RESEARCH & DEVELOPMENT NEWS

Fall 2018 Vol. 4, no. 3

FROM THE MANAGER

NCDOT Research Program – Fall 2018

2018 saw several changes to the NCDOT Research Program Development process. The biggest news was the first electronic research idea selection. The Research Office advertised simultaneously to external partners and to NCDOT employees. The result – 102 unique research ideas covering a wide gamut from subsurface investigation to pavements to UAV deployment.

The next big change was the elimination of the preliminary proposal phase. Our Research Technical Subcommittees whittled the ideas down to 73 that were timely and critical enough to merit further exploration. Full proposals were requested on these ideas. Researchers from 6 different universities responded with 87 proposals, a new record. These proposals will be vetted by NCDOT committees and technical experts before the final selection is made by the executive committee in January.

The FY2020 Program that kicked off in August 2018 is the largest in recent program history with 33 projects launched. It's quite possible the FY2021 program will be larger in both number of projects and total funding.

It's not too late to be thinking about your own research ideas for the next cycle. Please reach out to us for more information and a visit.

Neil Mastin,

Research & Development Unit Manager

Photo: Port of Wilmington

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Southeast Region Holds Sixth Annual UTC Conference

NCDOT's Research and Development (R&D) Unit recently participated in the 6th Annual University Transportation Center (UTC) Conference for the Southeastern Region hosted in Clemson, SC. The UTC initiative was first started in 1987, and has been re-authorized several times since then; most recently with the passage of Fixing America's Surface Transportation (FAST) act in 2015. A total of 36 UTCs are currently authorized at three different levels; national (5), regional (10), and tier 1 (21). North Carolina is proud to be host to three different UTCs; the Collaborative Sciences Center for Road Safety at UNC Chapel Hill (national), the Center for Advanced Transportation Mobility at NC A&T (tier 1), and finally, the Center for Advanced Multimodal Mobility Solutions and Education at UNC Charlotte (tier 1).

Each UTC is hosted by one lead university, and is comprised of between two and nine universities in total. In addition to being leads on three UTCs, NC universities are members of two additional ones; the Southeastern Transportation Research, Innovation, Development and Education Center at the University of Florida (regional), and the Mineta Consortium for Transportation Mobility at San Jose State University (tier 1). Each UTC is focused on a different research topic as they relate to transportation research initiatives. Recently completed and currently ongoing research projects were presented on varying topics, including:

- Environmental Analysis in Transportation
    - ◊ Optimizing Airline Recovery after Severe Weather Delays
    - ◊ Changes in Corrosion Rates of Infrastructure Adjacent to Polluted Freshwaters
    - ◊ Analysis of Data from Hurricane Irma and Hurricane Florence Concerning Fuel Shortages
- Connected and Automated Vehicles
    - ◊ Optimizing Freeway Merge Operations
    - ◊ Quantification of Uncertainty from Cyberattack
- Transportation Safety
    - ◊ Evaluation of Low-Cost Countermeasures for Preventing Wrong-Way Driving Incidents
    - ◊ Adolescent Perceptions of Advanced Driver Assistance Systems
    - ◊ Adolescent Attention Development

In addition to the presentations, there were over 50 poster presentations by various graduate students, and a state DOT representative panel to facilitate a Conference wide Q & A session. Three states were represented; North Carolina, Georgia, and South Carolina. Each state discussed their respective successes and challenges moving forward concerning working with state's respective UTCs. The panel answered questions from a wide variety of participants, which worked to strengthen our understanding of the UTC process and its expected outcomes. This UTC Conference was hosted by Clemson's UTC; The Center for Connected Multimodal Mobility.

Steven Bolyard,

Mobility, Safety and Design Engineer

Recently Completed Research Projects

Project Manager: Mustan Kadibhai

RP 2016-03 "Setting Appropriate Benefit/Condition Jumps for Pavement Treatments in PMS": Principal Investigator: Don Chen, Ph.D., University of North Carolina at Charlotte

Background

This research was conducted to determine pavement performance jumps after treatment for the North Carolina Department of Transportation (NCDOT). In this study, the performance jump is defined as the difference between pre-treatment performance values and the post-treatment performance values.

The NCDOT Pavement Management System (PMS) measures the performance of a pavement section in terms of Pavement Condition Rating (PCR), whose value ranges from 0 to 100. A PCR of 100 denotes that the pavement is free of any distresses. NCDOT resets the value of PCR to 100 after a treatment is performed, effectively inducing an improvement of performance. This practice is not invalid since it has been observed in other PMSs as engineering judgment plays a significant role in such systems. However, research has shown that this improvement, or performance jump, depends on a number of factors including the type of treatment applied. This indicates that the post-treatment PCR value might be less than 100.

