WisDOT Research Program

Annual 2023 Report

Foreword

It is my pleasure to present the Wisconsin Department of Transportation (WisDOT) 2023 annual report on research activities. This report highlights WisDOT's efforts to uphold our mission to provide leadership in the development and operation of a safe and efficient transportation system.

WisDOT's Research and Library Services Unit coordinates the department's research activities and provides access to information that leads to data-driven decision making. Over the last year, the team has continued its efforts to align research with the department's strategic priorities; to facilitate and track implementation of research results; to promote the use of emerging technologies; to bolster the department's efforts to improve transportation safety; and to support the adoption of associated policies and procedures to demonstrate accountability to our transportation stakeholders and the public.

WisDOT's award-winning $4.47 million research program funded 57 research projects, completed six Wisconsin Highway Research Program (WHRP) projects, and led two projects funded through the Transportation Pooled Fund (TPF) Program. This year, WisDOT was awarded a 'High Value Research' designation for a TPF project, "Bridge Element Deterioration for Midwest States", by the American Association of State Highway Transportation Officials (AASHTO). The research results provide asset management models for bridge upkeep and repair that will help states reduce the cost of bridge maintenance over time. This project was made possible through strong partnerships with other state DOTs and will be implemented in Wisconsin and other Midwest states.

WisDOT continues to focus on critical transportation policy issues. In federal fiscal year 2023, four research program policy projects were completed focusing on workforce development, data governance, the Disadvantaged Business Enterprise (DBE) program and an evaluation of the department's design-build pilot program.

Research and library staff completed four synthesis reports and 30 literature searches; responded to 331 information requests; and delivered 614 resource items. In federal fiscal year 2023, the department released its new library portal platform, which allows users 24/7 on-demand access to search library collections, view featured and new publications, learn about Wisconsin transportation history and ask library staff for assistance.

I am proud to recognize these accomplishments and would like to thank the many individuals that serve on research committees and panels at the national, state and department levels. Their expertise and guidance are critical to the success and implementation of research.

Craig Thompson, Secretary
Wisconsin Department of Transportation

This is a report of research and technology transfer activities carried out by the Wisconsin Department of Transportation through the Part B research portion of the State Planning and Research Program of the Federal Highway Administration, U.S. Department of Transportation. The report describes activities during Federal Fiscal Year 2023, covering October 1, 2022 through September 30, 2023.

Contents

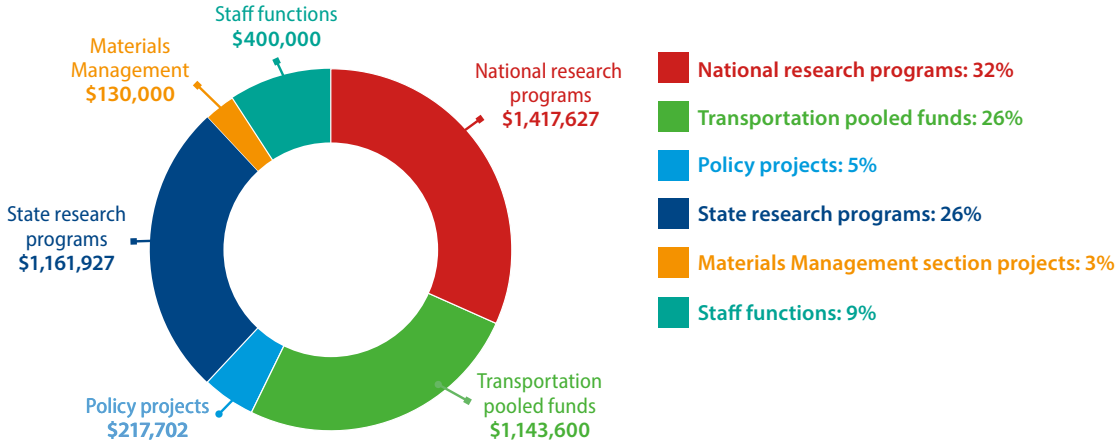
Common acronyms used in this document

AASHTO	American Association of State Highway and Transportation Officials
DBM	(WisDOT) Division of Business Management
DBSI	(WisDOT) Division of Budget and Strategic Initiatives
DMV	(WisDOT) Division of Motor Vehicles
DOT	U.S. Department of Transportation
DSP	(WisDOT) Division of State Patrol
DTIM	(WisDOT) Division of Transportation Investment Management
DTSD	(WisDOT) Division of Transportation System Development
EXEC	(WisDOT) Executive Offices
FFY	Federal Fiscal Year
IPIT	Institute for Physical Infrastructure and Transportation at University of Wisconsin – Milwaukee
FHWA	Federal Highway Administration
MMS	Materials Management Section
NCHRP	National Cooperative Highway Research Program
SPR	State Planning and Research Program
TPF	Transportation Pooled Fund
TRB	Transportation Research Board
TOPS	Traffic Operations and Safety Laboratory at University of Wisconsin - Madison
UW	University of Wisconsin
WHRP	Wisconsin Highway Research Program
WisDOT	Wisconsin Department of Transportation

Program overview

The Wisconsin Department of Transportation (WisDOT) managed a $4.47 million program for research and technology transfer services during federal fiscal year (FFY) 2023. The State Planning and Research Part B (SPR-B) federal program funded 92 percent ($4.09 million) of the program, while state funds covered the remaining eight percent ($0.38 million).

Research program funding



National research

The department participates in national research initiatives through the Transportation Research Board (TRB), National Cooperative Highway Research Program (NCHRP) and American Association of State Highway Transportation Officials (AASHTO) Technical Services Program.

Pooled fund research

The Transportation Pooled Fund (TPF) program allows federal, state and local agencies to combine resources to support transportation research studies of common interest. In FFY 2023, WisDOT research led two pooled fund projects and participated in 41 others. These projects include advances in safety and engineering methods and materials. For a full list of pooled fund projects, see pages 31-32.

Policy projects

The WisDOT Policy Research Program promotes and funds research that addresses planning, operations, safety, finance, economic impacts, environmental issues, emerging technology and other policy aspects of all transportation modes and all agency operations. See page 18-26 for a summary of this year's policy projects.

State research

The Wisconsin Highway Research Program (WHRP), established in 1998 by WisDOT in collaboration with the University of Wisconsin–Madison, aims to better design, build, and reconstruct the state's transportation system. The four areas of focus include geotechnics, structures, flexible and rigid pavements. See page 29 for all completed and in-progress projects.

Materials Management projects

Funds for WisDOT's Materials Management Section (MMS) internal projects, including the investigation and implementation of new materials and methods conducted at WisDOT's own MMS lab.

Staff functions

Efficient management of transportation knowledge and research findings contributes to continuous improvement. The Research and Library team conducts technology transfer activities and provides library services to coordinate dissemination of research recommendations to enhance operations within the department.

Completed Research Briefs

Quality Testing of Wisconsin Aggregates

Research Objectives

- Investigate the feasibility of implementing coarse aggregates (CA) soundness testing based on AASHTO T 103 or WisDOT Modified AASHTO T 103 procedures
- Understand the accuracy of the existing soundness procedures
- Recommend CA acceptance thresholds for Wisconsin aggregates used in base course, HMA pavement and PCC pavement regarding freeze-thaw durability

Research Benefits

- Improved specifications for coarse aggregate quality
- More accurate determination of the soundness of coarse aggregates
- Quality of coarse aggregates directly impacts long-term durability of Wisconsin pavements

Principal Investigator

Hani H. Titi, PhD, PE, M.ASCE
University of Wisconsin-Milwaukee
hanititi@uwm.edu

Project Manager

Erik Lyngdal, PE
Wisconsin DOT
erik.lyngdal@dot.wi.gov

Background

Various types of aggregates are used annually in Wisconsin for road- and bridge-related construction projects. Aggregates are important parts of base course and pavement surface layers in hot mix asphalt (HMA) and Portland Cement Concrete (PCC) pavements. As such, the long-term durability of pavements can be directly impacted by the quality of aggregates used. An internal audit of WisDOT specifications concluded that the frequency of testing for quality is less relative to surrounding states, which is due in part to higher-quality aggregate available to contractors in Wisconsin.

Despite this availability, localized pavement performance issues have raised concerns about the effectiveness of the current quality testing program and led to the need to improve specifications for aggregate quality. The main objective of this research project was to investigate the feasibility of implementing coarse aggregates (CA) soundness testing based on AASHTO T 103 or WisDOT Modified AASHTO T 103 test procedures. To accomplish this goal, a better understanding of the current soundness testing procedures is needed with respect to Wisconsin CA performance and use.

Before statewide implementation of AASHTO T 103, new limitations need to be selected for each aggregate application: base course, HMA pavement and PCC pavement.

