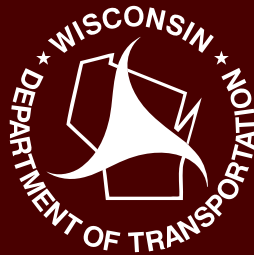


WisDOT Research Program

Annual  
2025 Report



# Foreword

The Wisconsin Department of Transportation (WisDOT) is committed to staying at the forefront of innovations that will help us deliver a safe and efficient transportation system in Wisconsin. The 2025 Research Program Annual report details the wide-ranging projects that support our mission.

Research allows us to get a better handle on the challenges facing our transportation industry, as well as the opportunities for improvement. It's vital to help us understand complicated concepts and is a fundamental step to find the solutions needed to improve safety and mobility for all who travel in Wisconsin.

In 2025, WisDOT's award-winning \$5.7 million research program sponsored or participated in over 70 research projects. The Division of Budget and Strategic Initiatives' Research and Library Services Unit completed 16 projects focused on construction materials, Artificial Intelligence in transportation, engineering countermeasures to mitigate reckless driving, non-driver transportation behavior and much more. Research and library staff completed two synthesis reports and 25 literature searches, responded to 270 information requests and delivered 538 resource items.

WisDOT research received special recognition in 2025 when the American Association of State Highway Transportation Officials (AASHTO) awarded the department a High Value Research honorable mention for the Policy project "Connected and Automated Vehicles (CAV) Attitudes and Perceptions." The research provides a detailed analysis of the public understanding of CAVs. The results highlight benefits, drawbacks and barriers to CAV implementation – and opportunities for WisDOT action.

Through research, pilots testing and continuous improvement methods, WisDOT ensures our processes, programs and services are truly effective. I am proud of the WisDOT team and research partners who are helping us better serve the people of Wisconsin and improve the quality of life in communities across the state.

Kristina Boardman  
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 2025, covering October 1, 2024 through September 30, 2025.*

## Contents

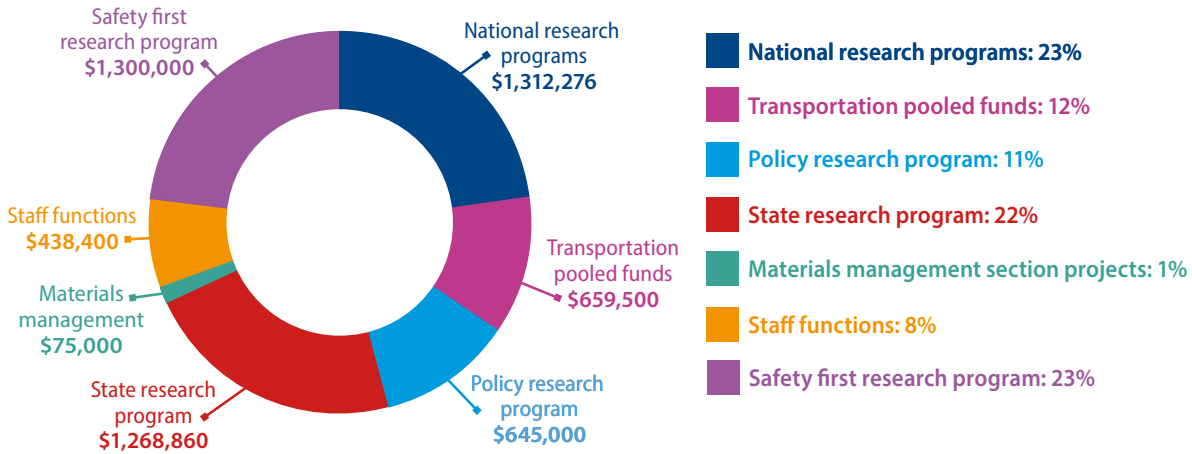
Foreword . . . . .	2
Program Overview . . . . .	4
Completed WHRP Projects. . . . .	5
Completed Policy and Safety First Research Programs Projects . .	20
Completed Materials Management Projects . . . . .	33
Technology Transfer and Library Activities . . . . .	40
Completed WHRP Research Projects Summary . . . . .	41
Ongoing WHRP Research Projects Summary . . . . .	42
Completed Policy and Safety First Research Projects. . . . .	43
Ongoing Policy and Safety First Research Projects . . . . .	44
Pooled Fund Participation . . . . .	45
Research Program Committees . . . . .	47

### Common acronyms used in this document

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

# Program Overview

The Wisconsin Department of Transportation (WisDOT) managed a \$5.7 million program for research and technology transfer services during federal fiscal year (FFY) 2025. The State Planning and Research Part B (SPR-B) federal program funded 87% (\$4.95 million) of the program, while state funds covered the remaining 13% (\$0.75 million).



## National research programs

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.

## Transportation pooled funds

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 2025, WisDOT participated in 48 TPFs. These projects include advances in safety and engineering methods and materials.

## Policy research program

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 agency operations.

## State research program

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, and flexible and rigid pavements.

## Materials management section projects

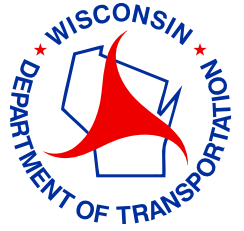
The research program funds WisDOT’s Materials Management Section (MMS) internal projects, including the investigation and implementation of new materials and methods conducted at WisDOT’s MMS lab.

## 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.

## Safety first research program

The Safety First Research Program funds projects to research, demonstrate or test new technology and innovative best practices to improve safety throughout the state’s multimodal transportation system.



# Completed Wisconsin Highway Research Program Projects

The Wisconsin Highway Research Program aims to better design, build and reconstruct the state's transportation system. The following briefs showcase the research projects completed during this fiscal year.

## Wind-Loaded Structures

### Objectives

- Assess the behavior and extent of loads transferred to two drilled shafts
- Evaluate the potential for using smaller-sized drilled shafts to reduce material and construction costs

### Benefits

- Structural response monitoring provided critical information about the in-service performance of the traffic sign structures
- Real-time sensors helped understand the effect of real wind and environmental conditions on traffic sign structures

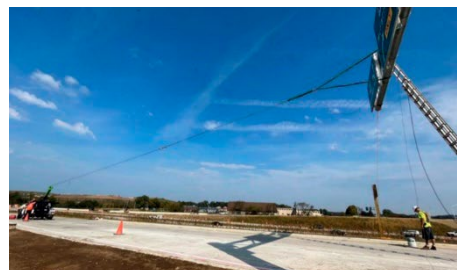
### Background

Cantilevered traffic sign support structures are regularly exposed to wind and truck-induced gusts, which generate complex torsional and flexural forces that must be effectively transferred to their foundations. These wind-induced stresses, particularly torsional and moment loads, pose significant challenges in design of structure and foundation of such systems. Recognizing the need for consistency and safety, the Wisconsin Department of Transportation (WisDOT) developed standardized foundation plans for these structures. However, questions remain regarding the adequacy and potential conservatism of these designs.

This study investigated the structural behavior and load transfer mechanisms of cantilevered traffic sign structures under wind loading, with a particular focus on the transmission of moment and torsional forces through the foundation system.

### Methodology

The research involved geotechnical surveys, finite element modeling (FEM), and structural health monitoring (SHM) to analyze foundation behavior and evaluate torsional capacity. Validation of the computational models was achieved through comparison with experimental results from free-vibration, static pull tests, and long-term monitoring.



*Static tests for torsional upstream and torsional downstream forces*

### Principal Investigator

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### Project Manager

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A parametric study was also conducted to explore opportunities for optimizing foundation design. Two full-span cantilevered truss sign structures with drilled shaft foundations were subjected to both static and dynamic loading to assess performance under realistic operational and environmental conditions. To assess performance under extreme loading conditions, FEM was performed using SAP2000 software. This computational approach simulated high wind speeds, transient gusts, and extreme scenarios. FEM allowed for a detailed analysis of stress distribution, structural deformations, and potential failure mechanisms.

***“This project investigated the loading and foundation demand of wind-loaded sign structures. The research results have the potential to improve current foundation designs, resulting in simplified and lower construction costs, while maintaining equivalent safety and reliability to existing foundation designs.”***

**– David Staab,  
WisDOT**

These simulations were cross-referenced with SHM data to validate the models.

## Results

Two traffic sign structures, S-13-562 and S-13-570, located in different soil conditions, were instrumented and subjected to pull tests involving statically increasing loads. These tests helped characterize the loads, stresses, and strains within the structures and their foundations. Since the structures remained in service, the applied loads engaged only 12–40% of the shafts’ ultimate capacity, as estimated from L-pile analysis. While the tests primarily captured the shafts’ linear response and were not sufficient to define their full capacity, they proved valuable for evaluating the performance of the installed strain gauges and provided a foundation for validating numerical models.

The long-term structural health monitoring continued for a year after instrumentation. Wind observed at the two sites were at a maximum speed of 27 mph which is 23% of the design wind speed of 115 mph. The structure and foundation were only stressed to a fraction of ultimate design. However, this data was used to verify numerical models. Due to low winds observed at the location of structures, synthetic winds were generated and applied to the FEM. These stochastic winds were used to assess the structural response and loads transferred to the piles at higher wind speed ranges. The loads at the top of the shaft were transferred to the L-Pile to characterize the maximum bending moment in the foundation.

## Recommendations for Implementation

The research indicates that the serviceability limits specified in the WisDOT Bridge Manual may be overly conservative. These results highlight the potential for more efficient foundation designs without compromising structural performance or safety.

To achieve an optimized foundation design, it is essential to consider structural limitations, loading conditions, and soil characteristics. A parametric study was conducted using linear analysis of 25 shaft models developed in FEM. The results support the feasibility of reducing shaft length without compromising performance. The study further suggests that shorter shaft types—such as the Two-Chord Truss Full Type II (TFII) or Type IV (TFIV)—can offer a more efficient and balanced design in terms of structural performance and material usage when compared to the longer Two-Chord Cantilever Type IV (TCIV).

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-22-06  
Wind-Loaded Structures

Wisconsin Highway Research Program

## Benchmarking Delta Tc ( $\Delta T_c$ ) for Wisconsin Materials

### Objectives

- Evaluate the  $\Delta T_c$  parameter to help predict the non-load related cracking susceptibility of Wisconsin asphalt mixtures
- Standardize, validate and recommend an aging procedure prior to the measurement of  $\Delta T_c$
- Recommend a plan for implementing  $\Delta T_c$  as a preferred performance measure for cracking susceptibility

### Benefit

- Helps state agencies establish methods to evaluate asphalt binders used in roadways

### Background

WisDOT is interested in looking at the potential use of the Delta Tc ( $\Delta T_c$ ) parameter as a means of benchmarking the asphalt binders currently supplied to the state and is encouraged by previous work under WHRP project 0092-19-04, Recycled Asphalt Binder Study, that successfully used  $\Delta T_c$  to evaluate the cracking susceptibility of high recycled mixtures. This study evaluates whether  $\Delta T_c$  is appropriate for use with conventional asphalt binders supplied to WisDOT, and if so, what type of criteria should exist to differentiate between good and poor performing asphalt binders. Currently, WisDOT relies on the intermediate temperature PG grade as a means of capturing poor intermediate temperature cracking performance, even though it is well known intermediate temperature PG grade has its limitations.

### Methodology

The research encompassed a literature review and extensive laboratory program consisting of both asphalt binder and mixture testing. Early in the literature review, as well as during the laboratory evaluation, it was evident that  $\Delta T_c$  may not be the best parameter for WisDOT implementation. Issues with testing variability and poor ability to rank polymer modified binders made the  $\Delta T_c$  parameter a less than desirable candidate for future specifications. The proposed methodology uses a similar approach to the intermediate temperature PG grade but only requires a single test temperature and loading frequency.