Setting a different value for the post-treatment PCR value other than 100 will help NCDOT engineers make effective decisions, as the pavement condition can drop to the treatment threshold quicker. For example, a drop from 92 to 60 is quicker than a drop from 100 to 60. Keeping this in mind, the decision makers can recommend the most appropriate pavement preservation strategy based on the treatments being applied and the benefit they provide in terms of performance jump. It will also enable engineers to predict the performance of pavements more accurately using the post-treatment performance curves developed during this study. This is because the deterioration of a pavement section changes once it is treated.

Purpose and Scope

The goal of this research was to determine the performance jumps of the most common types of treatment utilized by the NCDOT. Windshield data was preferred over automated data because the volume of repeated automated measurements of PCR was not sufficient to adequately calculate performance jumps for all families of pavements.

Research Approach

To achieve this goal, the sections with performance jumps were identified and their age reset to zero, and performance models were developed to model the PCR value after treatment. Additionally, after-treatment performance curves were developed. These curves were compared with performance curves before treatment to identify differences in performance. To gain the largest treatment benefit, the ideal pretreatment PCR values were also determined. The data being analyzed included treatment history and pavement condition data based on the windshield survey collection method for asphalt (ASP) and concrete (JCP) pavements.

Findings

- In North Carolina, *AC Construction/Reconstruction*, *Chip Seal*, *Mill + Resurface*, and *Resurface* are the most commonly applied treatments for ASP pavements; and *JCP Construction / Reconstruction*, *JCP Minor Re-*

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habilitation, and *Unbonded Concrete Overlay (UBC)* for JCP pavements.

- Post-treatment ASP performance curves' intercepts are not 100. In descending order, their average values are 92.8, 90.0, 87.8, and 84.6 for *AC Construction/ Reconstruction*, *Resurface*, *Mill + Resurface*, and *Chip Seal*, respectively. This means that an *AC Construction/ Reconstruction* treatment can typically bring a roadway section's PCR value back to 92.8, while a PCR value of 84.6 if *Chip Seal*, a less intensive treatment, is applied instead. The intercept of *Mill + Resurface* should be higher than *Resurface* because it is a more intensive treatment; this needs to be further studied.

- In descending order, average performance jumps of ASP treatments are 28.7, 28.3, 27.9, and 26.0 for *AC Construction/Reconstruction*, *Resurface*, *Mill + Resurface*, and *Chip Seal*, respectively. This means that an *AC Construction/Reconstruction* treatment can typically improve a roadway section's PCR value by 28.7, and so forth. Similar to the previous finding, the order of *Resurface* and *Mill + Resurface* should be reversed, which needs a further study.

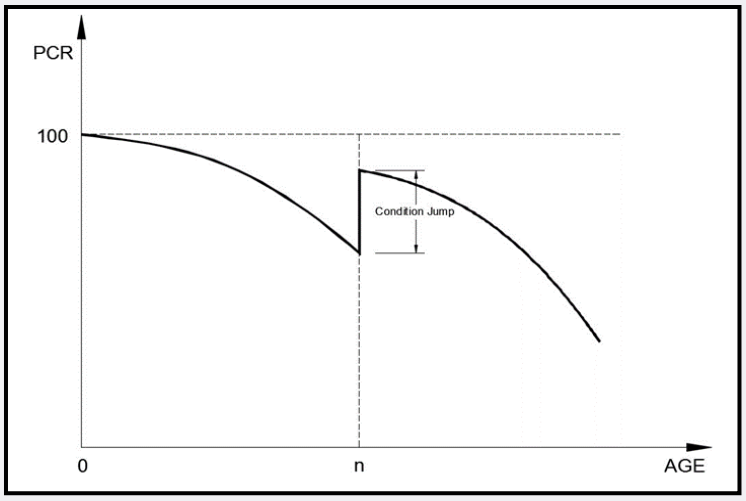

Image: Pavement Performance Curve with a Condition Jump

Recommendations

Based on the findings of this study, recommendations for avenues of further research are listed:

- It is recommended to combine *Mill + Resurface* and *Resurface* data and study their performance in a future study. *Mill + Resurface* is a more intensive treatment than *Resurface*, its performance, according to the results of this study, however, was worse than *Resurface*. It is possible that the decision of using *Mill + Resurface* was made not based on distress severities, but for maintaining geometric and operational features of curb and gutter. Therefore, data of these two treatments probably should be combined and studied again.