Methodology

Coarse aggregate samples were collected for laboratory testing and evaluation from 34 sources (quarries and pits) consisting of different rock formations and various classifications. The laboratory testing included measurements of specific gravity, absorption, and vacuum absorption, sodium sulfate soundness (SSS), and freeze-thaw (F-T) tests. Additionally, the influence of the following on the test results was investigated: test type, F-T test equipment, test laboratory, test repeatability, number of wetting/drying cycles, number of F-T cycles, absorption, aggregate source, aggregate size fraction, and aggregate classification.

To investigate the influence of the CA quality on F-T durability of PCC in pavements, PCC test cylinders were made and exposed to rapid F-T tests as well as evaluations of the static and dynamic moduli up to 300 F-T cycles. PCC testing included ASTM C666, ASTM C215, ASTM C597, ASTM C39 and ASTM C856.

Additionally, field investigation including coring, pavement distress survey, and pavement condition evaluation using the WisDOT pavement management database were conducted to quantify the

"Results of this research validated WisDOT's belief in AASHTO T 103 as the best test procedure to indicate freeze-thaw durability. WisDOT will be expanding use of T 103 through the aggregate source approval program"

– Erik Lyngdal, WisDOT

Interested in finding out more?

Final report is available at: WisDOT Research website

effect of CA on PCC pavement durability and performance. Professional petrographic analysis was performed on the PCC cylinders and pavement surface cores.

Photos of PCC cylinders during F-T cycles showing the effect that CA quality had on the cylinders. Photos show CA fracture, PCC surface scaling and CA initiated cracking in the PCC cylinder surface, respectively.

Results

Test results showed there is no typical SSS vs F-T relationship. CA absorption is an influencing factor of F-T durability, but mixed results were also observed when considering carbonates (calcareous vs dolomitic limestone). Results also showed that different CA classifications exhibited different F-T results due to the variability in the CA size fractions.

PCC F-T performance evaluation showed that PCC exposed to F-T at younger age will exhibit larger deterioration and loss of elastic modulus. Field investigation showed that low and medium severity durability cracking, PCC pavement surface pitting/popouts exist on the investigated PCC pavements in Wisconsin, but not to a great extent. A comprehensive analysis of the test data and other subsets indicated that approximately 7% of CA tested in Wisconsin failed the 12% total mass loss threshold in the SSS currently specified by WisDOT for CA used in PCC acceptance and the 18% threshold for dense graded base layers.

Recommendations for implementation

The research team recommends the following:

- Implement the WisDOT Modified AASHTO T 103 for CA durability evaluation.
- Require more frequent F-T testing for CA from rock formations with calcareous and dolomitic limestone.
- When the rock formation changes in a quarry, WisDOT should be notified, and samples should be evaluated.
- Different specifications for coarse aggregate acceptance can be implemented based on the source type, aggregate classification, and use in high-value projects.

This brief summarizes Project 0092-20-05,
"Quality Testing of Wisconsin Aggregates"
Wisconsin Highway Research Program

Completed Research Brief

Wisconsin Highway Research Program
Project 0092-21-02
April 2023

Optimizing Bridge Abutment Slope Protection at Stream Crossings

Research Objectives

- Develop guidance for identifying bridge site conditions corresponding to performance issues associated with the WisDOT standard slope protection.
- Develop guidance for alternative slope protection for problematic bridge slope locations with life-cycle cost considerations.

Research Benefits

- Greater understanding of the causes of slope failure at over-water bridge abutments
- Evaluation of current WisDOT practices helps to identify ways to mitigate slope failure in the future

Principal Investigator

James Hambleton
Northwestern University
jphambleton@northwestern.edu

Project Manager

Steve Neary
Wisconsin Dept. of Transportation
steven.neary@dot.wi.gov

Background

The Wisconsin Department of Transportation (WisDOT) is concerned with persistent slope movement at over-water bridge abutments. Repair alternatives are costly, and low clearance beneath bridge decks makes replacing riprap beneath an existing bridge very difficult. In addition, repairs can interrupt traffic for material and equipment delivery. Slope flattening may provide better protection; however, it requires additional bridge length, increasing structure costs. The current standard method of slope protection at these crossings uses heavy riprap on top of heavyweight geotextile fabric at a 1.5:1 (H:V) slope.

The goals of this project were to develop guidance for identifying site conditions at over-water bridges which correspond to performance issues associated with WisDOT's standard method for slope protection, and to develop guidance for alternative protection methods at problematic sites, considering life-cycle costs. An initial hypothesis of scour-related concerns was abandoned, and creeping movement was identified as the most likely cause of loss of slope protection in most cases.

Methodology

Synthesis of current research and literature, as well as a review of relevant specifications, was performed. This work summarized knowledge for the evaluation of causes and countermeasures for abutment protection for bridges at stream crossings. Next, identification of Wisconsin bridges with heavy riprap slope failure was undertaken with the goal of documenting and quantifying the conditions which may have led to this failure. A survey was conducted regarding the use of various slope failure countermeasures and their relative success in the upper Midwest. Site visits were completed for a selection of bridges in Wisconsin with measurable slope movement. Results from these visits prompted researchers to change their initial presumption that slope failure was caused by hydraulic scour. Instead, researchers modified the research approach to creeping (gradual) slope movement, which was more consistent with failure beginning at the top or middle of the abutment slope, rather than the bottom.

"Abutment slope repair is a recurring nuisance for WisDOT maintenance personnel. This research provides methods to reduce future maintenance costs at stream crossing bridges."
– Steve Neary, WisDOT

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Final report is available at: WisDOT Research website

Photos of an abutment and a close-up of erosion along the abutment

Results

Results indicate little need for expansive revisions to current design guidelines. Suggested modifications assert the importance of quality fill, adequate drainage, and compliance to specifications in construction. When free-draining, compactable soils are not available, slopes of 2:1 should be considered. Considering the number of 1.5:1 over-water bridges, it also appears that the criteria for flattening may be underestimating sites of concern.

Recommendations for implementation

The research team suggests proposed revisions to Section 15.2 of the WisDOT Bridge Manual language to include an explicit statement about the possibility of movement at the surface for 1.5:1 (H:V) slopes. Additionally, the team recommends modifying the criteria for flattening over-water bridges by a sufficient amount to increase the design cases by roughly 2%, which may mitigate the current rate of slope failure. Further, the research team suggests changes to the typical remediation of exposed abutment piles. Instead of using a flowable concrete slurry to plug gaps under exposed abutments, which adds considerable weight to the abutment slope, it is recommended that an expanding foam or similar lightweight material be used as standard practice.

This brief summarizes Project 0092-21-02,
"Optimizing Bridge Abutment Slope Protection at Stream Crossings"
Wisconsin Highway Research Program

Completed Research Brief

Wisconsin Highway Research Program
Project 0092-21-03
October 2023

Evaluating the Impact of Anti-Icing Solutions on Concrete Durability

Research Objectives

- Quantify the impact of applied anti-icing solutions on dry concrete surfaces
- Recommend countermeasures to reduce adverse impacts on concrete pavement and bridge deck durability

Research Benefits

- Determine long-term impacts of anti-icing solutions on Wisconsin roads
- Address concerns regarding possible chloride ingress to concrete
- Establish recommendations for future use of anti-icing solutions on Wisconsin roadways

Principal Investigator

Danny Xiao
University of Wisconsin - Platteville
xiaoxi@dot.wi.gov

Project Manager

Tirupan Mandal
WisDOT
tirupan.mandal@dot.wi.gov

Background

Deicing is a snow and ice control strategy of removing compacted snow or ice already bonded to a pavement surface by chemical and/or mechanical means. Anti-icing is a snow and ice control strategy of preventing the formation or development of bonded snow and ice to a pavement surface by applications of a chemical freezing-point depressant before, or in the early stage of, a winter weather event.

Many laboratory studies and field evaluations have been conducted proving the benefits of anti-icing. However, it is also proven that deicing and anti-icing materials cause damage to concrete infrastructure through deterioration of the concrete paste or corrosion of the reinforcing steel.

As anti-icing becomes more popular in Wisconsin, there are concerns that the direct application of anti-icing solutions to pavement may result in much higher anti-icing agent ingress to concrete compared to traditional deicing methods where rock salt is applied to a wet, saturated concrete surface. The penetration of anti-icing solutions may impact long-term durability of the concrete.