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*Field Cores recovered from FHWA Accelerated Loading Facility for asphalt mixture and binder testing*

***“The chemical and physical properties of asphalt binders used in construction are changing. This research provided valuable insight on how state agencies can better quantify the quality of asphalt binders used in Wisconsin roadways.”***  
– Erik Lyngdal

## Results

Using the information and data collected, it was determined that  $\Delta T_c$  should not be selected as an asphalt binder cracking parameter due to variability issues, as well as its difficulty to properly rank polymer modified asphalt binder performance. Instead, the study provided two parameters that can be determined at a single test temperature and loading frequency; Glover-Rowe Parameter at 15°C (GRP<sub>15C</sub>) and R-value at 15C. Criteria for the parameters were calibrated against an IDEAL-CT Index value of 30 after WisDOT long-term mixture aging. The parameters were found to be sensitive to asphalt binder supplier, different PG grades, inclusion of recycled asphalt binder and aging.

Currently approved WisDOT asphalt binders were found to meet the requirements of the procedure after 20-hour pressure aging vessel (PAV) conditioning, but many had issues meeting the requirements after 40-hour PAV conditioning. When blended with typical recycled asphalt pavement (RAP) binder from Wisconsin, the test parameters would limit most asphalt binders to 35% asphalt binder replacement before failing the proposed criteria. Lastly, the criteria was compared to recovered asphalt binder from the WisDOT Balanced Mix Design Implementation test sections and could identify Test Section #4, which was the only section designed and produced to have an IDEAL-CT Index less than 30.

## Recommendations for Implementation

Based on the findings, the research team recommends the following:

- The combined use of the GRP<sub>15C</sub> and 10 radians per second and the Rheological Index at 15°C provide the best means to characterize the asphalt binders in this study
- Intermediate temperature for the asphalt binder testing should be revised to 15°C for the entire state based on the in-situ climate temperatures
- Continue assessment for potential use of the GRP<sub>15C</sub> correlation to the low temperature PG grade as determined using the bending beam rheometer (BBR) m-value
- Further research should include a larger database of asphalt mixtures across the state and evaluate their respective fatigue cracking mixture and binder properties

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-23-01  
Benchmarking Delta T<sub>c</sub> ( $\Delta T_c$ ) for Wisconsin Materials

Wisconsin Highway Research Program

## Chemistry and Performance of Supplementary Cementitious Materials (SCMs) for Wisconsin Pavement

### Objectives

- Identify traditional and non-traditional SCMs, and reclaimed ashes available
- Establish appropriate testing methodologies for SCMs
- Develop a database for SCM properties and characteristics
- Propose revisions to WisDOT manuals, standards and policies

### Benefits

- Enhancing testing methods for screening new materials
- Results highlight potential for a new strength activity index for testing

### Background

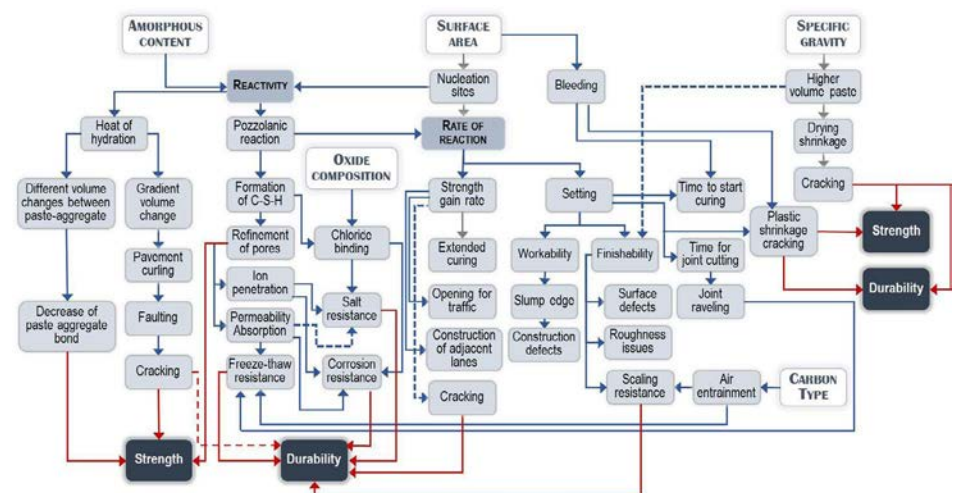
This study investigated the performance of supplementary cementitious materials (SCMs) and alternative supplementary cementitious materials (ASCM). Performance included materials characterization and concrete performance.

Most transportation agencies use SCMs in their concrete pavement mixtures, especially fly ashes, as a partial replacement for portland cement. SCMs are materials that react either with calcium hydroxide at high pH (pozzolanic) and/or with water at high pH (latent hydraulic), within a concrete mixture. SCMs contribute to long term performance, especially durability because they promote densification of the matrix.

The concrete industry faces two challenges. The supply of standard SCMs is insufficient to fulfill the current needs and there is an increasing demand to develop a more sustainable infrastructure without sacrificing performance.

### Methodology

Ten materials were studied. Characterization included chemical composition, x-ray diffraction, density, setting time, water requirement, particle size, a modified version of the strength activity index, a modified version of the foam index, and reactivity. Concrete performance included slump, the box test, air content, super air meter, compressive and flexural strengths, freezing and thawing resistance, surface resistivity and length change due to shrinkage.



SCMs main effects on concrete properties. Specific deterioration mechanisms such as alkali-silica reaction and sulfate resistance, among others. Red arrows indicate the ultimate effect on concrete strength and durability.

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### Project Manager

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***“The results from this study are going to improve WisDOT’s specifications for using SCMs and ASCMs in concrete mixtures. This will allow for greater testing efficiency and better performance of Wisconsin pavements.” – Tirupan Mandal, WisDOT***

## Results

Results showed that some of these materials (Micron3, Opus, PozzSlag, Liquid ASCM) either did not meet the requirements of the American Society for Testing and Materials (ASTM)’s specifications or did not meet the definition of the material in these specifications.

However, all concrete mixtures containing the SCM or ASCM in this study showed good performance, sometimes, at later ages, better than the control mixture, with exception of the liquid ASCM, which showed similar performance as the control.

The validity of the reactivity tests (ASTM C1897) was confirmed and it was recommended to be implemented when evaluating a material with no performance history or alternative SCMs.

The modified foam index was unable to correlate with concrete air entraining admixtures (AEA) demand but was found to be a good indicator of potential air entrainment problems, and the modified strength activity index (SAI) was found to be a good screening tool.

Loss on ignition (LOI) did not correlate with the AEA demand or with the foam index and the current 2% requirement for fly ashes is too restrictive.

## Recommendations for Implementation

Based on the results of the study, the researchers had several recommendations including:

- Removing the requirement for LOI and reword WisDOT specification 501.2.4.2.2.1
- Eliminating the APL for Class F fly ashes and allow the use of up to 30% of Class F fly ashes that comply with ASTM C618, with the exception of SAI. Replace SAI with the modified SAI performed in this study
- Removing the need for individual constituents to comply with their applicable specification, as long as the blended SCM does – with the exception of the SAI which should be replaced by the modified SAI
- Increasing the qualification age to 90 days, if the results at 28 days do not meet the requirements
- Adding a qualification requirement of low penetrability at 90 days, according to WRM T358
- Performing comprehensive research on shrinkage behavior, including estimation of field performance and cracking probability
- Introducing a framework for evaluating ASCMs and guidance on acceptability requirements

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-23-03  
Chemistry and Performance of Supplementary Cementitious Materials (SCMs)  
for Wisconsin Concrete Pavement  
Wisconsin Highway Research Program



## Bridge Deck Thermography Verification and Policy

### Objectives

- Develop specifications related to the equipment type, sensor platform and environmental parameters for IRT data collection
- Establish statewide policies on the bridge deck life-cycle condition to begin and stop using IRT
- Implement guidelines on the IRT's accuracy compared to the actual condition found during overlay construction

### Benefit

- Establish inspection protocols to assist WisDOT's bridge asset management program

### Background

As a part of the Wisconsin Department of Transportation's (WisDOT) overall bridge asset management program, different non-destructive evaluation techniques have been utilized on bridge decks to determine bridge condition. Since the early 1980s, WisDOT has used Infrared Thermography (IRT) to assess defect quantities and locations on bridge decks. These results were used to aid bridge monitoring, routine bridge inspections and help determine rehabilitation strategies.

WisDOT recently coordinated a statewide infrared program organized by WisDOT's Bureau of Structures (BOS) for all WisDOT responsible bridges. However, interpreting the procedures between different inspection methods, such as vehicle and fixed-wing aerial IRT inspection, is difficult. The accuracy of infrared thermography inspection can vary based on different infrared equipment, environmental parameters, and data collection procedures. This research project aims to develop infrared-based inspection and analysis protocols to assist with WisDOT's bridge asset management program.

### Methodology

Twelve bridge decks were selected to aid in determining the recommended IRT policies. The selected bridges were comprised of different wearing surfaces such as bare deck, Portland Cement Concrete overlay (PCC), Polymer Modified Asphalt overlay (PMA), Hot Mixed Asphalt overlay (HMA), and Thin Polymer Overlay (TPO). The four selected IRT bridge deck collection methods were handheld, drone or unmanned aerial vehicles (UAV), fixed-wing aerial, and ground vehicle mounted (vehicle). Each method was used to collect IRT images across the deck, and specific delamination locations were chosen to compare each method's ground sampling resolution. Then, each method was assessed to determine the pros and cons of the collection.

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### Project Manager

**Philip Meinel**

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Bridge ID	Feature On	Feature Under	Wearing Surface Type	Year Wearing Surface Placed
B400519	W GRANGE AVE	ROOT RIVER	Bare	1979
B660030	CTH Q COUNTY LINE RD	IH 41-USH 45	Bare	1996
B660053	MILEVIEW RD	USH 45	Bare	1984
B660037	USH 45 SB	IH 41	HMA Overlay	1997
B300048	STH 50 EB-STH 83 SB	SOO LINE	PMA Overlay	2006
B300058	STH 50 WB-STH 83 NB	SOO LINE RR	PMA Overlay	2006
B660031	MAPLE RD	IH 41-USH 45	Concrete Overlay	1996
B670122	CENTER DRIVE	IH 43	Concrete Overlay	2001
B670152	STH 59 EB	FOX RIVER	Concrete Overlay	2004
B300073	STH 165 WB	C & N.W. RR	TPO	2017
B300074	STH 165 EB	C & N.W. RR	TPO	2017
B400330	H DAVIDSON ACCESS RD	STH 190	TPO	2004

*Selected bridges for the study including their surface type and age*

**“This research helps establish more rigorous specifications for our deck survey contracts, which rely heavily on accurate thermography results for both planning and scoping.”**

**– Philip Meinel, Project Manager**

## Results

Each method has pros and cons for data collection and analysis, but all can identify defects on a bridge deck. Choosing the correct method is situational and must be determined based on specific project needs. Handheld cameras are recommended for spot-checking topside IRT data during routine bridge inspections or areas where a vehicle or drone cannot be utilized.

Drone IRT inspections are recommended when there are a limited number of bridges to inspect or if access is restricted by a vehicle or a handheld IRT camera. Fixed-wing aerial IRT systems are recommended when there is a large number of decks requiring IRT. Vehicle-mounted IRT systems are recommended for higher resolution requirements and on bridge decks with higher surface variation.