- It is recommended to use the average Pre_PCR values determined in this study to define pretreatment conditions for future performance models. Pretreatment condition can significantly impact pavement performance. One way to include pretreatment condition in the performance evaluation process is to include it as a grouping factor when develop performance models. For example, the US 0-5k family can be divided into two sub-families based on Good/ Poor pretreatment condition: US 0-5k /Good and US 0-5k /Poor, and these family models can be developed to more accurately predict pavement performance. In this process, the average Pre_PCR values determined in this study can be used as thresholds to define Good and Poor conditions.

- It is recommended that the influence of other factors associated with treatments be considered. This study focused on the dominant types of treatments applied, and future studies may focus on the materials used in these treatments, the thicknesses of overlays, and the effects of combinations of potential factors.

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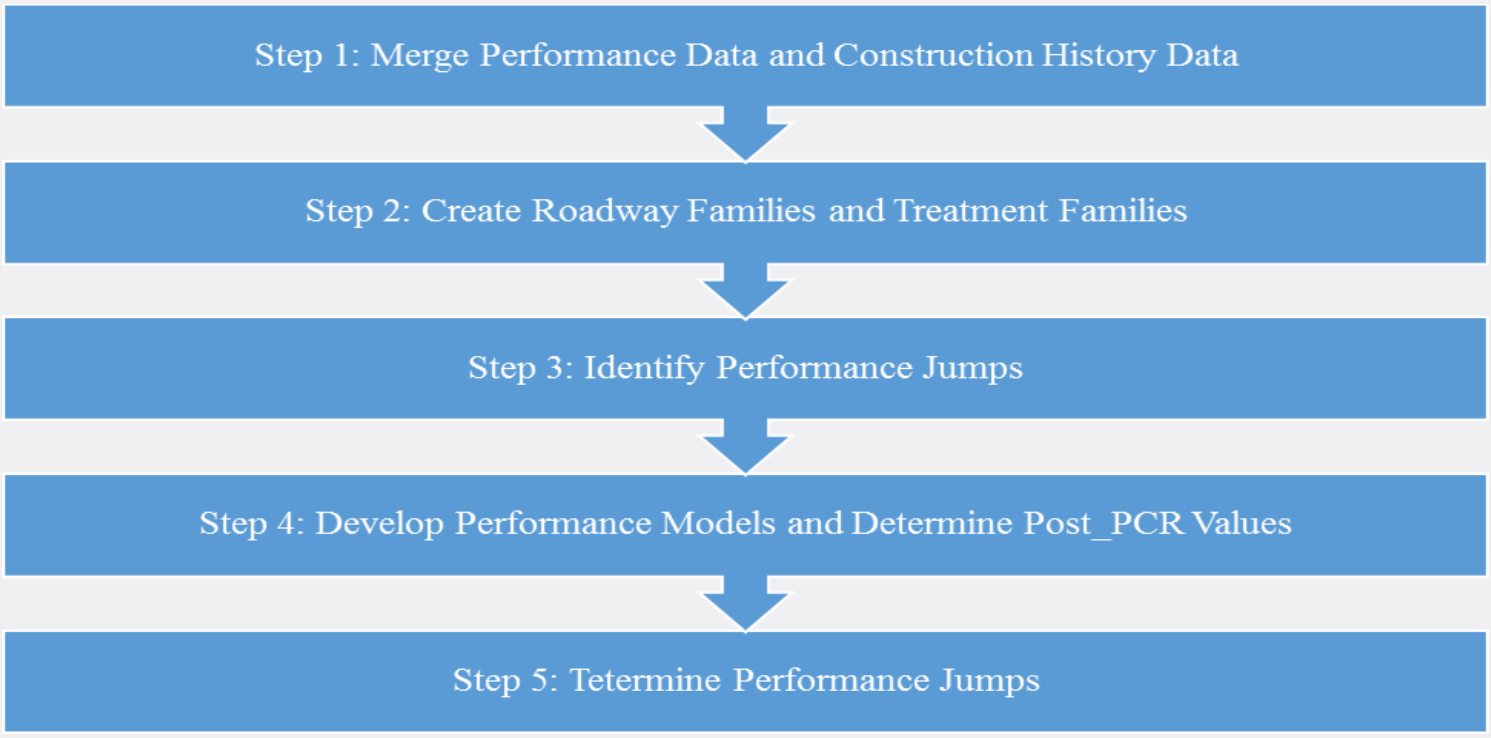
Recently Completed Research Projects (conclusion)



Methodology Flowchart

2018 Wisconsin DOT (WisDOT) Innovation Peer Exchange

NCDOT's Research and Development (R&D) Unit recently participated in Wisconsin's 2018 Research, Development, and Technology Peer Exchange located in Madison, WI. Peer exchanges are required by the Federal Highway Administration (FHWA) for every state to host their own every five (5) years. Each Peer Exchange generally consists of between four (4) to six (6) state DOT representatives, a Transportation Research Board (TRB) representative, as well as FHWA officials from both their local state division office, and the national research office.