Methodology

Three different methods were used to achieve the research objectives. First, researchers conducted a series of tests in controlled environments to compare the damage from deicing and anti-icing on typical Wisconsin concrete. Another method was an analysis of pavement and bridge management system data. Historical performance data of Wisconsin pavements and winter records were analyzed for any correlation between increased use of anti-icing chemicals and damage to concrete infrastructure.
The research team also conducted an accelerated field study at MnROAD where concrete panels from a Wisconsin project were placed and anti-icing and live traffic were applied from 2021-2023. Researchers hypothesized that the hydrostatic pressure from tire load in the field test would lead to more penetration of anti-icing chemicals, causing more damage to the concrete.

Results

Laboratory test results proved that the high-quality Wisconsin concrete mixture exhibited very good freeze-thaw performance. The anti-iced concrete samples had roughly half the amount of material loss from surface scaling as the deiced concrete samples.

"The results of this study show that current WisDOT practice is using 50% less salt with anti-icing and the salt's penetration into concrete has reduced by up to 50%. This is not only beneficial for the environment, but also helps in increasing the lifespan of concrete pavements in Wisconsin."

–Tirupan Mandal, WisDOT

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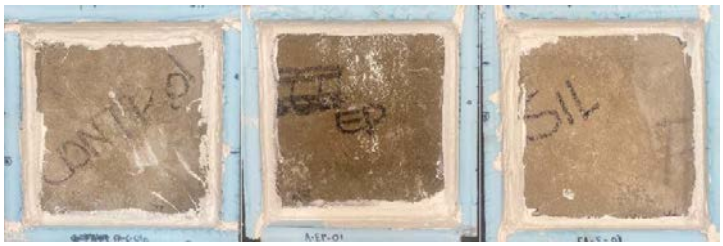
WisDOT Research website



Deicer scaling specimens before testing
(from left to right: A-FA Control, A Epoxy, A-FA Silane)

Deicer scaling specimens after 50 cycles

Silane surface treatment provided a significant reduction in chloride penetration of around 50% for most conditions and epoxy effectively blocking chlorides low to no chloride penetration into concrete.

Additionally, similar results occurred for the chloride content. Anti-icing uses less salt than deicing, and anti-icing had a similar amount of chloride runoff with deicing, hence less chloride retained in concrete. Therefore, the stated concern of anti-icing possibly leading to more chloride ingress to concrete is unfounded.

However, results from the field study showed the effect from traffic loads and in all cases confirmed the hypothesis that tire pressure greatly increases the ingress of chloride to concrete.

Recommendations for implementation

Based on the results, the research team recommends WisDOT continues the increased use of liquid brine by assisting more counties and municipalities with mixing equipment, storage facilities, tank trucks, staff training and other resources.

Furthermore, current policies on deicing and anti-icing application should be updated based on recent studies such as Clear Roads Project 19-01, and applying protective surface treatment to bridge decks should be continued to extend the service life of the bridge.

This brief summarizes Project 0092-21-03,
"Evaluating the Impact of Anti-Icing Solutions on Concrete Durability"
Wisconsin Highway Research Program

Completed Research Brief

Wisconsin Highway Research Program
Project 0092-21-04
March 2023

Interlayer Mixture Design

Research Objective

- Develop an alternative method for accepting interlayer mixture designs without the bending beam fatigue test.

Research Benefits

- A substantial financial savings during flexural fatigue testing
- With the proposed specification, it would be possible to do quality control and acceptance testing on IMDs using the IDEAL-CT

Principal Investigator

Don Christensen
Advanced Asphalt Technologies
dwcaat@hotmail.com

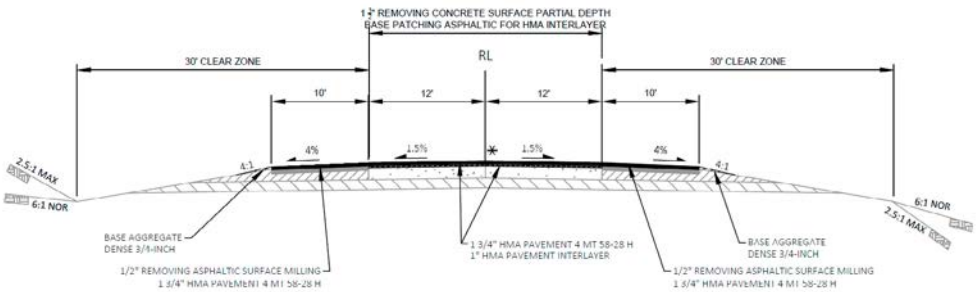
Project Manager

Tirupan Mandal
WisDOT
tirupan.mandal@dot.wi.gov

Background

The objective of this research project was to develop an alternative method for accepting interlayer mixture designs (IMDs) without the bending beam fatigue test. Mixtures accepted that use other means are expected to maintain the same level of quality that the beam fatigue test provides.

The problem addressed in this research is that the flexural fatigue testing currently used in accepting interlayer mixture designs is expensive and time-consuming. It would be very desirable if a simpler method for reliably ensuring the fatigue performance of IMDs could be developed and implemented in Wisconsin.



Typical Structure of a Wisconsin Pavement Including an IMD Layer

Methodology

The research approach involved producing 15 different mixtures, most meeting the basic binder and aggregate requirements of the IMD specification. However, a range in fatigue performance was needed to evaluate any method for predicting or controlling fatigue life. Some binders were therefore selected which would produce fatigue performance lower than needed for IMDs.

Six different asphalt binders were used in the project—five of them were from Wisconsin and typical of modified binders used in the state. These binders were differentiated by a range of tests that could potentially help to characterize fatigue performance, including dynamic modulus, double edge notched tension (DENT), elastic recovery from the multiple stress creep and recovery (MSCR) test, and the binder yield energy test.

Mixture tests used in the project as surrogates for fatigue included the Texas Overlay Test and the Ideal Cracking Test (IDEAL-CT) procedure. However, it was discovered early on that the overlay test was unable to discriminate between the performance of the IMDs because all mixes passed the test with very little reduction in stiffness.

"Deliverables from this research will now allow WisDOT to test and accept interlayer mix designs in-house that will involve an alternative, simple test method."
– Tirupan Mandal, WisDOT

Interested in finding out more?

Final report is available at:
WisDOT Research website

Results

Using the data produced through these tests, statistical analyses were performed to develop an accurate and simple model that could serve as a basis for a revised, simpler IMD fatigue specification. This model predicts IMD cycles to failure based upon binder G* at 20ºC and mixture CTindex at 20ºC (from the IDEAL-CT). The r2 for this model, at 95%, suggests the model is accurate enough to serve as the basis for an IMD fatigue specification. However, it was found that binder low temperature grade was highly correlated to binder G* at 20°C. (r2 = 92 %), so that IMD stiffness can be effectively controlled through the existing binder specification. The resulting recommended limits are a maximum binder low temperature grade of -34°C and a minimum mixture CTindex of 140 (after short-term oven aging). The IDEAL-CT mixture test is a simple procedure using a Marshall testing press to perform an indirect tension test at 20°C.

The cost of this procedure is about a quarter of that of the existing mixture test for IMDs—flexural fatigue testing. The proposed specification represents a savings of about $3,200 per IMD to producers, contractors, and the State of Wisconsin.

Recommendations for implementation

Based on the testing and analysis done as part of this research project, the researchers recommend the following:

- To ensure that IMDs have a fatigue life meeting or exceeding 100,000 cycles, binders for IMDs should meet a low temperature grade no higher than -34°C (RTFOT/PAV aging), and a minimum elastic recovery (AASHTO M 332) as specified within the final report.
- IMD mixtures should have a CTindex of at least 140 at 20ºC and a loading rate of 50 mm/min, following the procedure given in Appendix A of NCHRP Ideal Report 195.
- The current STSP for Interlayer Pavements should be modified per standards specified in the final report.
- Final recommendations on allowable ΔTc values for binders used in IMDs should be made after the WHRP project (ID 0092-23-01) on this topic is completed and the results reviewed for their implications for IMDs.

This brief summarizes Project 0092-21-04,
"Interlayer Mixture Design"
Wisconsin Highway Research Program

Geotechnical Asset Management for Slopes

Research Objectives

- Develop a GAM for slopes framework to better understand potential slope failure along highways
- Create a GIS-based slope failure susceptibility model that identifies key risk factors for slope failures and is flexible for use statewide

Research Benefits

- This project identifies a method to leverage readily available data to help WisDOT engineers and officials better understand slope failure susceptibility and make informed decisions regarding project prioritization and planning

Principal Investigator

Scott Anderson
BGC Engineering USA, Inc.
scanderson@bgcengineering.com

Project Manager

David Staab
WisDOT
david.staab@dot.wi.gov

Background

Slopes along highway corridors are geotechnical assets that need different tools and procedures to be managed compared to other asset classes. Due to natural variability, large geographical extent and difficulty accessing slopes, efficiently characterizing the condition and failure susceptibility of these slopes is difficult. The goal of this project was the development of a Geographic Information System (GIS)-based Geotechnical Asset Management (GAM) process in which a model can efficiently characterize slope failure susceptibility. To accomplish this task, researchers evaluated historic slope instability events and public and WisDOT data to build a model that statistically identifies key attributes associated with up-slope (cut slope) failures along a section of Wisconsin State Highway 35 (WIS 35) in Crawford County. The model was also informed and verified through field mapping observations.

