RESEARCH & DEVELOPMENT NEWS

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National Cooperative Research Studies

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Research and Development Manager

NCDOT employees have multiple avenues to participate in external research projects. The two most common routes are via national Cooperative Research Programs and Transportation Pooled Fund studies. The National Cooperative Highway Research Program (NCHRP) is one of the largest transportation research efforts in the world. States voluntarily contribute 5.5% of their Federal State Planning and Research (SPR) allocation to pursue work in areas with a national, regional or global scope.

State DOT employees can participate in the NCHRP Project process in several ways. Employees can work with AASHTO committees or Research and Development to submit ideas. NCDOT employees are also able to apply to and sit on the research panels that guide and review the work. NCHRP also coordinates activities such as Domestic and International Scans and the IDEA program. Project pages often contain very detailed information on research progress and addenda to the final reports. All results from research studies are published in NCHRP digests and are freely available to participating State DOTs in electronic and limited print formats. The NCDOT Research Library also has a collection of reports and can provide those or assist you in obtaining your own.

The two most common types of NCHRP projects are syntheses and full projects. Synthesis projects are typically shorter in duration and low cost – the goal is to identify best practices in a given area, to highlight prior research that might not be widely known and to summarize the findings in such a way that practitioners can make use of the results and be directed to more detailed information.

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Full Projects are usually larger in scope than any single DOT would tackle and involve the participation of many state agency stakeholders.

Research ideas are rated by state agencies each spring. The highest scoring an highest priority research needs are selected for development into Requests for Proposals (RFPs) based on those evaluations and feedback from appropriate AASHTO committees. The RFP selection is made by the AASHTO Standing Committee on Research (SCOR), with advice provided by the AASHTO Research Advisory Committee (RAC). RFPs are advertised on the NCHRP website and the responses are evaluated by the selected project panels.

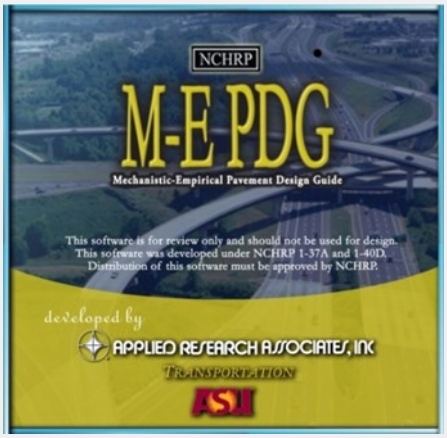
NCHRP ideas for full projects can be submitted by participating agencies no later than October 15 each year. Other programs and panel applications have differing deadlines. Project panel nominations are accepted in late spring and summer each year. NCDOT Research and Development will notify NCDOT personnel of the opportunities available for panel participation. The agency receives the most benefit for its research dollar if we have active participation on project panels and are involved in the creation of critical research ideas.

In addition to NCHRP, there are opportunities to participate in cooperative research involving, Rail (NCRRP), Airports (ACRP), Transit (TCRP), Freight (NCFRP) and Hazardous Materials (HMCRP). I invite you to explore all of these programs on their linked websites. As always, if you have any questions, please feel free to contact me at jmastin@ncdot.gov.

Next Quarter: Transportation Pooled Funds

What is the Mechanistic-Empirical Pavement Design Guide (M-E PDG)?

Mustan Kadibhai, P.E.



Anyone involved with pavement design or construction should have at least a basic understanding of the Mechanistic-Empirical Pavement Design Guide, also known as the M-E PDG and now by its AASHTOWare Name, Pavement ME.

The M-E PDG is designed to update the 1993 AASHTO Guide for Design of Pavement Structures, which is primarily based on empirical observations from the AASHO Road Test that began in the 1950s. By using newer data collected as part of the Long-Term Pavement Performance (LTPP) program, the M-E PDG allows for design inferences that would be harder to justify from the limited designs and traffic levels covered by the Road Test. In conjunction with the M-E PDG research project, software was developed to assist in organizing and performing these design calculations.

AASHTOWare Pavement ME Design is the state-of-the-art in pavement analysis/design software, which builds upon the National Cooperative Highway Research Program's Mechanistic-Empirical Pavement Design Guide (M-E PDG).

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Improvements to NCDOT's Wetland Prediction Model

Research Project No. 2013-13. Researcher: Sheng-Guo Wang, Ph.D. UNC-Charlotte, Engineering Technology and Construction Management Department

John W. Kirby

As part of FHWA and NCDOT streamlining initiatives, NCDOT PDEA and UNC Charlotte worked together to develop wetland prediction models for two pilot projects to reduce the amount of field work associated with wetland delineations. The goal of this project was to provide improved LiDAR-based wetland prediction models with highly automated, reliable, and user-friendly software tools based on ArcGIS. The purpose of the study was to improve and automate the initial modeling efforts. This exemplifies how innovative technologies can be used in lieu of extensive field wetland delineations and ultimately reduces transportation project delivery time and costs while protecting the environment. The research created a tool based in ArcGIS 10.1 to automate the process of generating the DEM terrain derivatives and create Random Forest (RF) classifiers to predict and map wetlands.