The primary philosophy of Peer Exchanges is for each state DOT Research and Development (R&D) program to *"examine and evaluate their own programs through a collaborative team of peers experts, and persons involved in the process, where the exchange of vision, ideas, and best practices could be fostered to benefit both their program and the program of the peer team participants"* – FHWA.

The 2018 Wisconsin DOT Peer Exchange was held September 19-21 with attendance by approximately 15 representatives from TRB, FHWA, Texas DOT, Missouri DOT, Wisconsin DOT, North Carolina DOT, and Kentucky DOT. Each state DOT gave a presentation of their Research, Development, and Technology Program, and how it operates; as well as several high value ongoing and completed research projects from their respective states. Discussing how each state DOT, solicits, selects, values, funds, implements, and quantifies each other's research projects is important to improving our own annual research program.

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2018 Wisconsin DOT (WisDOT) Innovation Peer Exchange (cont.)

The three primary topics for discussion after each state DOT discussed their programs were:

- Managing research as an asset
- The alignment of research with innovation
- Documenting and Communicating Best Management Practices (BMPs) and Successes of Research and Innovation

These three subject areas led to several key takeaways from this Peer Exchange; including :

These three subject areas led to several key takeaways from this Peer Exchange; including:

- The need for better agency-wide innovation promotion
- The need for better quantification of research results,
- A Better effort at targeted marketing and promotion of Research Program project success stories to both internal personnel, and the general public

The group decided that increased visibility of our research programs within each respective state DOT would greatly enhance the quality and quantity of research ideas submitted every year. And that once these ideas are selected and turned into completed projects, creating quick 2-5 minute videos for some of the more prominent projects would be helpful in disseminating the information to both internal and external audiences. The group believes that greater participation in the innovation process from a wider array of participants would result in a greater visibility and understanding of the importance of the research program in general.

Steven Bolyard,

Mobility, Safety and Design Engineer

Librarian's Corner

by Lamara Williams-Jones

Did You Know?

[==========]

- North Carolina has nearly 3,300 miles of main-line railroad track and approximately 5,000 crossings.
- North Carolina has more than 5,000 lane miles of signed on-road bicycle routes, a majority of which can be mapped in the state bicycle route system as shown on www.ncbikeways.com
- North Carolina has 72 publicly owned airports and more than 330 privately owned airports, heliports and other landing areas.
- The Port of Wilmington is strategically located on the East Coast of the United States within 700 miles of more than 70% of the U.S. industrial base.
- Through North Carolina's Adopt-A-Highway Program, about 5,070 volunteer groups have adopted nearly 10,000 miles of state-maintained roadsides that they help clean, saving taxpayers approximately $5 million annually in clean-up costs.

Library Notes

- Come across a resource you need that's not available in our Online Catalog? I may be able to get the item for you via Interlibrary Loan at minimal or no cost to you.
- 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.

New Publications from Transportation Research Board

Critical Issues in Transportation 2018

Transportation Research Board

In this report, which is updated periodically by the TRB Executive Committee, a series of challenging questions are posed to explore issues and opportunities that may arise 10 to 20 years into the future. These questions, 63 in all, have been organized into 12 topic areas and provide a way to frame future areas of research, policy analysis, and debate. Critical issues identified deserve attention because of transportation's central role in serving individuals and society. This document serves to sharpen society's collective understanding of transportation and its ramifications, while informing decisions by individual citizens and officials in both the public and private sectors.

Guidelines for Shielding Bridge Piers

National Cooperative Highway Research Program (NCHRP) Research Report 892:

This report provides proposed load and resistance factor design (LRFD) bridge design pier protection specifications and proposed occupant protection guidelines. Bridge piers are generally close to the roadway to minimize bridge lengths. As a consequence, barriers are normally placed around piers to reduce the potential of vehicle crashes damaging the piers. However, the design and placement of the barriers may not have taken into consideration the possibility that vehicles, particularly large trucks, might still impact the pier. The report also includes four examples that illustrate the use of the proposed specifications and guidelines for shielding bridge piers.

Many more publication links can be found at TRB Publications by Subject

Calendar of Events

December 2018

- **NC DOT Board of Transportation Meeting, December 5-6.**

January 2019

- **NC DOT Board of Transportation Meeting, January 9-10.**
- **Transportation Research Board Annual Meeting, January 13-17, Washington, D.C.**

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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RESEARCH & DEVELOPMENT