The resulting model characterizes slope failure susceptibility along the WIS 35 corridor. With appropriate adjustments to account for geographic differences affecting slope instability, the GAM framework and model can potentially be expanded across Wisconsin to provide WisDOT engineers and management with additional information to better prioritize and plan future projects and maintenance efforts.

Methodology

The model developed for this project uses an inventory of known slope failures within the WIS 35 study corridor along with geometric inputs taken from aerial LiDAR data and geological data from field mapping and published sources to inform a weights of evidence calculation of slope failure susceptibility for any segment of highway within the study corridor. Based on information provided by WisDOT and field verification, the researchers interpreted that past failures were fundamentally similar enough to be grouped together statistically. The documented slope failures tended to be governed by slope geometry, the geologic materials of the slope such as the inherent strength of the rock mass and soils, and proximity of those slopes to the highway. Geologic materials were mapped at an outcrop scale and a GIS-based analytical model was developed that extracted the geometric parameters of adjacent slopes in an automated way. The data extraction methods and principles applied to the susceptibility calculation are generic and can be deployed anywhere in the state. However, the weights of evidence found from the geology and topography combined with the records of past failure is unique to the region, in this case, the Driftless Area.

"The GAM framework and model developed during this project is an efficient way to use existing data to provide high-level evaluation of slopes along our highways to potentially identify areas of concern and prioritize use of limited resources."

– David Staab, WisDOT

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Final report is available at: WisDOT Research website

Representative photos for each of the three hazard mechanisms identified along the study corridor (A. Rockfall B. Fragmental rockfall and rockslides C. Shallow colluvial slides). Photos from BCG Engineering.

Results

The main project output is a slope-failure susceptibility model and GIS map that categorizes the study corridor slopes based on factors statistically correlated to slope instability. The model can be used within a GAM framework to provide WisDOT with additional information to prioritize and plan future projects and maintenance efforts. For example, the model can help manage the slope asset class by identifying high susceptibility corridor segments, including where failure has not yet occurred. In other words, it is not simply an event-based inventory. Proactive inspection and mitigation of high susceptibility slopes is similar to asset preservation activities for other asset classes and helps WisDOT manage risk and achieve its performance objectives of safe, reliable corridors at low life-cycle cost.

Additional work could measure the costs and benefits associated with different scenarios, enabling WisDOT to make informed decisions regarding future efforts on the areas with the greatest risk or largest benefit. Similar susceptibility maps could be developed for other parts of the state. Adopting a GIS-based system to methodically track slope conditions and events statewide would provide WisDOT an opportunity to expand its knowledge of threats from natural hazards and deteriorating assets in a way that builds upon event history but is not limited by it.

Recommendations for implementation

As part of the research the following recommendations are suggested for future applications of the model:

- Expansion of the shallow slope failure susceptibility model within the Driftless Area of Wisconsin
- Development of an embankment (down-slope or fill slope) failure susceptibility model
- Creation and implementation of statewide landslide susceptibility mapping

This brief summarizes Project 0092-21-06,
"Geotechnical Asset Management for Slopes"
Wisconsin Highway Research Program

Completed Research Brief

Wisconsin Highway Research Program
Project 0092-22-01
January 2024

Improving Bridge Concrete Overlay Performance

Research Objectives

- Evaluate, identify and mitigate causes of cracking in low-slump concrete overlays for bridge decks
- Provide guidance for maintaining low-slump concrete overlays and recommend changes

Research Benefits

- Substantially reduce or eliminate incidents of cracking while restoring high-performing, low-slump concrete overlays
- Review best practices and investigate potential alternative overlay types

Principal Investigator

Habib Tabatabai
University of Wisconsin - Milwaukee
ht@uwm.edu

Project Manager

James Luebke
WisDOT
james.luebke@dot.wi.gov

Background

Long-term exposure to deicing salts and reinforcing bar corrosion can lead to significant distress in deck slabs after roughly 40 to 60 years of service. Concrete overlays are commonly used on bridge decks to extend the service life of the deck when signs of distress become evident. This practice has successfully extended the service life of the bridge deck and postponed the more costly but eventual deck replacement. Even though the concrete mix design and placement procedures have not changed over time, extensive cracking of the overlays has been noted in recent years in states across the country. This study reviewed experiences and best practices of other states' concrete overlays and conducted laboratory studies to evaluate and determine the appropriate concrete overlay systems for Wisconsin.

Methodology

As part of this study, a comprehensive online survey of bridge deck concrete overlay performance was performed. Twenty-four responses from eleven states were received. Then, an experimental research program was initiated to study the causes of cracking in concrete overlays.

These included calorimetry tests to evaluate heat of hydration, ring tests to assess restrained shrinkage, field slab tests to evaluate cracking potential under realistic environmental conditions, salt ponding tests to evaluate chloride penetration, and dog bone restraint tests (a new test) to assess the effect of various curing procedures on cracking potential in concrete. Seven different mix designs (variants of the current WisDOT Grade E mix) were tested.

Results

Test results showed that all seven mix designs exhibited very high strengths with values ranging from 7700 to 11000 psi. Addition of 1.5 lb/cy of PVA fiber to the mixes with or without the reduction of cement content resulted in higher compressive strengths. The latex modified concrete had the lowest compressive strength of all mixes, but still exhibited a high strength. The calorimetry tests indicated that the new Type IL cement can generate higher peaks of heat flow compared to the Type I cement. The reduction of cement content (i.e., increasing the water-cement ratio from 0.36 to 0.5) resulted in reduced heat flow for both IL and I samples. Finally, replacing cement with fly ash resulted in progressively smaller heat flow peaks.

The salt ponding test results indicated that the latex modified concrete had the lowest chloride content. The reduction in cement content or

"This research helps WisDOT better understand the causes for concrete overlay cracking and provides several strategies for improving their performance."
–James Luebke, WisDOT

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addition of fly ash did not increase the chloride content. The ring tests reveal trends in the development of restraint strains in various mixes, including the current WisDOT Grade E mix. The dog bone tests established that wet curing with presoaked burlap and covered with polyethylene sheathing is a better curing procedure when compared with covering the concrete with plastic sheathing alone. The field slab tests indicate that Grade E mix with Type I cement developed an early crack which grew with time.

Placement of overlay using double vibrating screed.

Recommendations for Implementation

Based on the tests involved with this study, the research team makes the following recommendations:

- Place concrete overlays when the deck slab has not deteriorated significantly. Overlays are meant to extend the service life of the bridge deck. Overlays cannot do that if the substrate (bridge deck) is highly contaminated with chlorides, and the reinforcing bars are corroding.
- Reduce Grade E cement by 15%-20% and replace with fly ash when practical. Recent shortages of fly ash and the long-term trends in reducing coal-based power may require alternate solutions.
- Allow 7-14 days for curing with pre-soaked wet burlap covered in polyethylene sheathing. The current WisDOT provision for curing is three days but tests show the benefits of a longer curing time.
- Full- and partial-depth patch repairs should be performed before placing the overlay. While not tested in this research, it is anticipated that simultaneous casting of the patch areas and the overlay may increase restraint stresses due to apparent "shear key" effect.

WisDOT Research Program

2023

Policy Research Program Reports

Maximization of Disadvantaged Business Enterprise (DBE) Participation

Research Objectives

- Maximize participation of Wisconsin (DBE) owners and firms in federally funded construction and professional service contracts awarded through WisDOT
- Identify and remove barriers for eligible DBEs

Research Benefits

- Provides an opportunity to learn from the best practices of DBE programs in other states
- The research provided recommendations, which if implemented, could place WisDOT as the national leader in developing successful DBEs who will significantly contribute to the economic development and growth of the state and the region

Principal Investigator

Al Ghorbanpoor
University of Wisconsin - Milwaukee
algh@uwm.edu

Project Manager

Madalena Maestri
WisDOT
madalena.maestri@dot.wi.gov

Background

The Disadvantaged Business Enterprise (DBE) program provides opportunities for companies operated by socially and economically disadvantaged persons to participate in federally assisted highway contracts. As a recipient of USDOT funds, WisDOT is required to develop, implement and maintain a DBE program. WisDOT has been a national leader in offering a wide array of support services to DBEs and has met most of the program goals over the last several years.