This research expands on the current efforts to integrate innovative technologies such as airborne Lidar, digital imagery and pattern recognition to characterize and monitor the natural environment. The implementation of this study will reduce field work, costs and project delivery times. For example, using wetland prediction models for the Kinston Bypass Project, NCDOT was able to save $350,000 on wetland and stream delineations on just one project. As this technology is used on other projects, additional funds will be saved. Further automation and upgrades will results in increasing efficiency.

This project was awarded by the AASHTO SCOR RAC as a 2015 Sweet 16 High Value Research project and recognized by NCDOT Secretary Tennyson at the October 8, 2015 Board of Transportation Meeting.

L-R: Morgan Weatherford (PDEA), John Kirby (R&D), Neil Mastin (R&D), Secretary Nick Tennyson, David Johnson (PDEA), Phil Harris (PDEA), Colin Mellor (PDEA), Leilani Paugh (PDEA).

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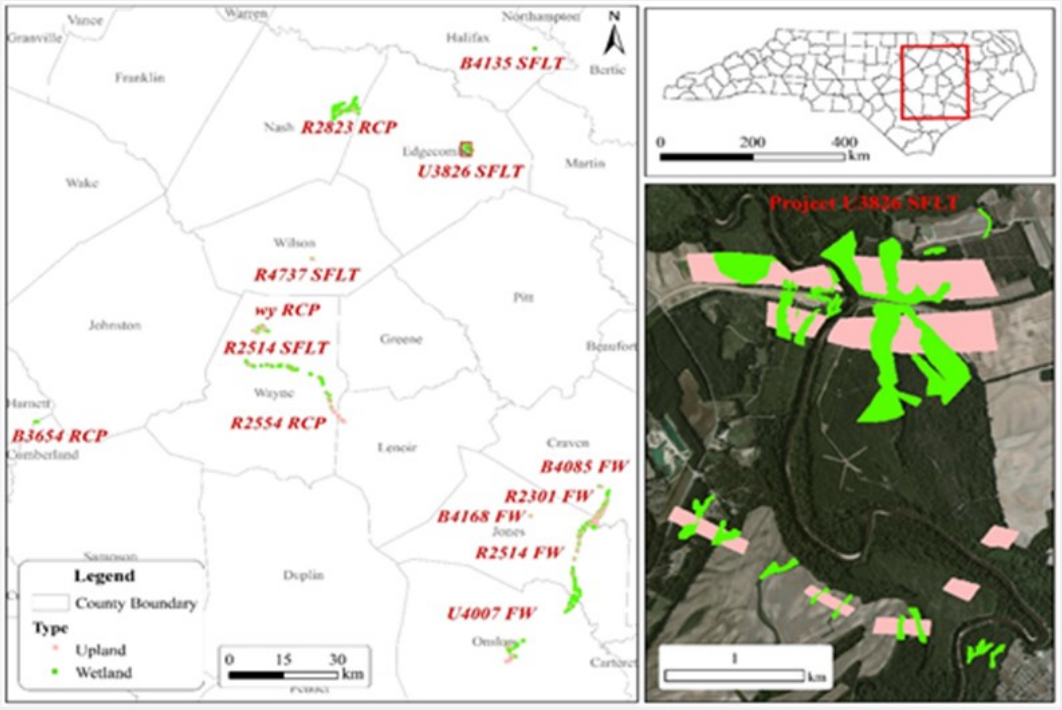
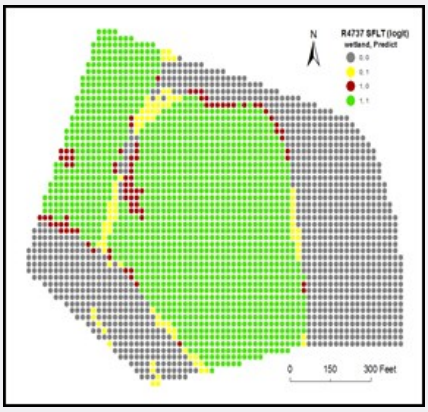
NCDOT's Wetland Prediction (continued)



Study Area showing 13 sample areas



Wetland Prediction Results for R-2301

Researchers in the Field

Details relating to the project can be found on the NCDOT R&D Project Website for Project RP2013-13

More information on the High Value Research Program can be found on AASHTO's website.