The validity of IRT inspection for use in rehabilitation planning depends on several factors including the accuracy of the inspection, how close the inspection is to the rehabilitation date, the quantity of defects found by an IRT inspection, and the wearing surface type. The most significant variances in results were found in decks that had overlays and/or a high quantity of defects identified in the IRT inspection.

Additionally, there may be outliers in the dataset due to past IRT inspection procedures which did not follow current WisDOT standards. It may be possible to anticipate the difference in IRT inspections and rehabilitation quantities when looking at different wearing surfaces or the quantity of defects on an IRT inspection. However, further data collection may be necessary to understand the relationships better.

## Recommendations for Implementation

Each method has pros and cons for data collection and analysis, but all can identify defects on a bridge deck. Choosing the correct method is situational and must be determined based on specific project needs. Based on the study, researchers made the following recommendations:

- Program level IRT surveys can be collected with handheld, drone, fixed-wing aerial or vehicle-mounted IRT cameras
- IRT data should be collected when temperatures are above 32 degrees Fahrenheit and the deck is dry for at least 24 hours prior. The time needed after sunrise for the sun to emit enough thermal load to identify bridge deck defects depends on the wearing surface. The optimal time is at least six hours after sunrise
- Once a new deck is placed, the first IRT inspection should occur at year 18 for bare decks, then in seven-year intervals after that. When a new overlay wearing surface is placed, the initial inspection should reset and follow the recommended initial inspection year for each overlay type, then in five-year intervals going forward

Table 8 - Recommended IRT Collection Time Hours After Sunrise

Overlay Type	Start	End
General	6 HR	10 HR
Bare	3 HR	10 HR
PCC	6 HR	12 HR
AC	5 HR	11 HR
TPO	4 HR	11 HR

Table 11 - Recommended First IRT Inspection Year

Wearing Surface	Start Year
Bare	18
PCC	5
PMA	5
HMA	2
TPO	2

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-23-04  
Bridge Deck Thermography Verification and Policy

Wisconsin Highway Research Program

## Field Investigation of Dowel and Tie Bar Placement

### Objectives

- Investigate and quantify dowel and tie bar placement in Wisconsin roadways
- Recommend tolerance limits for dowel and tie bar alignments to achieve long-term performance
- Document the relationship between misalignment and joint performance
- Develop field inspection procedures for proper bar installation

### Benefits

- Evaluates any potential relationship between dowel and/or tie bar misalignment and pavement distresses
- Helps better understand the impact of misalignment on pavement performance

### Principal Investigator

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### Project Manager

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### Background

This report presents the results of dowel and tie bar alignment data collected using the MIT-DOWEL-SCAN and MIT-SCAN-T2 from various counties in Wisconsin. Considering the potential negative impact of dowel and tie bar misalignment on pavement performance, it is important to investigate any dowel and/or tie bar misalignment and determine if the alignment is within tolerance limits. In addition, an investigation is needed to inspect joint and pavement condition and establish any potential relationship with dowel and/or tie bar misalignment, which may help better understand the impact of misalignment on pavement performance.

### Methodology

The data was analyzed using the latest version of the MagnoProof® software to calculate the various dowel alignment parameters including horizontal skew, vertical tilt, longitudinal translation, and vertical translation. These measured parameters were used to compute joint score (JS) and equivalent dowel diameter (EDD). Chi-squared tests were performed to determine any relationship between JS and spalling, slab cracking, and longitudinal translation. AASHTOWare® Pavement ME Design (PMED) was used to evaluate the impact of dowel misalignment on pavement performance.



*MIT-DOWEL-SCAN testing in Chippewa County*

### Results

In total, 1,293 joints were evaluated by the research team across twelve sites in six counties which included 12,862 dowel bars after the data was passed through the initial filtering process. The data set also included additional MIT-DOWEL-SCAN data provided by WisDOT, which included 386 joints consisting of 3,954 dowel bars.

The data showed moderate to good dowel alignment for both basket and dowel bar inserter sections with over 95 percent of dowel bars

***“Achieving long-lasting and well-performing rigid pavements requires an understanding of factors affecting their long-term performance. The results of this research on the effects of dowel and tie bar alignment on Wisconsin’s pavement performance will help advance the department’s efforts in constructing and maintaining quality concrete pavements.”***

**– Peter Kemp, WisDOT**

having horizontal skew and vertical tilt values between 0 and  $\pm 1.0$  inches, longitudinal translation between 0 and  $\pm 3.0$  inches, and vertical translation between 0 and  $\pm 1.5$  inches.

Results did not indicate any relationship between JS and spalling or cracking for any of the sections, suggesting that other factors may have a stronger effect on spalling and transverse cracking than JS. In two counties, the results indicated a relationship between JS and longitudinal translation. Although JS and longitudinal translation are independent metrics, the relationship between the two in these two counties suggests the contractor experienced challenges with dowel bar placement during paving.

The chi-squared results were also confirmed by performing a logistic regression analysis that included JS, pavement age, and slab thickness as the independent parameters with spalling and cracking as the dependent parameters. EDD ranged from 1.6 percent to 20.5 percent equivalent reduction in dowel diameter as compared with actual dowel diameter.

Results from the PMED runs using EDD as compared to actual dowel diameter showed increased roughness and faulting over the life of the pavement caused by the equivalent reduction in dowel diameter due to misalignment. However, slab cracking was not affected by change in dowel diameter.

## Recommendations for Implementation

The research team proposes several recommendations for WisDOT’s specifications and protocols including:

- Install tie bars parallel to the substrate surface and perpendicular to the longitudinal joint for 415.3.7.2 longitudinal joints
- Install dowel bars parallel to the substrate surface and parallel to the centerline of the pavement for 415.3.7.3 transverse joints. Before placing the concrete, mark the location on both sides of each transverse joint. Ensure the proposed saw cut is centered on the dowel bars and that the dowels remain parallel to the centerline. Transfer the markings on the top surface of the concrete immediately after completing the final finishing operations
- At least seven days before the beginning of concrete paving, provide a Quality Control Plan to the engineer for acceptance that provides a method for keeping the dowel basket assemblies anchored. The plan should include the type, location, number and length of the fasteners, proposed installation equipment, dowel basket assembly anchoring plan and action plan if misaligned baskets are identified during the pavement placement

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-22-02  
Field Investigation of Dowel and Tie Bar Placement

Wisconsin Highway Research Program

## Timely and Uniform Application of Curing Materials

### Objectives

- Observe and record how uniformly the curing materials are applied
- Document how curing compound application times and coverage relate to the development of distress
- Develop a measurable methodology to establish optimal times and assess uniform application

### Benefits

- Establish a methodology that can be used for quality control, capable of measuring and monitoring the effectiveness of MFCC in the field
- Extend the service life of concrete

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### Background

Concrete curing using Membrane Forming Curing Compound (MFCC) is widely used by state transportation departments, due to less maintenance and low cost compared with water curing or covering with plastic sheeting. However, there is no existing method for quantifying or systematically evaluating the quality or effectiveness of curing in the field.

Many specifications rely on the curing application rate, which is the quantity of curing compound that can be applied on a specific surface area of concrete pavement. For some other states, the acceptance of the curing compound application depends on the inspector experience and quality standards such as uniform coverage compared to white paper sheet. Therefore, this study is exploring ways to provide a methodology that can be used as quality control, capable of measuring or monitoring the effectiveness of MFCC applications in the field.

### Methodology

Laboratory testing provided anticipated baseline concrete performance for a variety of potential environmental conditions. Four field sites were assessed during the 2023 and 2024 construction season. The laboratory portion evaluated moisture loss and surface hydration for a wide range of simulated environmental conditions, quality of MFCC application, and timing. A new technique of embedded resistance was developed to assess the differences between the cure-affected zone and the bulk or interior of the concrete.



*Field test construction on WIS 15*

The field portion of the research involved simple observations of construction timing and measures of how much MFCC was applied along with chilled mirror humidity profiles, shrinkage, ground penetrating radar (GPR), and joint activation and movement assessment. The Evaluation Index (EI) parameter was utilized and showed that the optimum application rate can be determined from the

***“Results from this study showed that sufficient application rate is more important than uniformity for most environmental conditions. Application rate and timing can be controlled in the field and were highly correlated to shrinkage, joint activation, and slab movement.”***

**– Tirupan Mandal,  
WisDOT**

anticipated weather conditions and that real-time monitoring using a weather station, relative humidity, and embedded resistance can confirm the applied MFCC is producing the desired concrete conditions. Finally, GPR can be used to confirm complete coverage.

## Results

Results from laboratory tests showed that for most environmental conditions, having sufficient MFCC but non-uniformly applied is more beneficial than insufficient and uniform coverage. However, at the highest evaporative conditions both coverage rate and consistency are important. Results also show that when MFCC is applied too early, when significant bleed water is present, the long-term evaporation rate is much higher due to dilution of the MFCC. The concrete tested at 0.5 inches below the surface was agnostic to environmental conditions, supporting definition of the cure-affected zone as between 0.5 inches and the surface.

The field results show that application of MFCC is highly variable, and the rate and timing can be controlled in the field and were highly correlated to shrinkage, joint activation, and slab movement. For the observed construction projects, the rate of paving varied between three feet per minute up to eight feet per minute. The curing cart speeds varied from 50 feet per minute to 100 feet per minute with most operational speeds around 75 feet per minute. For three of the sites, timing and curing operations occurred at the same time with US 53 being the lone site where these operations were performed separately. Since the speed of the curing cart is so much greater than the paving operation, the curing cart operates for short bursts of activity. On average the curing cart operator allowed a gap of 100-200 feet to develop between the texture cart and the curing cart before applying the MFCC, with the texture cart approximately 50 feet behind the paver.

## Recommendations for Implementation

Based on the results, the research team made several recommendations:

- Since time and rate of application of MFCC influence concrete properties, take the first 300 feet of the day to calibrate the speed of the application rate and adjust the bar height to ensure proper overlap. This improves uniformity and integration of the curing application as well as saw-cutting operations and joint activation
- Conduct further research on chilled mirror-based technology to monitor internal humidity and rates of evaporation. Other sensor technologies such as time domain reflectometry also have potential for this application
- Consider the use of GPR and GPS technologies for the paving operation to establish a fixed time window for texturing and curing operations

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-22-03  
Timely and Uniform Application of Curing Materials

Wisconsin Highway Research Program

## Investigation of MSE Wall Corrosion in Wisconsin

### Objectives

- Assess steel reinforcement condition of MSE wall
- Evaluate electrochemical and geotechnical properties of the backfill material
- Determine the remaining life service of the MSE wall
- Evaluate WisDOT's design and maintenance practices relative to corrosion of buried steel
- Provide recommendations to enhance long-term durability and safety of MSE walls

### Benefits

- Improve design and maintenance practices for MSE walls
- Provide recommendations to enhance long-term durability and safety of MSE walls

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### Background

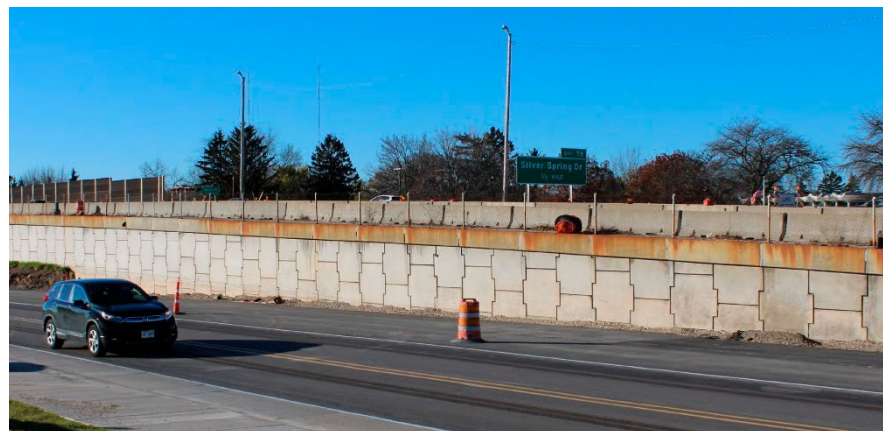
Mechanically Stabilized Earth (MSE) walls play a crucial role in transportation infrastructure due to their cost-effectiveness, ability to tolerate deformations, and higher resistance to seismic loading than rigid concrete wall structures, among other advantages. These walls typically consist of metallic or geosynthetic reinforcing layers that provide tensile strength to the backfill and facing elements. While MSE walls are intended for long-term performance, the durability of their steel reinforcements is a key factor influencing their service life. When embedded in soil, steel reinforcements are susceptible to corrosion due to electrochemical interactions with the surrounding backfill.