However, a prevalent shortage of qualified DBEs and disparities in the number and size of contract awards to DBEs presents an opportunity to review WisDOT's DBE program to streamline the operation, and look at ways to maximize DBEs' participation in federally funded transportation projects by removing barriers to success for new, existing and prospective DBE businesses.

Methodology

The research team conducted a series of surveys, telephone conversations, and interviews with staff from various state DOTs, prime contractors and consultants, and construction industry leaders. The research team also surveyed Wisconsin DBE firms to get a better understanding of their experiences and the barriers they have faced, and a more in-depth view of their experiences managing their businesses. Researchers analyzed and gathered data to reach conclusions on the state of the DBE program operation in Wisconsin. They also reviewed all publicly available DBE Disparity Studies conducted by other state DOTs. The research team assessed the strengths, weaknesses, opportunities, and threats (SWOT) for WisDOT's DBE program using input from a variety of stakeholders and findings from a review of program information and data.

Results

Researchers found that WisDOT has met most of its DBE goals over the last several years and is ranked among the top one-third of the states.

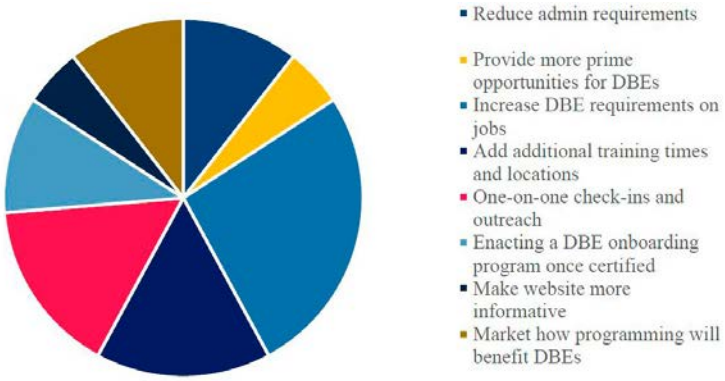
Survey responses from DBE firms indicate that overall, DBEs view WisDOT's DBE program and support services as helpful and effective. Some firms feel more could be done to improve outcomes including increasing DBE requirements on jobs, adding additional training times and locations, and one-on-one check-ins and outreach to strengthen WisDOT's relationship with DBEs and promote how programming will benefit DBEs. Researchers determined that the shortage of qualified DBEs in the state ultimately impedes the progress of the highway construction industry and could be caused by several barriers.

"This research highlights the progress made in WisDOT's DBE program over the last few years and points to where we still have room to grow in serving and supporting DBE firms.

The technical training and business building pilot shows promise of being a very effective scaffolding tool for increasing DBE efficacy and growth."

–Madalena Maestri, WisDOT

Interested in finding out more? Visit:
WisDOT Research website



Initiatives to enhance DBE participation as identified by DBEs.

These barriers include a lack of business and management acumen, access to capital/bonding/insurance, adequate financial and human capacity and opportunities for strategic and professional networking.

Recommendations for Implementation

Researchers outlined several recommendations for improving WisDOT's DBE program:

- Develop a strategic plan for DBE operations and offer education and training opportunities to different DBE types
- Re-evaluate and review DBE contract award policies to assist existing DBEs and help develop new qualified firms
- Encourage and incentivize DBEs to take advantage of educational and training opportunities and offer professional education development (PED) credits for completion
- Address concerns raised by many stakeholders on awarding a highly disproportionate level of DBE contracts to Caucasian (white female) owners

The research team also propose developing a pilot training and onboarding program for DBEs. Training would focus on preparing participating DBEs to remove deficiencies, build capacity, and successfully submit competitive quotes and bids. Onboarding training would offer guidance and education to enable DBEs to successfully complete contract tasks and meet contractual obligations.

This brief summarizes Project 0092-22-67,
"Maximization of Disadvantaged Business Enterprise Participation"
Policy Research Program

Pilot Design-Build Program Evaluation

Research Objectives

- Evaluate WisDOT pilot program for design-build project delivery
- Determine best practices for alternative delivery of projects

Research Benefits

- Allows WisDOT to develop and refine policies and processes based on other states' experiences
- Can inform future alternative delivery efforts on WisDOT projects

Principal Investigators

Dr. Xiao Qin
University of Wisconsin – Milwaukee, IPIT Director
qinx@uwm.edu

Mark Gottlieb
University of Wisconsin – Milwaukee, IPIT Associate Director
markgott@uwm.edu

Project Manager

Ben Thompson
WisDOT
benjamin.thompson@dot.wi.gov

Background

Historically, apart from a very limited number of specifically authorized exceptions, WisDOT has been required to utilize the design-bid-build method of project delivery. Over the years, several studies have been undertaken, and proposals made, to expand the department's authority to utilize alternative methods of project delivery, including design-build.

Rather than separate design and construction contracts, which is typical under traditional design-bid-build delivery, design-build delivery generally requires just one contract with a design-build team to provide both design and construction services. The goal of alternative methods of project delivery is to improve the cost-effectiveness, efficiency, quality and schedule of highway and bridge projects.

Under legislation adopted in 2019, WisDOT is authorized to award up to six highway or bridge projects under one of three delivery methods: low-bid, best-value, and fixed-price design build. WisDOT is required to administer at least one of each of the three subtypes, with maximum costs of $75 million for best-value and fixed price, and $25 million for low-bid.

Methodology

To achieve the project objectives, the University of Wisconsin – Milwaukee's Institute for Physical Infrastructure and Transportation (IPIT) team acquired data from WisDOT documentation, conducted a national review of available literature, peer-state interviews, and interviews with design-build teams that submitted statements of qualification or proposals for the first three pilot projects.

WisDOT selected the three projects and assigned their delivery methods based on schedule, programmed cost, environmental constraints, and their potential for innovation as determined in their risk analysis. The three projects are identified below:

- US 45 – Construction/replacement of eight miles of pavement (low-bid design-build)
- WIS 125 – Removal of multi-cell box culvert and replacement with slab span structure (best-value design-build)
- WIS 130 – Bridge replacement (best-value design-build)

A review was conducted of each of the pilot projects. Each review consisted of a project overview and summary of the qualification and proposal phases of the procurement. This included a review of documents related to these processes, as well as summaries of the

"The Pilot Design-Build Program Evaluation Report has enabled WisDOT to take a critical look at the procurement processes for our first three design-build projects. The report gives WisDOT important feedback and recommendations for improvements to the design-build process as procurement for future projects."

– Ben Thompson, WisDOT

Interested in finding out more?

Final report is available at: WisDOT Research website

interviews with the proposing teams. Interviews were conducted with successful and unsuccessful proposing teams, and with WisDOT project staff.

Results

Based on a review of the available data, the IPIT researchers concluded that the procurement process for the three projects conformed to the requirements of state statutes, federal regulations, and the draft WisDOT Design-Build Manual for alternative delivery. However, they found that while US 45 was an appropriate choice for the low-bid design-build pilot, it failed to generate enough competitive interest. And being a low-cost project with limited opportunity for innovations, WIS 125 may have been too small and not complex enough to fully benefit from best-value design-build.

Recommendations for Implementation

The IPIT research team provided a total of 17 recommendations for possible improvement divided into four categories: program organization and administration, project selection, qualification and proposal phase, and miscellaneous recommendations. A cross section of the recommendations is provided below:

- Strengthen staffing and internal training
- Increase minimum cost to consider project for design-build
- Consider one-step procurement for non-complex, no-bid design-build projects (would require legislative approval)
- Increase the minimum number of qualified teams solicited to submit proposals
- Adapt the public information process to fit the different characteristics of design-build

This brief summarizes Project 0092-22-68,
"Pilot Design-Build Program Evaluation"
Policy Research Program

WisDOT Skills Readiness and Knowledge Management

Research Objectives

- Understand and analyze the nature of gaps in skills needed for job performance
- Assess current status of knowledge management and practices at WisDOT to offer recommendations

Research Benefits

- Provide a strong foundation for WisDOT to build upon and position the agency for future success
- Identify areas of needed improvement to strengthen WisDOT's knowledge and skills base

Principal Investigator

Romila Singh
University of Wisconsin - Milwaukee
romila@uwm.edu

Project Manager

Hannah Brown
WisDOT
Hannah.brown@dot.wi.gov

Background

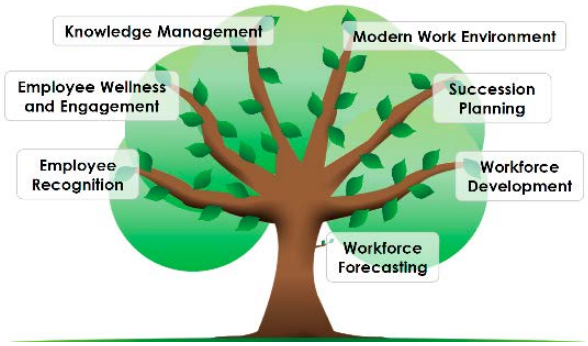
Talent shortages continue to be a major challenge for organizations and are viewed as a significant threat to an organization's short-term and long-term operations and success. Changes in technology, workforce demographics and market disruptions lend to this issue. Over time, as agencies adapt to these changes, new skill requirements emerge which are often accompanied by a reevaluation of education, experiences and qualifications necessary for job performance.