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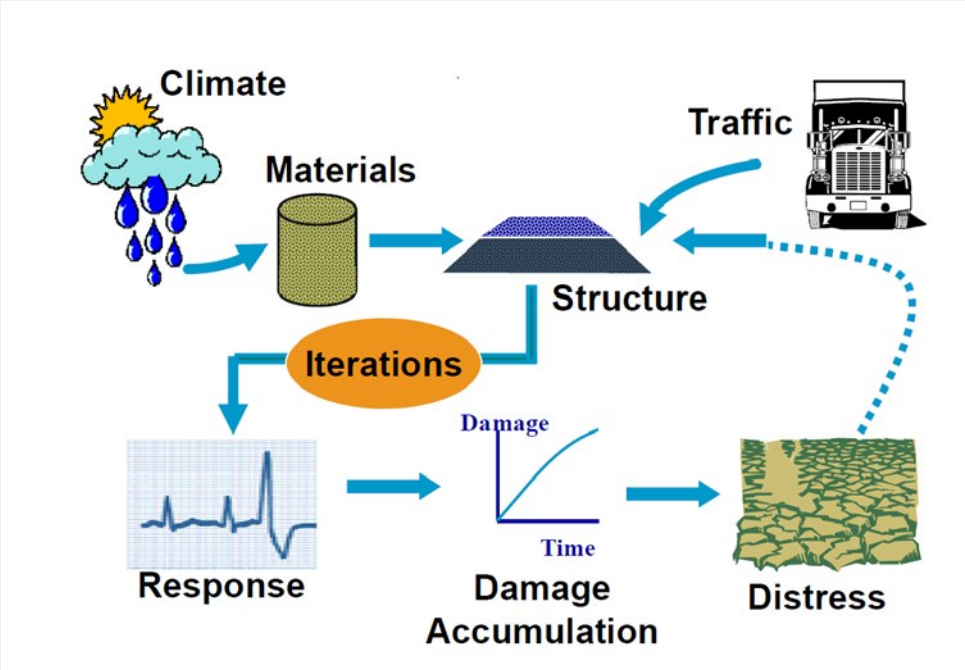
About the M-E PDG (continued)

After local calibration, engineers can now design pavements with greater confidence because the software incorporates material data, climate data, and traffic information to predict the pavement performance in a comprehensive and realistic manner.

The Pavement ME Design employs mechanistic -empirical approaches that promote accurate characterization of pavement structures and provide uniform guidelines for designing flexible, rigid, and composite pavements. By using these approaches, engineers can create more reliable pavement designs. The Pavement ME Design software also offers procedures for evaluating existing pavements and recommendations for rehabilitation treatments, drainage, and foundation improvements. In addition, there are procedures for performing traffic analyses, including options for calibrating to local conditions and incorporates measures for design reliability.

Engineers can use the guide to analyze common causes of pavement distress, including fatigue, rutting, thermal cracking in asphalt pavements, and cracking and faulting in concrete pavements. The goal of Pavement ME is to identify the physical causes of distresses in pavement structures and calibrate them with observed pavement performance. The focus on physical causes is the "mechanistic" part in Pavement ME, and using observed performance to calibrate the mechanistic relationships is the "empirical" part. Pavement ME computes how a trial design will respond under the climatic and traffic conditions for a project of interest. These pavement responses are used to calculate the level of damage the pavement will sustain over time, in terms of pavement distresses and deterioration in ride quality. Improvement of the models in the software and software itself continues under the sponsorship of AASHTO, NCHRP, the Federal Highway Administration and state highway agencies.

Inputs for PavementME



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One of the significant changes with the MEPDG is that the approach to pavement design is effectively reversed. In conventional design methods, various inputs are considered and used to produce the design requirements for the pavement structure. In mechanistic-empirical design, the design of the pavement structure is initially assumed on a trial basis, along with inputs for traffic and climate. MEPDG software can compute how the trial design will respond to the load and environmental stresses created by these inputs. This leads to an estimate of the level of damage the pavement will sustain over time, in terms of pavement distresses and deterioration in ride quality. Using the mechanistic models and data, the MEPDG process analyzes the pavement design with respect to performance indicators that reflect the projected impact of stresses and strains on the pavement over time. These performance indicators include pavement roughness for all pavements, quantified according to the International Roughness Index (IRI), along with specific indicators according to the pavement type.

NCDOT has used M-E PDG for pavement designs on major projects since 2011. The procedure has resulted in more economical designs. The completed projects are being monitored, and we are optimistic that the performance of the pavements will be good over their design lives.