As part of a highway widening project, WisDOT planned to remove an MSE wall along I-43 in Glendale, Milwaukee County, in 2024. The MSE wall, built in 1992, was reinforced with galvanized steel strips.

### Methodology

Geocomp was contracted by WisDOT and performed a field investigation and analysis of this MSE wall. Geocomp investigated five 10 feet by 15 feet excavation sections (1 through 5) along the MSE wall by carefully deconstructing its components. The wall height decreased, and distance from the bridge increased, from Section 1 to 4. Section 5 was a shallow trench between Sections 1 and 2.

Their testing included field soil resistivity, gradation, moisture content, pH, Atterberg limits, Proctor, direct shear, chloride content, sulfate content, galvanized coating and steel thickness and corrosion loss measurements.



*MSE Wall along I-43 in Glendale, Milwaukee County constructed in 1992*

***“This research showed salt use and pavement condition are key factors that were not previously used to determine the condition of wall elements. This new information will allow the department to add crucial information to the department’s toolbox for designing and maintaining the MSE wall inventory and allow us to develop better risk matrices to manage that inventory.” – Steve Doocy, WisDOT***

## Results

The study’s findings emphasize the critical impact of pavement distress and salt intrusion on the deterioration of MSE wall reinforcements. Overall, the data show that corrosion loss decreases with increasing depth of the reinforcing straps. The results show significant corrosion in metal straps at shallow depths, while minimal to no corrosion was observed beyond a depth of 10 feet. Additionally, metal straps in sections closer to the bridge, where the wall is taller, show higher corrosion levels. Field investigations revealed that moisture and salt intrusion through pavement cracks and joints likely altered the backfill electrochemical properties over time, creating a highly corrosive environment.

Geocomp excavations uncovered elevated chloride levels in the reinforced backfill and significant corrosion loss, as indicated by pitting corrosion loss as high as 90% of the strip’s cross-sectional area in some locations. The excessive corrosion loss of metal strips extended to a depth of up to 13 feet from the top of the MSE wall. Deterministic stability analyses indicated that, had the MSE wall remained in service, an internal failure was highly probable within 10 to 15 years.

## Recommendations for Implementation

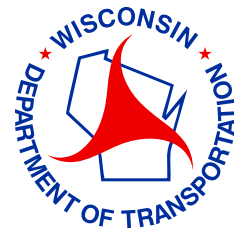
Geocomp made several recommendations for design and construction practices to reduce corrosion including:

- Use non-aggressive fills in the reinforced zone, use galvanized coated reinforcements, and design the reinforcements with a sacrificial thickness
- Design the pavement cross slopes to force and manage the surface water to flow away from the reinforced zones
- Ensure uniform compaction of the backfill around the MSE wall to minimize differential settlement in fill
- Use impervious membranes and drainage systems to mitigate the intrusion of de-icing salts and chemicals into the backfill
- Design a dedicated drainage system for the bridge and its approach slab to prevent water infiltration into the backfill
- In the absence of other design modifications, the upper rows of reinforcement straps are more exposed to excessive corrosion. Increasing the sacrificial thickness of these upper rows could extend the service life
- Regularly maintain pavement surfaces and drainage structures to prevent salt and moisture intrusion
- Give special attention to pavement directly above the reinforced zone, ensuring cracks and joints are routinely sealed

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-24-02  
Investigation of MSE Wall Corrosion in Wisconsin

Wisconsin Highway Research Program



# Completed Policy and Safety First Research Programs Projects

The 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 agency operations.

The Safety First Research Program funds projects to research, demonstrate or test new technology and innovative best practices to improve safety throughout the state's multimodal transportation system.

## Wisconsin Non-Driver Transportation Behavior Study

### Objectives

- Understand the transportation needs, behaviors, challenges and opportunities for Wisconsin's non-drivers
- Examine relevant data that influence the available transportation options on non-drivers daily activities
- Identify non-driver preferences for possible transportation services, technologies and policies that could improve their mobility

### Benefits

- Lay the groundwork to create a more inclusive transportation system that ensures equitable access to essential services and activities for all Wisconsin residents

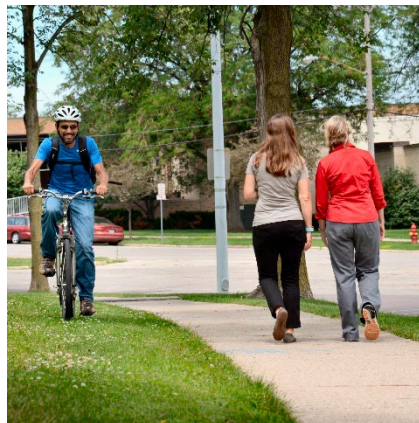
### Background

Non-driving populations consist of diverse groups, such as aging adults, students, children, low-income individuals, and those with disabilities, as well as individuals who choose not to drive, lack access to a vehicle, or have limited transportation options. Non-drivers account for approximately 31% of the state's population, with rural areas experiencing the greatest mobility barriers due to limited transportation options.

This study explores the transportation challenges faced by non-drivers in Wisconsin, a population comprising aging adults, individuals with disabilities, low-income residents, and those without access to vehicles; to understand the transportation needs, behaviors, and challenges of non-drivers and their support networks, termed "non-driver-adjacent" individuals, who often provide rides or other transportation assistance.

### Methodology

A literature review was conducted on topics of mobility, challenges faced by non-drivers, socioeconomic and demographic factors, technological impact, and potential solutions and strategies. A statewide survey was also conducted of 1,268 respondents, including 505 non-drivers and 763 non-driver-adjacent individuals, collected insights into the reasons for not driving, transportation options used, service satisfaction, and unmet needs.



*Non-drivers of all ages make up 31% of Wisconsin's population*

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### Results

The survey results reveal significant mobility challenges across the state. Non-drivers identified high costs of vehicle ownership (28.71%), lack of a driver's license (33.07%), and disabilities (23.71%) as primary barriers to driving. Public transit (32%) was widely used but limited in

***“Understanding the dynamic transportation-related challenges faced by non-drivers in Wisconsin will help us address the unique challenges, improve mobility options and enhance overall quality of life.” – Ethan Severson, WisDOT***

rural areas, while ride-hailing (5.8%) services were viewed as prohibitively expensive for routine use.

Non-driver-adjacent group reported time constraints and scheduling conflicts as major challenges in providing rides. Many noted the need for better public and community-based transportation options to alleviate their burden. Respondents expressed mixed satisfaction with existing transportation services. Family-provided (72.5%) rides were highly valued for their flexibility and reliability, but public transit (50.4%) and paratransit services (38.1%) received lower satisfaction ratings due to limited coverage, indirect routes, and insufficient service information.

### Recommendations for Implementation

The research illuminated critical gaps in Wisconsin’s transportation network that hinder the mobility of non-drivers and their support networks. To address these issues, the study recommended a range of strategies including:

- Expanding public transit coverage and frequency, particularly in underserved areas
- Enhancing pedestrian and cycling infrastructure to promote active transportation
- Developing affordable, community-driven ride-sharing programs
- Implementing financial subsidies to reduce the cost burden of transportation for low-income individuals
- Leveraging technology to improve service delivery, including real-time tracking and optimized scheduling for public and paratransit services

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-24-10  
Wisconsin Non-Driver Transportation Behavior Study  
Policy Research Program



## Engineering Countermeasures to Mitigate Reckless Driving Behavior

### Objectives

- Enhance understanding of the role of reckless driving in traffic safety on Wisconsin roads
- Identify effective countermeasures to mitigate the impacts of reckless driving

### Benefits

- Offers a data-driven foundation for prioritizing safety interventions
- Improves safety resource allocation and supports targeted efforts to reduce reckless driving crashes in Wisconsin

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### Background

Despite great advancements in vehicle technology and infrastructure, reckless driving remains a significant risk to safety on roadways. This project sought to enhance understanding of reckless driving, identify engineering-focused countermeasures to mitigate its impact, and identify locations most likely to experience reckless driving crashes in Wisconsin.

According to WisDOT's 2022 year-end crash statistics, there were 17,895 speed-related crashes, 29,237 distracted driving related crashes, and 7,048 impaired driving related crashes, which accounted for 13.9%, 22.7% and 5.5% of all crashes in the state, respectively.

### Methodology

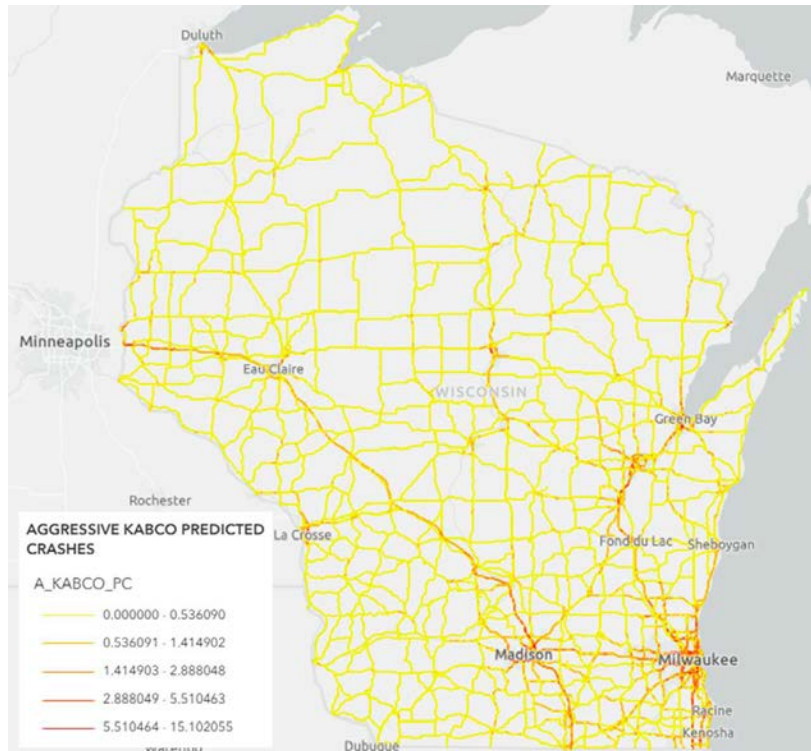
The study consisted of a literature review, stakeholder interviews and the development of data-driven crash risk models. The literature review synthesized national findings on countermeasures such as dynamic speed feedback signs, rumble strips, high-tension cable barriers, and infrastructure adjustments like road diets and traffic calming features. These interventions were evaluated using crash modification factors (CMFs), simulations, and empirical studies. Interviews with stakeholders—including other state DOTs' insurance companies, and vehicle manufacturers—provided insight into practical challenges and innovative solutions. These included automated speed enforcement systems, intelligent speed assistance (ISA), and in-vehicle drowsiness alerts.