The purpose of this project was to understand and analyze the nature of gaps in skills needed for job performance, the current status of Knowledge Management (KM) practices across WisDOT and offer recommendations on how best to address some of the gaps using insights derived from a review of best practices and data analysis.

Methodology

The project utilized literature and research from sources including the National Cooperative Highway Research Program (NCHRP), Transportation Research Board (TRB), US DOT, Federal Highway Administration (FHWA), and the Society for Human Resource Management (SHRM) to identify trends and best practices in skills assessments and knowledge management practices.

The project team created and conducted an agency-wide survey that assessed the importance of key skills to job performance across three time periods (past, present and future) and main components of KM practices. A two-week response time yielded a total of 1,153 surveys, about 30% of current staff.



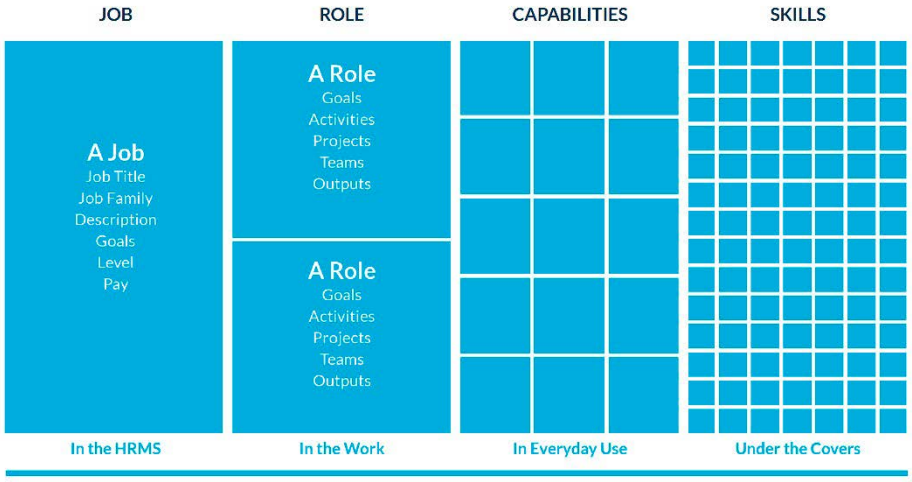
Leading practices in strategic workforce management by transportation agencies (NCHRP)

"Implementation of formal knowledge management practices will ensure employees have the skills and resources needed to most efficiently do their job, leading to the success of the agency."
–Hannah Brown, WisDOT

Interested in finding out more? Visit:
WisDOT Research website

Results

Data analysis identified that across all divisions of WisDOT, employees have a set of core durable and transferable skills that have contributed to their successful job performance.



The relationship between jobs, roles, capabilities and skills
Source: Bersin (2022) Rise of the Talent Intelligence Platform: A Primer

These skills include communication, analytical, problem-solving, critical thinking and collaboration with colleagues and stakeholders. Analysis of the data on KM practices across all divisions also reveals a strong foundation for information and knowledge capture systems.

Recommendations for Implementation

The research team offered four recommendations:

- Establish a team of cross-functional professionals to engage in annual workforce planning activities that are coordinated with the strategic planning process and engage multiple levels of leadership. The team will be responsible for carrying out some of the essential activities associated with this function, including skills assessment and knowledge management.
- Create a comprehensive succession planning and knowledge management strategy that is aligned with the strategic workforce planning and development plans.
- Re-envision talent management practices that are aligned with the strategic workforce management plan and are skills-based and data-driven. Prioritize mission-critical roles and positions.
- Invest in skills-based technology that addresses skill and knowledge gaps.

This brief summarizes Project 0092-22-69,
"WisDOT Skills Readiness and Knowledge Management"
Policy Research Program

WisDOT Data Governance, Phase II

Research Objectives

- Develop recommendations for WisDOT's Data Governance, including structure, personnel, and implementation
- Draft important documents related to Data Governance

Research Benefits

- Address gaps in data classification, identification, and labeling
- Minimize the risk of data breaches
- Ensure that WisDOT is prepared to handle increasingly large quantities of data, especially as the use of Connected Autonomous Vehicles (CAVs) rises
- Ensure WisDOT's data is consistent, accurate, and complies with all regulations

Principal Investigator

Andrew Graettinger
Institute for Physical Infrastructure and Transportation (IPIT)
UW-Milwaukee
andrewjg@uwm.edu

Project Manager

Michael Kessenich
WisDOT
michaelj.kessenich@dot.wi.gov

Background

WisDOT's current data cataloging processes are fairly decentralized and may benefit from an overarching Data Governance Framework. The amount of data within WisDOT is growing exponentially, yet data is dispersed across multiple sources without a centralized repository. In addition, there are gaps in the data identification and labeling process.

These gaps have caused the agency to struggle to adequately identify and label all information assets. Without proper data governance, WisDOT is at higher risk of data breaches, which often result in substantial costs and reputational damage.

Creating a Data Governance Framework and data cataloging practices would include harmonizing data sources, implementing access controls, documenting ownership, and creating technical and descriptive information to address all components of WisDOT data.

Methodology

The research team first revisited a literature review from Phase I of the project on Data Governance which included Data Governance practices. They then reviewed a previous survey sent to all 50 state DOTs, that asked about Data Governance implementation and software.

Researchers conducted phone interviews with DOTs in California, Florida, Indiana, Iowa, Ohio and South Carolina to discuss the progress they have made towards Data Governance. Researchers addressed the structure, documentation, rules, implementation, and technology requirements in those states. States also sent Data Governance documentations, such as visualizations of their Data Governance organizational structure, guiding principles, key considerations and implementation roadmaps.

Additionally, the research team met regularly with WisDOT's CAV Strategic Work Plan internal committee, a group devoted to CAV technology and deployment, research development, policy advice, and state coordination. Because of the new CAV data and new ways to collect data are of interest, insights were important to this research and they provided feedback on the Data Governance materials that were developed.

Results

The survey results and interviews with state DOTs provided several insights into best practices of Data Governance. First, it was repeatedly emphasized that the success of Data Governance initiatives hinges on departmental leadership; making this a strategic priority ensures that it

"This project has given us a roadmap for implementing Data Governance across WisDOT. It includes a governance framework, roles and responsibilities, process flows and other artifacts that help us prepare for the onslaught of data expected to come from Connected and Autonomous Vehicles (CAVs) as well as the rapid growth in video, imagery and other file types."

–Michael Kessenich, WisDOT

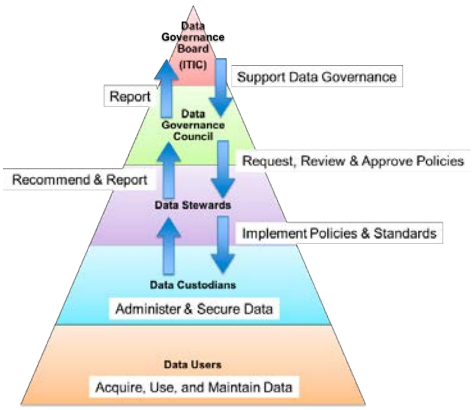
Interested in finding out more? Visit:
WisDOT Research website

becomes an essential part of the organization's operations. Agency leadership support for Data Governance fosters employee buy-in and makes it more likely that resources will be allocated to the initiative.

Similarly, many DOTs emphasized that Data Governance should not be limited to the IT department; rather, it must be organization-wide. Collaboration from all departments ensures that diverse perspectives are brought to the table, and it helps customize data practices to each division within the department. Having Data Governance officers with a variety of backgrounds (finance, engineering, policy, etc.) brings a wide range of expertise into the decision-making process. It generates buy-in so that all members of the department can engage in Data Governance practices.

Change management is a key part of implementing data practices. Incorporating change management principles facilitates the adoption of Data Governance principles and practices.

Finally, the DOTs agree that strong Data Governance procedures will benefit their agency through improved data quality, increased efficiency, better resource allocation, policy compliance and cost savings.



Proposed structure designed for the WisDOT Data Governance program.