In order to produce satisfactory results, the MEPDG relies on a high level of detail being supplied as input parameters for materials and traffic. To determine all of the parameters involved, NCDOT did the following research projects:

RP 2003-09 "Typical Dynamic Moduli for North Carolina Asphalt Concrete Mixes"

RP 2005-28 "Implementation Plan for the New Mechanistic-Empirical Pavement Design Guide"

RP 2007-07 "Local Calibration of the MEPDG for Flexible Pavement Design"

RP 2008-11 "Development of Traffic Data Input Resources for the Mechanistic Empirical Pavement Design Process"

RP 2012-01 "MEPDG Inputs for Warm Mix Asphalts"

RP 2013-02 "Development of IRI Limits and Targets for Network Management and Construction Approval Purposes"

RP 2014-01 "Improved Climatic Data for Mechanistic-Empirical Pavement Design"

Some material in this article has been taken from: What Is Mechanistic-Empirical Design? – The MEPDG and You

Dr. Richard Kim of North Carolina State University provided his inputs to the article.

More information is available at: AASHTOWare.org

New Publications from TRB

Work Zone Speed Management: National Cooperative Highway Research Program (NCHRP) Synthesis 482 This documents the current state of practice for work zone speed management, including data, procedures, techniques, and technical issues related to observing and comparing work zone speeds.

A Guide to Building and Retaining Workforce Capacity for the Railroad Industry: National Cooperative Rail Research Program (NCRRP) Report 2 This report presents competency models that describe workforce requirements for the passenger and freight railroad industry. The models are based on assessments of past trends, current forecasts, and a detailed gap analysis of employee supply and demand. A strategy for improving employee retention and enhancing educational programs designed to attract new employees to the industry is also presented.

Short-Term Laboratory Conditioning of Asphalt Mixtures: National Cooperative Highway Research Program (NCHRP) Report 815 This report develops procedures and associated criteria for laboratory conditioning of asphalt mixtures to simulate short-term aging. The report presents proposed changes to the American Association of State Highway and Transportation Officials (AASHTO) R 30, Mixture Conditioning of Hot-Mix Asphalt (HMA), and a proposed AASHTO practice for conducting plant aging studies.

Maintenance Services, Transportation Weather, and Winter Maintenance: Transportation Research Record (TRR) No. 2482 This journal consists of 17 papers that explore maintenance services, transportation weather, and winter maintenance, including: Temperature Dependence of Solution-Induced Weakening of Compacted Snow, Winter Road Surface Condition Monitoring: Field Evaluation of a Smartphone-Based System, Ice Formation and the Effectiveness of Deicing Agent on Porous Asphalt and Stone Mastic Asphalt .

Labor–Management Partnerships for Public Transportation Volume 1: Toolkit: Transit Cooperative Research Program (TCRP) Report 181 This toolkit provides resources for public transportation management and labor union leaders to establish, manage, and improve labor–management partnerships. The first volume describes among other things the development of a labor–management partnership charter to start or improve a partnership.

Many more publication links can be found on NCDOT's TRB News Feed

Calendar of Events 2015 & 2016

December 2015

- **NC DOT Board of Transportation Meeting, December 2-3, 2015**

January 2016

- **NC DOT Board of Transportation Meeting, January 6-7, 2016**
- **Transportation Research Board (TRB) Annual Meeting January 10–14, 2016, Washington, DC.**

Librarian's Corner

Lamara Williams-Jones

DOI and ORCID and How Both Can help you to distinguish your Research

How do you distinguish articles with similar titles or authors with similar names? Two identifiers can help with this.

DOI

AMBIO 2014, 43:69–81

DOI 10.1007/s13280-013-0478-3

Development of Tools for Integrated Monitoring and Assessment of Hazardous Substances and Their Biological Effects in the Baltic Sea
Kari K. Lehtonen, Brita Sundelin, Thomas Lang, Jakob Strand

A digital object identifier (**DOI**) is assigned to each article published and made available electronically. It is a unique alphanumeric string assigned by the International DOI Foundation to identify content and provide a persistent link to its location on the Internet. All DOI numbers begin with a 10 and contain prefix and a suffix separated by a slash. The prefix is a unique number of four or more digits assigned to organizations; the suffix is assigned by the publisher and was designed to be flexible with publisher identification standards.

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Sources: Burley, Paul, and Leighton Christiansen. "Disambiguating Transportation Authors with Unique ORCID Identifiers, Poster P15-6911." Washington, DC, USA, 2015. and orcid.org

Contact the NCDOT Librarian, Lamara Williams-Jones, for assistance: 919-508-1820, Monday through Friday from 8:30 to 4:30. Since there is only one Librarian, customers should call before visiting the Library. Watch this space for future articles about the Library's services and helpful topics. We look forward to serving you!

NCDOT Research and Development Unit General Information

How to find us:

We are located at 104 Fayetteville Street, Raleigh, in the Transportation Technology Center (formerly The Raney Building).

The Research & Development web page contains more information about the Unit and what we do.

The Research Library's catalog is also available on the web.

NCDOT RESEARCH AND DEVELOPMENT

The Research & Development Unit oversees transportation-related research that investigates materials, operations, planning, traffic and safety, structures, human environments, natural environments, and more. Please contact one of our engineers listed on this page if you have questions.

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