The research team developed statistical models using Wisconsin-specific crash, roadway, and public health data. These models predict the likelihood of reckless driving crashes on various roadway types and have been integrated into a network screening tool. This tool can enable WisDOT to prioritize high-risk locations for targeted intervention.

To support visual interpretation of these results, the predicted crash risks and observed crashes were mapped across the statewide network, enabling spatial identification of high-risk roadway segments. The maps provide a clear and intuitive way to highlight locations where specific reckless driving behaviors are more likely to result in crashes, helping agencies focus safety efforts geographically.

***“Understanding where and what type of reckless driving incidents are occurring will help us choose the best countermeasures to prevent further fatalities or severe injuries.”***

**– Maryne Taute,  
WisDOT**



*Map showing predicted aggressive driving-related crashes by segment*

## Results

Based on the study, sites with higher predicted crashes are often associated with factors such as higher annual average daily traffic, longer segment lengths, and undivided or relatively wide roadways. On the other hand, sites with lower predicted crashes are often associated with relatively higher posted speed limits and the presence of wider shoulders. Additionally, speeding was identified as having a relatively higher risk of resulting in crashes.

## Recommendations for Implementation

Based on the research results, the team recommends that WisDOT prioritize network screening at sites with higher risks and consider targeted countermeasures such as median installation, shoulder widening, and traffic calming treatments. At sites where speeding contributes significantly to crash risk, it is recommended that WisDOT consider implementing speed management strategies, such as speed feedback signs or geometric modifications.

To maintain the effectiveness of the tool, regular model updates and validation with the most recent crash data are encouraged, alongside ongoing training for users to correctly interpret outputs and implement appropriate safety improvements.

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-24-11  
Engineering Countermeasures to Mitigate Reckless Driving Behaviors  
Policy Research Program



## Countermeasures to Improve Pedestrian Visibility to Tall Vehicles

### Objectives

- Investigate the relationship between tall vehicles and pedestrian visibility to provide safety recommendations
- Analyze crash data and identify safety and policy measures aimed at improving pedestrian safety and visibility

### Benefits

- Research provides WisDOT with actionable strategies to address the increasing threat posed by tall vehicles to pedestrian safety
- Recommendations will create a safer transportation environment for all users

### Background

Over the past few decades, tall vehicles have become much more commonplace on American roads. These vehicles pose great risks to pedestrians as they have significantly larger blind zones and higher levels of pedestrian injury severity. This phenomenon, combined with distractions from electronic devices and risky driving behaviors, has contributed to an 80% rise in pedestrian fatalities in the United States since 2009.

A 2023 Insurance Institute for Highway Safety (IIHS) study found that vehicles with hood heights over 40 inches are approximately 45% more likely to cause fatal pedestrian crashes than lower-profile vehicles. Wisconsin’s crash trends reflect this national pattern, with tall vehicle-involved crashes now surpassing those involving non-tall vehicles in recent years.

### Methodology

The research team conducted a comprehensive review of 83 academic and industry sources and analyzed 39 years of single-vehicle single-pedestrian (SVSP) crash data from Wisconsin, Tennessee, and Florida. The dataset comprised 101,778 crashes that spanned the 2010s, a decade marked by rapid growth of tall vehicles. Vehicle heights were identified by joining crash data with the Canadian Vehicle Specifications (CVS) database through the National Highway Traffic Safety Administration (NHTSA) VIN Decoder, defining tall vehicles as those exceeding 66 inches in height.

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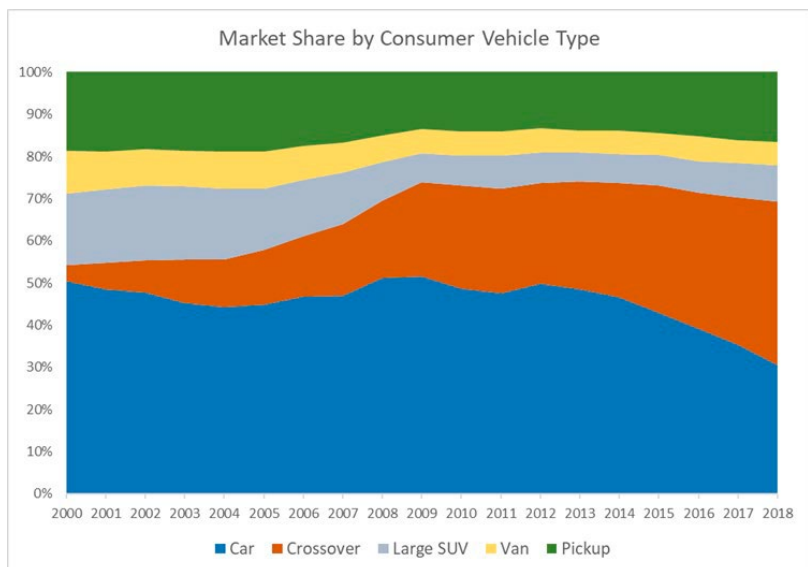
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Consumer Vehicle Market Share. Consumer Reports, 2019

***“Cars are getting bigger – we need to understand the implications of this so we can be proactive in our response. We must continue to create safer roads for all road users, including pedestrians.” – Maryne Taute, WisDOT***

## Results

Results from the study revealed several key predictors of SVSP crashes in Wisconsin. Left turns and backing maneuvers significantly increased the likelihood of tall vehicle involvement, while right turns and actions like merging or parking were negatively associated. Driver behaviors such as failure to yield were also strong predictors, each linked to a 54% higher chance of tall vehicle involvement, highlighting visibility challenges. Pedestrian location being in the crosswalk or roadway increased the likelihood of a tall vehicle crash by at least 50%.

Rural roads, likely due to the prevalence of large vehicles, were associated with a 56% increase in tall SVSP crashes. Additionally, posted speed limits of  $\leq 15$  mph, 30–40 mph, and  $\geq 45$  mph were all significantly associated with higher tall vehicle involvement (increases of 56%, 55%, and 54%, respectively), compared to 20–25 mph zones. Divided roadways and parking lots/private property also showed strong associations, each linked to a 53% higher likelihood of tall vehicle involvement, underscoring the influence of roadway design and visibility limitations.

Generally, tall vehicles in Wisconsin exhibit 22% higher severity risk, likely due to greater average height and more low-speed crashes than in other states. Other key predictors of injury severity include high speed limits, poor lighting, alcohol or drug impairment (especially in drivers). Male drivers were consistently associated with higher injury severity.

## Recommendations for Implementation

Based on the research findings, the team recommends several proven countermeasures that improve pedestrian visibility including:

- Low-cost, high-impact engineering treatments such as advance yield markings, high-visibility crosswalks, curb extensions with daylighting, leading pedestrian intervals (LPs), refuge islands, and raised crosswalks
- Flashing pedestrian beacons like Rectangular Rapid Flashing Beacons (RRFBs) and High-Intensity Activated Crosswalks (HAWKs) to improve driver awareness
- Intersection and midblock design changes that reduce speeds and improve sightlines

Using the Safe System approach, countermeasure selection should be based on pedestrian safety being fully integrated into transportation planning, and roadway design should shift from prioritizing efficiency to emphasizing safety. Agencies should use data-driven analysis to identify and address pedestrian visibility issues. Since speeding and failure to yield are major contributors to crashes involving tall vehicles, agencies should update their driver education materials and partner with local communities to promote awareness of pedestrian visibility challenges.

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-24-12  
Countermeasures to Improve Pedestrian Visibility to Tall Vehicles

Policy Research Program

## Artificial Intelligence in Transportation

### Objectives

- Map the current and potential applications of AI in asset management, transportation safety, traffic operations, digital twin, autonomous vehicles and generative AI
- Understand the perceptions, expectations and concerns about AI from diverse stakeholder groups including state agencies and academic/industry experts

### Benefits

- Inform the strategic planning and implementation roadmap for WisDOT and other agencies through evidence-based insights into user perceptions, benefit-risk tradeoffs and key areas for investment

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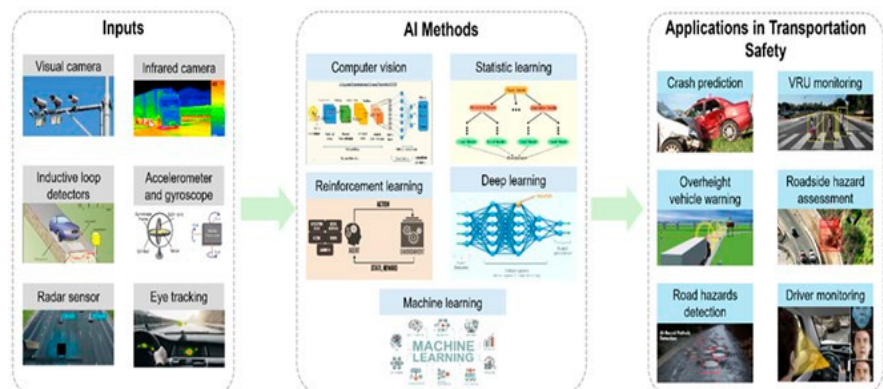
### Background

Artificial Intelligence (AI) has emerged as a transformative force in transportation, enabling smarter, safer, and more efficient systems. Key areas where AI has demonstrated significant potential include transportation asset management, transportation safety, transportation operations, digital twins, autonomous vehicles, and generative AI. The U.S. Department of Transportation (USDOT), in collaboration with the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), and Federal Aviation Administration (FAA), has started exploring AI's potential within the transportation ecosystem.

However, integrating AI into transportation agency operations requires a strategic understanding of current capabilities, stakeholder perceptions, data readiness, and implementation risks. This study aims to address these gaps by providing a comprehensive, stakeholder-informed roadmap for advancing AI deployment across WisDOT operations.

### Methodology

To achieve this, researchers conducted a targeted literature review categorized by the key areas listed above. Researchers also collected perception data through a structured survey and follow-up interviews and performed a cross-sectional analysis of professional attitudes toward AI deployment. Key dimensions of analysis included data quality and availability, perceived benefit-risk balance, application maturity, time investment expectations, and organizational perspectives.



*AI-driven methods and applications for enhancing transportation safety*

### Results

The results highlight areas of alignment and divergence among transportation professionals and reveal how experience, institutional affiliation, and domain maturity shape attitudes toward AI. The results

***“As AI is increasingly in the news, it’s important to understand its benefits without getting lost in the hype. This research will help WisDOT take advantage of this technology to improve our transportation system in ways that are strategic, human-centered, and most importantly, safe.” – Johanna Schmidt, WisDOT***

show state agencies prioritize trustworthiness and practical implementation, while academic stakeholders focus more on innovation and technical readiness.

The research reveals that while AI is advancing rapidly in the broader transportation sector, its adoption by public agencies remains in relatively early stages. Significant opportunities for these agencies lie in asset management, safety, and traffic operations, which offer the best near-term benefits. Key challenges include data quality and management, alongside notable skills gaps in the workforce.

