutting model and further calibration for the MEPDG rutting prediction model was found.

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## Whispering the Techniques of Language: An Psychological Quest through **Aashto 1993 Pavement Design Guide**

In a digitally-driven world where displays reign great and quick conversation drowns out the subtleties of language, the profound strategies and mental nuances concealed within phrases often get unheard. Yet, situated within the pages of **Aashto 1993 Pavement Design Guide** a interesting fictional value sporting with fresh thoughts, lies an extraordinary quest waiting to be undertaken. Composed by a talented wordsmith, that marvelous opus invites readers on an introspective journey, softly unraveling the veiled truths and profound impact resonating within the fabric of each and every word. Within the mental depths of the poignant evaluation, we shall embark upon a honest exploration of the book is core styles, dissect its fascinating publishing style, and yield to the effective resonance it evokes serious within the recesses of readers hearts.

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