As a result of these discussions, the research team drafted several documents related to Data Governance, including a proposed structure, a board/council charter, a list of detailed roles and responsibilities for employees at various points in the structure, a process flow diagram for data intake, and a data intake form for capturing information about new data.

Recommendations for Implementation

The following recommendations are proposed:

- Form a Data Governance board and council
- Implement the developed documents
- Promote Data Governance through organizational change management
- Adopt technology for data catalog
- Acquire the needed resources, especially several full-time positions dedicated to Data Governance

This brief summarizes Project 0092-22-71,
WisDOT Data Governance, Phase II
Policy Research Program

Materials Management projects

Materials Management projects are an important research and technology transfer activity for the Wisconsin Department of Transportation. These projects ensure that WisDOT is collecting reliable data, revising specifications and updating methodologies on the materials used to build and maintain Wisconsin's transportation system. Five projects were completed in Federal Fiscal Year 2023.

MMS AASHTOWARE Project Contract Management Software/ AASHTOWARE Project Materials

(0092-20-49)

WisDOT Division and Project Lead:

Myungook Kang, DTSD

Research Objectives:

To facilitate the implementation of the AASHTOWare Project Construction and Materials management system by collecting necessary construction materials reference data and creating a framework for an AASHTOWare Materials database.

Research Findings:

This project successfully initiated implementation of AASHTOWare Project (AWP) Materials by creating an excel file with reference data from WisDOT engineering and specification documentation. AWP Materials reference data needs to be updated regularly to reflect the latest versions of WisDOT construction specifications and manuals. View Final Report.

Field Friction Testing

(0092-21-54)

WisDOT Division and Project Lead:

Peter Kemp, DTSD

Research Objectives:

To develop performance curves for high-friction surface treatments (HFST) and improve pavement surface friction characteristics to reduce run-off-the-road crashes.

Results and Recommendations for Implementation:

Initial analysis has indicated HFST as the preferred alternative for skid characteristic enhancement. The Bureau of Project Development should adopt HFST as a safety improvement for road treatments. View Final Report.

Superpave Gyratory Compactor Rapid Angle Measurement (RAM) Kit

(0092-22-52)

WisDOT Division and Project Lead:

Ali Arabzadeh, DTSD

Research Objectives:

To improve precision of gyratory compaction test machine calibration and improve correlation between laboratory compaction testing of hot mix asphalt (HMA) and field results while decreasing interlaboratory variability.

Results and Recommendations for Implementation:

With RAMs, WisDOT could ensure the accuracy of the gyratory compactors and perform the calibrations in a timely manner. The result from the RAM is a measured angle that should be within an acceptable range. To maintain the accuracy of the gyratory compactors, monthly RAM measurements are recommended. View Final Report.

Measuring the Tensile Strength Ratio (TSR) of Asphalt Mixtures to Ensure Resistance to Moisture Damage

(0092-22-53)

WisDOT Division and Project Lead:

Ali Arabzadeh, DTSD

Research Objectives:

To evaluate the moisture damage resistance of asphalt mixtures at the design and production stages.

Results and Recommendations for Implementation:

With the purchased testing fixture, the Bureau of Technical Services' (BTS's) central laboratory has been able to continue the evaluation/ verification of moisture damage resistance of the mixtures at the design and production stages. To ensure that the asphalt mixtures of Wisconsin are resistant to moisture damage, the performance of the mixtures should be evaluated using the TSR. View Final Report.

Falling Weight Deflectometer (FWD) and Ground Penetrating Radar (GPR) Testing on Pavements

(0092-22-55)

WisDOT Division and Project Lead:

Peter Kemp, DTSD

Research Objectives:

Develop a structural value to help promote highly polymerized asphalt layers for a delay in reflective cracking of hot mix asphalt overlays.

Results and Recommendations for Implementation:

No correlation was found for the TSDD and standard GPR testing. However, structural numbers can be determined using the resilient modulus and GPR thickness data. The research team recommends adoption of resultant Sn in the department pavement design software WisPave. View Final Report.

Technology transfer and library activities

The WisDOT Research and Library Services provides information services for WisDOT staff and stakeholders and supports implementation of research results. Through services including synthesis reports and literature searches, we connect WisDOT employees with the most up-to-date research and industry trends.

Synthesis reports

A synthesis report is an evaluation of other state transportation agencies' policies and procedures made by comparing, contrasting, and combining information gathered from agencies' websites or through electronic surveys. Three synthesis reports were completed in FFY 2023 on topics, including: federal apportionment authority, technical career paths for DOT employees, and traffic data.

Literature searches

A literature search is a systematic and thorough search of all types of published literature to identify a breadth of quality references relevant to a specific topic. Customers apply the collected information to decision making for funding and crafting research efforts and for general policy improvement. Thirty literature searches were completed in FFY 2023. Topics included: roadside oral fluids testing, connected and automated vehicle education, pavement buckling, and non-driver transportation behavior.

WisDOT library services

Library staff handled 331 information requests, and delivered 614 digital items (books, reports, periodicals, and articles).

WisDOT Library Portal

WisDOT launched the new library portal platform, which expands access to the library catalog. The self-service platform offers users instant access to information via the catalog search, as well as the ability to upload state and federally funded research, consultant reports and agency documents. Along with various search features, the portal also has an Ask-a-Librarian tool that allows staff, researchers and the public to request specific information from WisDOT library staff.

Completed research projects

PROGRAM	PROJECT ID	PERFORMING ORGANIZATION	PRINCIPAL INVESTIGATOR	PROJECT BUDGET	WISDOT PROJECT MANAGER	PROJECT TITLE	IMPLEMENTATION METHOD	COMPLETION DATE
WHRP – Geotech	0092-20-05	University of Wisconsin - Milwaukee	Hani Titi	$175,000	Erik Lyngdal	Quality Testing of Wisconsin Aggregates	Revise a specification	10/2022
WHRP – Structures	0092-21-02	Northwestern University	James Hambleton	$80,000	Steve Neary	Optimizing Bridge Abutment Slope Protection at Stream Crossing	Revise a specification, new product implementation	12/2021
WHRP – Rigid Pavement	0092-21-03	University of Wisconsin - Platteville	Danny Xiao	$150,000	Dan Reid	Evaluating the Impact of Anti Icing Solutions on Concrete Durability	Revise a specification, new product implementation	08/2023
WHRP – Flexible Pavement	0092-21-04	Advanced Asphalt Technologies LLC.	Donald Christensen	$175,000	Tirupan Mandal	Interlayer Mixture Design	Develop alternative method	12/2022
WHRP – Flexible Geotech	0092-21-06	BGC Engineering USA, Inc.	Scott Anderson	$140,868	David Staab	Geotechnical Asset Management For Slopes	Develop a model	10/2022
WHRP – Structures	0092-22-01	University of Wisconsin - Milwaukee	Habib Tabatabai	$149,991	James Luebke	Improving Bridge Concrete Overlay Performance	Revise a specification	08/2023

Ongoing research projects

PROGRAM	PROJECT ID	PERFORMING ORGANIZATION	PRINCIPAL INVESTIGATOR	PROJECT BUDGET	WISDOT PROJECT MANAGER	PROJECT TITLE	ANTICIPATED IMPLEMENTATION STATUS
WHRP – Rigid Pavement	0092-22-02	Applied Research Associates, Inc.	Shreenath Rao	$130,000	Sinan Coban	Field Investigation of Dowel and Tie Bar Placement	Revise a specification
WHRP – Rigid Pavement	0092-22-03	University of Missouri – Kansas City	John Kevern	$170,000	Tirupan Mandal	Timely and Uniform Application of Curing Materials	Revise a specification
WHRP – Flexible Pavement	0092-22-04	NCAT at Auburn University	Randy West	$250,000	Tirupan Mandal	Balanced Mixture Design Pilot and Field Testing Sections	Develop a model
WHRP – Geotech	0092-22-05	Michigan State University	Bora Cetin	$125,000	Andrew Zimmer	Weight-Volume Relationships and Conversion Factors for Soils and Aggregates of Wisconsin	Develop a model
WHRP - Geotech	0092-22-06	Iowa State University	Alice Alipour	$200,000	Dave Staab	Wind-Load Structures	Develop a model, revise a specification
WHRP – Flexible Pavement	0092-23-01	Rutgers, The State University of New Jersey	Thomas Bennert	$175,000	Erik Lyngdal	Benchmarking Delta Tc (ΔTc) for Wisconsin Materials	Revise a specification
WHRP - Geotech	0092-23-02	Michigan Technological University	Zhen Liu	$227,617	David Staab	Seasonal Weight Restriction Decision Making based on Monitoring of Frost Susceptibility of Pavement Structures	Develop a model, develop a web-based decision support tool
WHRP – Rigid Pavement	0092-23-03	American Engineering Testing, Inc.	Jussara Tanesi	$199,779	Tirupan Mandal	Chemistry and Performance of Supplementary Cementitious Materials (SCMs) for Wisconsin Concrete Pavement	Revise a specification, new product implementation
WHRP – Structures	0092-23-04	AECOM Technical Services, Inc.	Brady Seston	$129,462	Philip Meinel	Bridge Deck Thermography Verification and Policy	Revise a specification, update policy and provide further guidance
WHRP – Structures	0092-23-05	Iowa State University	Behrouz Shafei	$75,000	James Luebke	Underwater Concrete Pours and Non-Segregating Concrete	Revise a specification, update policy and provide further guidance