## Recommendations for Implementation

Researchers proposed several recommendations for both short-, medium- and long-term implementation including these highest priority steps:

- Establish comprehensive data governance frameworks that standardize collection, storage and quality control protocols across the organization. This foundation is essential as data quality consistently emerges as a prerequisite for successful AI implementation
- Prioritize asset management, safety and operations applications for initial AI deployments. These areas offer the clearest near-term opportunities for demonstrating AI benefits while building organizational capabilities
- Implement AI training programs that develop differentiated skills for employees at different career stages and with varying AI exposure. This approach could address the workforce gaps identified in the survey and maximize the value of diverse perspectives and experiences
- Establish AI Center of Excellence to create a dedicated team of AI experts who can provide internal consulting, training, and project support across the organization. The Center would serve as the operational backbone of AI efforts across the agency and act as a key coordination node, interfacing with both the AI Ethics Committee and the Transportation AI Research Consortium to align implementation with ethical standards and research insights
- Develop robust AI governance policies that address data privacy, and model documentation, testing standards and human oversight mechanisms. Clear governance frameworks provide guidelines for development teams while ensuring responsible innovation
- Pursue a diversified partnership strategy that leverages vendor relationships for proven solutions, academic collaborations for research and peer agency exchanges for knowledge. This balanced approach accelerates capability development while managing resource constraints

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-24-14  
Artificial Intelligence in Transportation

Policy Research Program



## Investing in Engineering Talent

### Objectives

- Examine challenges in hiring, retention and engagement of engineering employees
- Document the challenges in knowledge transfer and management processes
- Provide best practices and recommendations for implementation

### Benefits

- Lays groundwork for creating effective workforce management, and transfer and retention of knowledge strategies
- Addresses current workforce attraction and retention challenges WisDOT faces
- Positions WisDOT as an attractive employer for a multigenerational engineering and technically skilled workforce

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### Project Manager

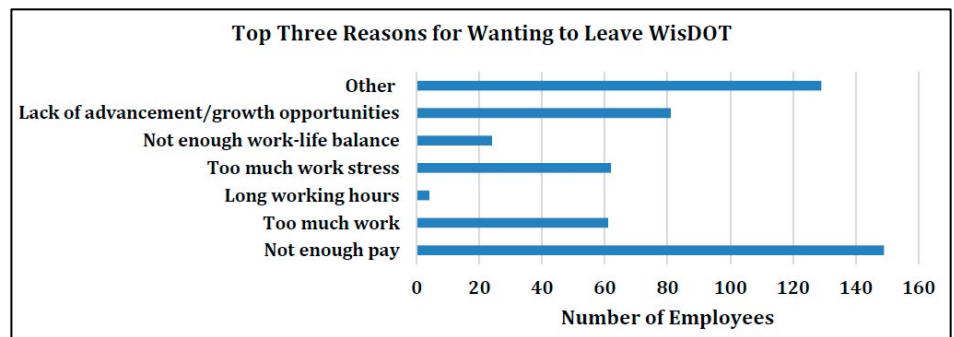
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### Background

State transportation departments have been facing heightened pressures to attract, engage, and retain multigenerational qualified engineers and technical staff due to a combination of factors including high demand for engineers, decreasing graduation rate of civil engineers, budget constraints, the retirement wave and varying needs and priorities of a multigenerational workforce.

The current project aimed to examine WisDOT’s twin challenges related to workforce management strategies and the retention and transfer of specialized, technical knowledge for engineering and technical professionals within the Division of Transportation System Development (DTSD). Specifically, the research project examined WisDOT DTSD employees’ perceptions of practices related to attraction (including hiring and onboarding), retention (including satisfaction with training, career development, pay, varied benefits, e.g., flex work and work-life balance), attrition (including retiring and retirement-eligible employees), and knowledge management and transfer strategies to recommend an implementation plan based on data analysis and peer DOT’s best practices.



*Surveyed DTSD employees’ reasons for wanting to leave WisDOT*

### Methodology

Researchers undertook a literature review of transportation engineering workforce, examined different types of institutional knowledge programs and practices related to highway and bridge improvement and maintenance programs, challenges in maintaining institutional knowledge, and the current knowledge transfer process and benchmarked these practices against peer DOTs. The team examined DTSD’s attraction, retention, and engagement practices through the perspectives of their multigenerational technical staff at different career stages. Lastly, they examined the engineering faculty’s assessment on student readiness as well as recent civil engineering students and graduates’ expectations, preferences, and attitudes toward engineering

***“Continued attention to and investment in recruitment, retention and knowledge management are critical for state agencies like WisDOT to compete for the emerging talent that will expertly serve the traveling public.” – David Hunt, WisDOT***

careers. Internship and placement data from several civil engineering college programs were also analyzed.

## Results

Through their analysis, researchers found 49% of newly hired employees with less than five years of DTSD tenure envisioned finishing their careers at WisDOT. Reasons for choosing to work at WisDOT: a generous benefits package, work-life balance even with less competitive salaries, and reputation for learning the right way to do things. They want mentors and coaches for new hires. They also expressed a need for improvement in application materials, interview process, and onboarding.

Another finding is the relatively low WisDOT salaries compared to private sector and peer DOTs (e.g., MN, MI) which could effectively price out WisDOT from hiring their preferred civil engineering candidates. There is evidence that workforce and staffing challenges at DTSD are due to uncompetitive pay, high turnover of key staff with expertise that’s not been captured and inadequate succession planning.

Another concern is the decreasing graduation rates of civil engineers and technically skilled applicants at national and regional levels that serve as the applicant pool for WisDOT. This will pose a danger of leaving DTSD’s critical civil engineering and other technical roles unfilled.

Findings show that civil engineering and technical students’ expectations from their first jobs include competitive and fair salaries, career growth and advancement opportunities, opportunities to work with cutting edge technology, hands-on field experiences, opportunities to work on sustainable infrastructure, smart cities, and reducing the environmental impact of transportation systems, and work-life balance, job stability, and security. There was a significant overlap between the expectations and career goals of civil engineering students and those from technical colleges.

## Recommendations for Implementation

Researchers used the results to offer the following evidence-based recommendations:

- Invest in knowledge management by creating a comprehensive succession planning and knowledge management program.
- Increase investment in employee engagement, retention and development efforts.
- Increase financial and administrative support for marketing and storytelling to attract new talent.
- Strengthen operational support by investing in workforce development professionals.
- Engage leadership at all levels to invest in their employees’ professional development.

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-24-16  
Investing in Engineering Talent

Policy Research Program

## Wildlife Crossing Hotspot Analyses for Major Highways in Wisconsin

### Objectives

- Explore ways to enhance road safety by reducing collisions with large wild animals
- Ensure safe crossing opportunities for wildlife
- Identify and prioritize road sections along state routes that have a high concentration of collisions involving large animals

### Benefits

- Reduce collisions with wild animals and provide them safe passage
- Reduce road mortality for species that are of conservation concern

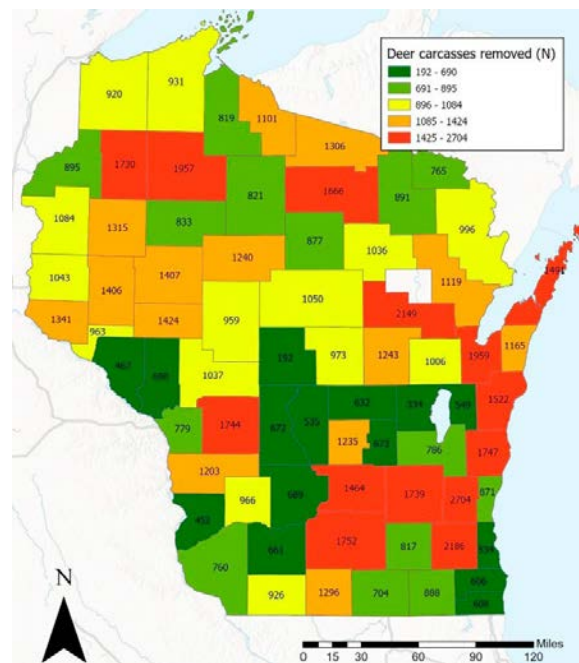
### Background

Wildlife-vehicle collisions are becoming increasingly common across much of North America, posing risks to both human safety and the individual animals involved. In the United States alone, several million collisions with large wild mammals occur annually. These collisions nearly always result in vehicle damage and costly repairs, but they also cause tens of thousands of human injuries and hundreds of human fatalities each year.

Much emphasis has been placed on mitigating vehicle collisions with large animals, but there are other reasons to consider wildlife mitigation along highways. This report identifies five categories of road and traffic impacts on wildlife: habitat loss, wildlife mortality, barriers to wildlife movement, decrease in habitat quality near roads and right-of-way habitat corridors.

### Methodology

Researchers identified and prioritized road sections in Wisconsin along state-maintained routes that have a relatively high concentration of collisions involving large wild mammals, mostly with white-tailed deer. Using large wild mammal crash and carcass data to conduct cost-benefit analyses, researchers identified road sections where the implementation of mitigation measures may be less expensive than doing nothing and letting these types of collisions continue to occur.



Deer carcasses removed from roads by county 2018-2023

### Principal Investigator

Marcel Huijser  
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### Project Manager

Jennifer Gibson  
WisDOT  
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***“This research provided WisDOT valuable insight into wildlife-vehicle collision hotspots and tools to aid our agency in prioritizing mitigation efforts. The report will support WisDOT’s continued effort to develop a wildlife collision reduction and crossing opportunity strategy.”***

**– Jennifer Gibson,  
WisDOT**

## Results

Researchers identified 36 species of conservation concern in Wisconsin. The species of conservation concern included 4 amphibian species (3 frog species, 1 salamander species), 20 reptile species (3 lizard species, 13 snake species, 4 turtle species), and 12 mammal species (1 insectivore species, 5 rodent species, 1 mustelid species, 1 canid species, 2 felid species, 2 ungulate species).

Researchers identified road sections, or counties, where species of conservation concern have been observed. Road sections that would need to be prioritized for reducing collisions with common large mammals are mostly in the eastern and southeastern parts of Wisconsin. Areas where a relatively high number of species occur that are of conservation concern are predominantly in the southwestern parts of Wisconsin.

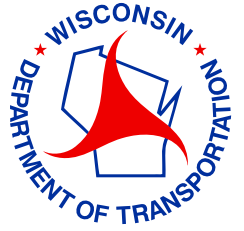
Fences or barrier walls in combination with wildlife crossing structures are the most robust and effective mitigation measure package to both reduce collisions with large and small animal species and maintain or improve connectivity for wildlife. However, it is also important to be aware of the limitations of existing crossing structures that were not built for wildlife versus designated wildlife crossing structures. While designated wildlife crossing structures should be located where connectivity for wildlife is needed most, existing structures that were not built for wildlife are not necessarily located where connectivity for wildlife is needed most.

## Recommendations for Implementation

- When starting a project, researchers recommend starting by identifying objectives and how they relate to improving human safety through reducing collisions with large animals. Or, if they benefit biological conservation through reducing direct road mortality by reducing the barrier effect of roads and traffic
- Devising a strategic plan around these objectives including policies, funding mechanisms and implementation programs increase the likelihood of the project objectives being met
- Action plans should be species-specific, meaning conservation-related objectives need to consider the landscape in which the animals live, not just the road and associated right-of-way. Species-specific action plans should be compiled in coordination with natural resource management agencies, counties, NGOs and volunteers

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-24-17  
Wildlife Crossing Hotspot Analyses for Major Highways in Wisconsin  
Policy Research Program



# Completed Materials Management Projects

Materials Management projects are an important research and technology transfer activity for WisDOT. These projects ensure the department is collecting reliable data, revising specifications and updating methodologies on the materials used to build and maintain Wisconsin's transportation system.



## Effects of Elevated Temperature on Cold-in-Place Recycling (CIR) Mix Design

### Objectives

- Perform a series of laboratory tests and mix designs on millings gathered from two WisDOT projects in different regions
- Investigate the effects of elevated temperature on CIR mix design, particularly with respect to tensile strength, tensile strength ratio (TSR), and oil content.

### Benefits

- Provides further insights into assessing existing criteria for constructing good-quality and cost-effective CIR layers to preserve the state's roadway system.
- Helps better understand how elevated temperature can affect CIR mix design and performance.

### Background

Current Standardized Special Provision (STSP) used for cold-in-place recycling (CIR) (stp-327-010) states that the asphalt binder stabilizing agent and the metered water added at the mill used for cooling and compaction should be 2.00 percent each with a field adjustment tolerance +/- 0.30 percent. Also, the STSP states that 500-foot test sections will be required as a comparison at the department's direction if the stabilizing agent or water application rate is not within the range of 1.70 to 2.30 percent (no test section will be considered below 1.50 percent asphalt binder stabilizing agent).

The adjustments to the stabilizing agent application rate are generally done on hot days to improve constructability; however, the effects of elevated temperature on the performance of recycled aggregate base layers are not clearly known. Therefore, there is a need to perform CIR mix designs at different temperatures. This study was designed to run CIR mix designs using different recycled asphalt pavement (RAP) materials at standard (77°F) and elevated (104°F) temperatures.

### Methodology

WisDOT provided two sources of millings used in foamed CIR mix design testing. Approximately 970 and 500 lbs of millings from two projects were provided to American Engineering Testing, Inc. (AET).

Materials provided to AET for the mix design testing included:

- Source #1 millings – STH 48 (Northwest Region)
- Source #2 millings – STH 23 (Southwest Region)
- PG 52-34 binder – MTE Texpar, Davenport, tank/batch 5-5, sampled 4-23-25

AET followed the WisDOT CIR Mix Design Process provided in stp-327-010 and the WisDOT CIR Mix Design Template V1.2.

Foaming characteristics of the bituminous binder were determined at 3 temperatures and 4 water content injection rates, using the Wirtgen foaming laboratory (WLB-10S) according to the Wirtgen manual for cold recycling.

For source #1 millings (STH 48), AET performed an extraction/gradation, gradation of the as received millings, Proctor according to AASHTO T 180, and RAP coating test according to AASHTO T 59. For source #2 millings (STH 23), AET did not perform gradation, extraction, Proctor, and coating test on this source of millings. WisDOT provided the gradation, extraction, Proctor, and coating test results to AET. Both millings were graded to meet specifications for a medium gradation band according to AASHTO M 357-25.

**WisDOT Project Manager**

**Sinan Coban**

WisDOT

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***“Understanding how temperature affects CIR mix design and process will help us build quality recycled asphalt base layers.”***

**– Sinan Coban,  
WisDOT**

For source #1 millings (STH 48), mix designs at 4 foamed asphalt contents and 2 water contents (8 combinations) were completed at 77°F and 104°F. For source #2 millings (STH 23), a total of two points were performed at 2.0% foamed asphalt with 2.0% water and 2.0% foamed asphalt with 3.0% water at 77°F due to limited material. However, for source #2 millings (STH 23), mix designs at 4 foamed asphalt contents and 2 water contents (8 combinations) were completed at 104°F.

For the mix designs at 77°F, the millings were both mixed and compacted at 77°F. For the 104°F mix designs, the batched millings were preheated in the oven to 104°F prior to mixing. After mixing, the foamed CIR mixture was returned to the oven and maintained at 104°F during specimen compaction.

## Results

The foaming characteristics of the binder used met the minimum expansion ratio of 8 and half-life of 6 criteria at each temperature and water content combination. There were changes in the mix designs performed at different temperatures. Overall, the mix designs completed at 104°F exhibited higher bulk specific gravities and less air voids for both materials.

In addition, higher conditioned and unconditioned tensile strengths were observed in the mix designs completed at 104°F. The tensile strength and tensile strength ratio (TSR) values of source #1 millings were consistently higher than those of source #2 millings, potentially indicating that some material properties such as morphology and rock type played a role in the results, which requires further investigation. Overall, the effect of the elevated temperature on the selection of the recommended foamed asphalt and compaction water contents could not be clearly observed.

## Recommendations for Implementation

Further research should be conducted to expand the population of test materials to better investigate the effects of specimen size, gradation, aggregate morphology, and rock type on CIR mix designs at standard and elevated temperatures. The repeatability of the tests will also need to be investigated. In addition, the other binder alternative (PG 46-34 without polymer modification) listed in the currently used STSP for CIR (stp-327-010) should be included in mix designs conducted at different temperatures in future research.

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-25-50  
Effects of Elevated Temperature on Cold-in-Place Recycling (CIR) Mix Design  
Materials Management Section Project

## Use of Calorimetry to Evaluate Concrete Performance

### Objective

- Evaluate compatibility and performance of cementitious materials and admixtures used in concrete mixes in Wisconsin.

### Benefits

- Ensure durability of concrete pavements in Wisconsin by understanding how compatibility of current cementitious materials affect material handling, curing, and workmanship.

### Background

In the last two years, numerous projects across the state have experienced issues with concrete cracking and inadequate joint sawing caused by changes in concrete setting time which is influenced by the heat of hydration of cementitious material and their compatibility with concrete admixtures used. Calorimetry measures the heat generated from the early hydration reactions of cementitious materials which gives visibility into the behavior of concrete and is an indicator of relative performance of cementitious mixes. Calorimeters are effective tools used during mix design to determine potential material incompatibility or optimal dosages/sequence of addition of admixtures. They can also be used to determine setting times and saw cut times in lieu of physical testing.

### Methodology

The research funding for this project allowed the Wisconsin Department of Transportation (WisDOT) central laboratory to purchase a calorimeter to evaluate compatibility and performance of materials used in concrete mixes in Wisconsin. To measure the compatibility of materials, four different concrete mixtures with different proportions and types of cementitious materials were prepared. Supplementary cementitious materials (SCMs) were used at different replacement rates to replace cement content in the total quantity of cementitious materials as outlined below:

- Sample #1: 30% fly ash replacement
- Sample #2: 22% fly ash replacement
- Sample #3: 15% fly ash replacement
- Sample #4: 30% slag replacement

One concrete specimen was prepared for each mixture, and the concrete cylinders were then inserted in the calorimeter (Figure 1).



Figure 1. Calorimeter equipment

WisDOT Project Manager

Aleksandra Graff

Concrete Engineer

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**“Calorimeter provides real-time information that can be used to monitor variations in concrete during production.”**

**Aleksandra Graff,  
WisDOT**

## Results

The calorimeter generates the hydration curve, also known as the heat signature, for each specimen. With the purchased calorimeter, the Bureau of Technical Services’ (BTS’s) central laboratory has been able to evaluate the heat signature for each specimen (Figure 2) and determine setting time of concrete mixes containing different SCM replacement rates.

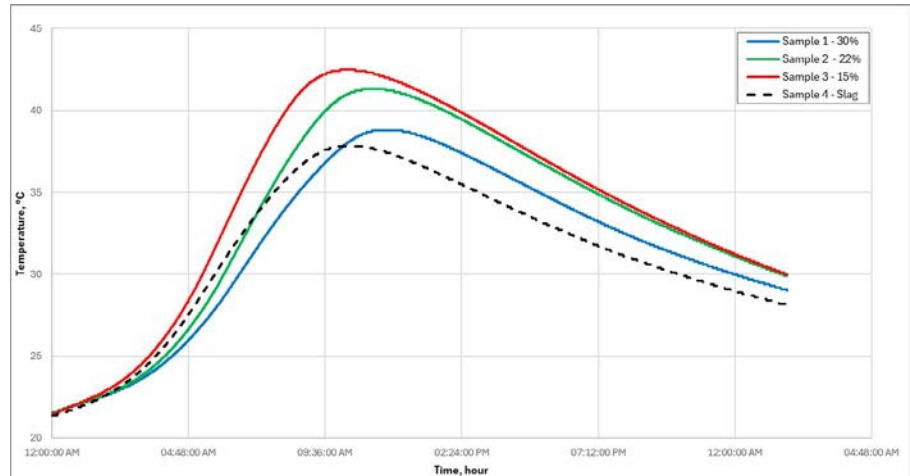


Figure 2. Heat Signatures generated by calorimeter

SCM replacement rates used in this project represent typical proportions found in Class I concrete pavements. Results indicate the following:

- Samples with slag and 15% fly ash replacement rates led to faster setting time of concrete mixes
- As the fly ash replacement rate increased (15%→22%→30%) the setting time of concrete was delayed, and the heat generated by the specimen decreased
- Heat signature for the slag specimen was lower than the heat generated by the fly ash specimen

Heat signatures will allow WisDOT to better predict concrete sawing times, strength gain, curing, and opening of concrete pavement to traffic. Similarly, it will allow WisDOT to see any potential incompatibilities between cementitious materials and chemical admixtures.

## Recommendations for Implementation

To ensure that the concrete mixtures used in Class I concrete pavements in Wisconsin are compatible, the performance of the mixtures during mix design phase should be evaluated using the calorimeter. The BTS’s Concrete Unit is planning to test various concrete mixes used on different pavement projects in different regions to determine material compatibility and conduct in-house research.

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-25-51  
Use of Calorimetry to Evaluate Concrete Performance

Materials Management Section

## Use of Phoenix Test to Evaluate Concrete Performance

### Objectives

- Timely and accurate evaluation of w/cm ratio in Class I concrete mixes in Wisconsin using Phoenix equipment.

### Benefits

- Assess the effects of variations in the w/cm ratio on concrete performance-based tests to provide specific guidance and recommendations regarding acceptable fluctuations in the w/cm ratio for WisDOT projects.

### Background

Wisconsin Department of Transportation (WisDOT) Standard Specifications (SS) has upper limits on water-to-cementitious material (w/cm) ratio for concrete mixes; however, currently there is currently no method to verify this value in the field. The w/cm ratio is a proven predictor of concrete strength, workability, permeability and durability. Given that water is one of the most variable components in concrete and considering current practices, it is challenging to accurately measure the precise amount, particularly when unrecorded mix water is included in the concrete prior to hardening. The Phoenix equipment (Figure 1) is a specially designed oven that is capable of accurately measuring the water in fresh concrete in approximately 15 minutes and it can be used to evaluate w/cm ratio in concrete mixes during placement.

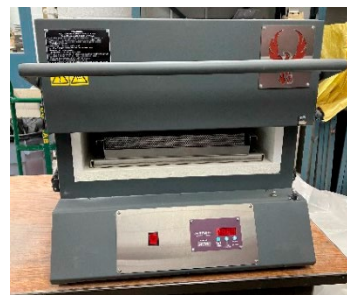


Figure 1: Phoenix equipment

### Methodology

The Phoenix test allowed the WisDOT Bureau of Technical Services' central laboratory to evaluate w/cm ratio of concrete mixes in real-time in Wisconsin using the batch weights and the total water content in the fresh concrete. Two concrete mixtures with the same proportions were tested. To determine the w/cm ratio of the concrete mixtures, the Minnesota DOT *Standard Method of Test for Measuring the Water Content in Fresh Concrete by Rapid Evaporation (Phoenix Test Method)* procedure was used, including the following steps:

- A rigid container of a fixed volume was used; the mass of the container was measured before and after filling, and after emptying the concrete sample.
- The sample was transferred to a pan and the mass of the pan was measured before and after filling with the sample.
- The pan is then placed into the furnace and heated between the temperatures of 1,450°F and 1,500°F for approximately 15 minutes.
- The mass of the sample-filled container was measured again to ensure that the water evaporated.
- The difference in the mass of the specimen before and after the test determines the water content of the specimen.