Pooled fund participation

PROJECT NUMBER	TITLE	FFY 2022 FUNDING AMOUNT	WISDOT TECHNICAL REPRESENTATIVE	LEAD AGENCY/ STATE
TPF-5(255)	Highway Safety Manual Implementation	N/A	Kevin Scopoline	FHWA
TPF-5(305)	Regional and National Implementation and Coordination of ME Design	N/A	Ali Morovatdar	FHWA
TPF-5(317)	Evaluation of Low-Cost Safety Improvements	N/A	Kevin Scopoline	FHWA
TPF-5(326)	Develop and Support Transportation Performance Management Capacity Development Needs for State DOTs	N/A	Dan Lamm	Rhode Island
TPF-5(347)	Development of Maintenance Decision Support System	$30,000	Mike Adams	South Dakota
TPF-5(368)	Performance Engineered Concrete Paving Mixtures	N/A	James Parry	Iowa
TPF-5(370)	Fostering Innovation in Pedestrian and Bicycle Transportation Pooled Fund	N/A	Christopher Squires	FHWA
TPF-5(372)	Building Information Modeling (BIM) for Bridges and Structures	$25,000	Josh Dietsche	Iowa
TPF-5(374)	Accelerating Performance Testing on the 2018 NCAT Pavement Test Track with MnROAD Research	N/A	Steve Hefel	Alabama
TPF-5(375)	National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques (MnROAD/NCAT Joint Study Phase 2)	$50,000	Haluk Sinan Coban	Minnesota
TPF-5(377)	Enhanced Traffic Signal Performance Measures	N/A	Jeremy Iwen	Indiana
TPF-5(381)	Evaluation of Lateral Pile Resistance Near MSE Walls at a Dedicated Wall Site Phase 2	N/A	Jeff Horsfall	Utah
TPF-5(382)	Drivers Failing to Yield at Multi-Lane Roundabout Exits	N/A	Kevin Scopoline	FHWA
TPF-5(385)	Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)	$77,000	Haluk Sinan Coban	Virginia
TPF-5(388)	Developing Implementation Strategies for Risk Based Inspection (RBI)	N/A	Steve Doocy	Missouri
TPF-5(389)	Connected Vehicle Pooled Fund Study	$50,000	David Karnes	Virginia
TPF-5(395)	Traffic Disruption-Free Bridge Inspection Initiative with Robotic Systems	$25,000	David Bohnsack	Missouri
TPF-5(396)	Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)	$154,000	Ali Morovatdar	Virginia
TPF-5(399)	Improve Pavement Surface Distress and Transverse Profile Data Collection and Analysis, Phase 2	$20,000	Andrew Schilling	FHWA
TPF-5(430)	Midwest Roadside Safety Pooled Fund Program	$65,000	Erik Emerson	Nebraska
TPF-5(432)	Bridge Element Deterioration for Midwest States	N/A	Philip Meinel	Wisconsin
TPF-5(435)	Aurora Program (FY20-FY24)	$25,000	Mike Adams	Iowa
TPF-5(437)	Technology Transfer Concrete Consortium (FY20-FY24)	$8,000	Tirupan Mandal	Iowa

Pooled fund participation *(continued)*

PROJECT NUMBER	TITLE	FFY 2022 FUNDING AMOUNT	WISDOT TECHNICAL REPRESENTATIVE	LEAD AGENCY/ STATE
TPF-5(438)	Smart Work Zone Deployment Initiative (FY20-FY24)	$25,000	Erin Schwark	Iowa
TPF-5(441)	No Boundaries Transportation Maintenance Innovations	$10,000	Amy Brooks	Colorado
TPF-5(442)	Transportation Research and Connectivity	$15,000	John Cherney	Oklahoma
TPF-5(443)	Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)	$25,000	Ali Arabzadeh	Minnesota
TPF-5(447)	Traffic Control Device (TCD) Consortium (3)	$10,000	Ryan Mayer	FHWA
TPF-5(448)	Integrating Construction Practices and Weather into Freeze Thaw Specifications	N/A	Tirupan Mandal	Oklahoma
TPF-5(458)	Traffic Analysis, Modeling, and Simulation	$5,000	Vicki Haskell	FHWA
TPF-5(460)	Flood-Frequency Analysis in the Midwest: Addressing Potential Nonstationary Annual Peak-Flow Records	$55,600	Steve Neary	Nebraska
TPF-5(465)	Consortium for Asphalt Pavement Research and Implementation (CAPRI)	$10,000	Daniel Kopacz	Alabama
TPF-5(466)	NRRA - Phase II	$150,000	Barry Paye	Minnesota
TPF-5(467)	Research Project Tracking System	$46,000	Evelyn Bromberg	Kentucky
TPF-5(478)	Demonstration to Advance New Pavement Technologies Pooled Fund	$10,000	Erik Lyngdal	FHWA
TPF-5(479)	Clear Roads Winter Highway Operations Phase 3 Pooled Fund	$25,000	Emil Juni	Minnesota
TPF-5(480)	Building Information Modeling (BIM) for Infrastructure	$30,000	Drew Kottke	Iowa
TPF-5(486)	Steel Bridge Research, Inspection, Training and Education Engineering Center (SBRITE)	$30,000	Jason Lahm	Indiana
TPF-5(487)	Transportation Management Centers Pooled Fund Study Phase 2	$50,000	Randall Hoyt	FHWA
TPF-5(490)	Enterprise- Phase 3 (Phase 2 Continuation)	$30,000	Elizabeth Lloyd-Weis	Michigan
TPF-5(492)	Biennial Asset Management	$24,000	Scot Becker	Iowa

Committees and contacts

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James Bender
WisDOT, DTSD, Innovation and Technology Section Chief

Dave Brose
American Council of Engineering Companies of Wisconsin

Karl Buck
FHWA - Wisconsin Division

Joshua Dietsche
WisDOT, DTSD, Bureau of Structures

Brian Gaber
WisDOT, DTIM, Office of Asset and Performance Management

Matt Grove
Wisconsin Transportation Builders Association

Michael Hoelker
WisDOT, DTSD, Bureau of Project Development Director

Shawn Hoffman
Wisconsin Earth Movers Association

Scott Lawry
WisDOT, DTSD Deputy Administrator, Statewide Bureaus

Kevin McMullen
Wisconsin Concrete Pavement Association

Barry Paye
WisDOT, DTSD, Bureau of Technical Services

Tim Rank
WisDOT, DTSD Regional Representative

Amr El Ragaby
Academic Representative, UW-Platteville

Debbie Schwerman
Wisconsin Asphalt Pavement Association

WHRP Technical Oversight Committee chairs

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Ali Arabzadeh
WisDOT, DTSD, Bureau of Technical Services

GEOTECHNICS

David Staab
WisDOT, DTSD, Bureau of Technical Services

RIGID PAVEMENTS

Tirupan Mandal
WisDOT, DTSD, Bureau of Technical Services

STRUCTURES

James Luebke
WisDOT, DTSD, Bureau of Structures

TECHNICAL SUPPORT

Dante Fratta
Principal Investigator, University of Wisconsin - Madison

Research and Library Advisory Committee

Shari Krueger, Chair
WisDOT, DBSI

Karl Buck
FHWA – Wisconsin Division

Ryan Spaight
WisDOT, DBSI

Robert Combs
WisDOT, DMV

Ethan Severson
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WisDOT, DTSD

Mark Knickelbine
WisDOT, OPA

Scott Schoenmann
WisDOT, DTIM

Matthew Rohrbeck
WisDOT, DBM

Michael Schwendau
WisDOT, DSP

Research and Library Services Unit staff

Shari Krueger
Supervisor

John Cherney
Librarian

Susie Seefelt Lesieutre
Librarian

Jacqueline Kamin
Budget and Research Implementation Coordinator

Evelyn Bromberg
National Programs Coordinator

Carter Angelo
Research Communications Coordinator

WisDOT Research
wisconsindot.gov/Pages/about-wisdot/research/default.aspx
research@dot.wi.gov