WisDOT Project Manager

Tirupan Mandal

WisDOT

Concrete Materials Unit Supervisor

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**“Phoenix equipment will allow WisDOT to accurately measure the w/cm ratio of concrete mixes used across Wisconsin.” –**

**–Tirupan Mandal,**

**WisDOT**

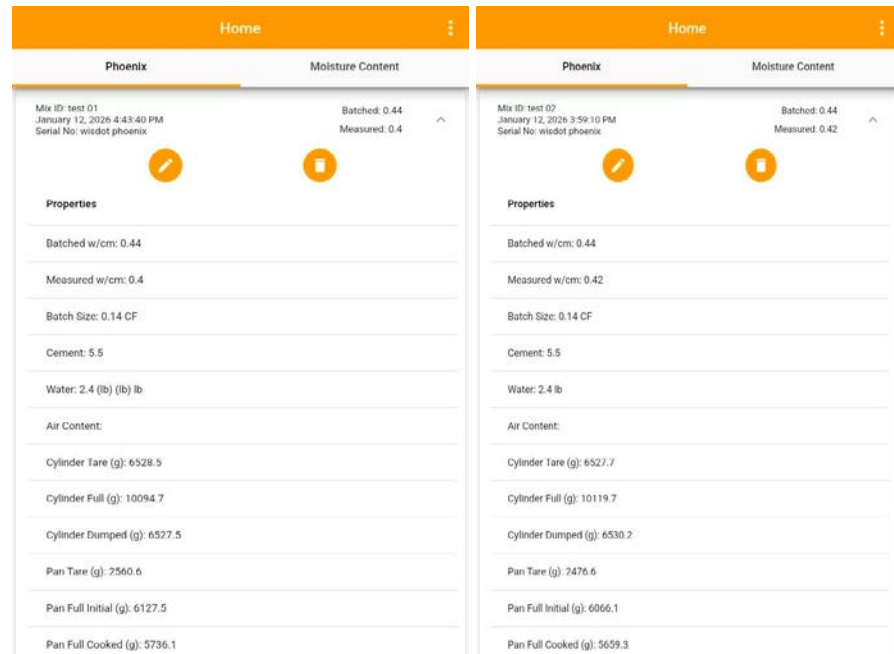
## Results

With the Phoenix equipment, the central laboratory was able to determine w/cm ratio of two concrete mixtures in real-time using the same mixture proportions.

Batched w/cm ratio of 0.44 was used for both test samples and the results for the actual w/cm ratio were the following:

- Test #1: 0.40
- Test #2: 0.42

The software application provided with the equipment was used to calculate the results as shown in Figure 2.



*Figure 2: Batched vs. actual w/cm ratio for Test #1 (left) and Test #2 (right)*

Final test results (Test #1 and Test #2) indicate that actual w/cm ratio can be different for concrete mixtures batched using the same material proportions and batching process proving material inconsistencies observed with concrete mixtures on WisDOT projects over the years.

## Recommendations for Implementation

Timely and accurate evaluation of w/cm ratio will allow for concrete mixes to be adjusted in real-time. The BTS Concrete Unit is planning to test various concrete mixes in-house and during placement on different pavement projects in different regions using Phoenix equipment to ensure that the concrete mixtures used in Class I concrete pavements and structures are meeting WisDOT SS requirements.

Additionally, WisDOT is planning to analyze, correlate and validate the w/cm ratio against performance-based tests conducted on freshly mixed concrete and provide specific guidance and recommendations regarding acceptable fluctuations in the w/cm ratio for WisDOT projects.

Interested in finding out more?  
Final report is available at:  
[WisDOT Research website](#)

This brief summarizes Project 0092-25-52  
Use of Phoenix Test to Evaluate Concrete Performance

Materials Management Section Project

# Technology Transfer and Library Activities

*The WisDOT Research and Library Services provides information services for department 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.*

## WisDOT Library Portal

WisDOT launched the library portal platform in 2023, which expanded 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. Over 1,000 library searches were conducted by users in FFY 2025.

## WisDOT Library Services

Library staff handled 270 information requests and delivered 538 digital items (books, reports, periodicals and articles).

## 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. Two synthesis reports were completed in FFY 2025 on the topics of employee stay interviews and media listening.

## 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. WisDOT completed 25 literature searches in FFY 2025. Topics included: AI workforce readiness, J-turns and restricted crossing U-turns, raised crosswalks and intersections, and durability distresses in concrete pavements.

# Completed WHRP Research Projects Summary

PROGRAM	PROJECT ID	PERFORMING ORGANIZATION	PRINCIPAL INVESTIGATOR	PROJECT BUDGET	WISDOT PROJECT MANAGER	PROJECT TITLE	IMPLEMENTATION METHOD	COMPLETION DATE
WHRP–Rigid	0092-22-02	Applied Research Associates, Inc.	Shreenath Rao	\$130,000	Sinan Coban	Field Investigation of Dowel and Tie Bar Placement	Revise a specification	10/2025
WHRP–Geotechnics	0092-22-03	University of Missouri–Kansas City	John Kevern	\$170,000	Tirupan Mandal	Timely and Uniform Application of Curing Materials	New product implementation, revise a specification	10/2025
WHRP–Structures	0092-22-06	Iowa State University	Alice Alipour	\$200,000	David Staab	Wind-Loaded Structures	Develop a model, revise a specification	6/2025
WHRP–Flex	0092-23-01	Rutgers University	Thomas Bennert	\$175,000	Erik Lyngdal	Benchmarking Delta TC for Wisconsin Materials	Revise a specification	5/2025
WHRP–Rigid	0092-23-03	American Engineering Testing, Inc.	Jussara Tanesi	\$199,779	Tirupan Mandal	Chemistry and Performance of Supplementary Cementitious Materials for Wisconsin Concrete Pavement	New design method or guidance	1/2025
WHRP–Structures	0092-23-04	AECOM Technical Services, Inc.	Brady Seston	\$149,963	Philip Meinel	Bridge Deck Thermography Verification and Policy	Revise a specification	10/2025
WHRP–Geotechnics	0092-24-02	Geocomp, Inc.	Allen Marr	\$228,286	Steve Doocy	Investigation of MSE Wall Corrosion in Wisconsin	New product implementation, revise a specification	6/2025

# Ongoing WHRP Research Projects Summary

PROGRAM	PROJECT ID	PERFORMING ORGANIZATION	PRINCIPAL INVESTIGATOR	PROJECT BUDGET	WISDOT PROJECT MANAGER	PROJECT TITLE	ANTICIPATED IMPLEMENTATION STATUS
WHRP–Geotechnics	0092-23-02	University of Virginia	Zhen (Leo) Liu	\$227,617	David Staab	Seasonal Weight Restriction Decision Making Based on Understanding and Monitoring of Frost Susceptibility of Pavement Structures	New SWR protocol and web-based app
WHRP–Flexible	0092-24-01	Iowa State University	Chris Williams	\$249,980	Erik Lyngdal	Design Requirements for High Traffic Asphalt Mixes to Ensure Pavement Performance	Suggested improvements to the mix design process
WHRP–Rigid	0092-24-03	Marquette University	Jaime Hernandez	\$129,999	Tirupan Mandal	Modeling Concrete Pavement to Assess Buckling Risk	Design verification tool, instructional guide for tool usage and summary of practical measures to minimize buckling failure
WHRP–Rigid	0092-24-04	American Engineering Testing, Inc.	Jussara Tanesi	\$204,399	Tirupan Mandal	Alternative Conditioning Method to Calculate Formation Factor for Wisconsin Concrete Pavement	Tool creation and data to standardize and simplify WisDOT's use of FF testing
WHRP–Structures	0092-24-05	Wiss Janney, Elstner, Associates, Inc.	John Lawler, Le Pham	\$199,860	Andrew Smith	Vertical Overhead Concrete Patches	Repair strategies, specifications and training materials
WHRP–Structures	0092-24-06	Applied Research Associates, Inc.	Mike Prohaska	\$159,994	Ruth Coisman	State of Practice for Specifying and Repairing Mechanically Stabilized Earth Walls	Updated design and repair recommendations along with training materials and specification revisions

## Completed Policy and Safety First Research Projects

PROGRAM	PROJECT ID	PERFORMING ORGANIZATION	PRINCIPAL INVESTIGATOR	PROJECT BUDGET	WISDOT PROJECT MANAGER	PROJECT TITLE	IMPLEMENTATION METHOD	COMPLETION DATE
Policy	0092-24-10	University of Wisconsin–Milwaukee	Xiao Qin	\$89,998	Ethan Severson	Wisconsin Non-Driver Transportation Behavior Study	Inform policy, new design method or guidance, recommend future studies	2/2025
Safety First	0092-24-11	Pennsylvania State University	S. Ilgin Guler	\$120,000	Maryne Taute	Engineering Countermeasures to Mitigate Reckless Driving Behavior	Develop a model, inform policy, new design method or guidance, revise a specification	7/2025
Policy	0092-24-12	University of Wisconsin–Milwaukee	Xiao Qin	\$95,000	Maryne Taute	Countermeasures to Improve Pedestrian Visibility to Tall Vehicles	Develop a model, inform policy, new design method or guidance	7/2025
Policy	0092-24-14	University of Wisconsin–Madison	Sikai Chen	\$95,000	Johanna Schmidt	Artificial Intelligence in Transportation	Inform policy, new product implementation, recommend future studies	8/2025
Policy	0092-24-16	University of Wisconsin–Milwaukee	Romila Singh	\$95,000	David Hunt	Maintaining Knowledge and Investing in Talent for Next-Generation Transportation Engineering	Inform policy, new design method or guidance	7/2025
Safety First	0092-24-17	Montana State University	Marcel Huijser	\$95,000	Jennifer Gibson	Wildlife Crossing Hotspot Analysis	Develop a model, new design method or guidance, recommend future studies	7/2025

# Ongoing Policy and Safety First Research Projects

PROGRAM	PROJECT ID	PERFORMING ORGANIZATION	PRINCIPAL INVESTIGATOR	END DATE PROJECT BUDGET	WISDOT PROJECT MANAGER	PROJECT TITLE	ANTICIPATED IMPLEMENTATION STATUS
Policy	0092-25-11	The University of Texas Arlington	Kate Hyun	\$125,000	Maryne Taute	Driver to Non-Driver Transitions: Related Health, Mobility and Safety Outcomes	Inform policy, new design method or guidance, recommend future studies
Policy	0092-25-12	High Street Consulting Group, LLC	Kevin Ford	\$120,000	Michael DeAmico	Post-Construction Analysis of Major Mega and Regionally Significant Projects	New design method or guidance
Safety First	0092-25-20	University of Wisconsin–Madison	Andi Bill	\$250,000	Brad Basten	Whiteout Multi-Vehicle Connected Vehicle Crash Alert Warning System	Develop a model, inform policy, new product implementation
Safety First	0092-25-21	University of Wisconsin–Madison	Andi Bill	\$200,000	Brad Basten	Automated Vehicle (AV) Operation in Inclement Weather	New design method or guidance, new product implementation, recommend future studies
Safety First	0092-25-22	University of Wisconsin–Madison	Soyoung (Sue) Ahn	\$200,000	Ben Rouleau	Wisconsin Highway Delay Causation Study	New design method or guidance
Safety First	0092-25-23	University of Wisconsin - Milwaukee	Tom Shi	\$125,000	Brad Basten	Enhanced Light Crosswalk Illumination	Develop a model, new design method or guidance
Safety First	0092-25-24	University of Wisconsin–Madison	Xiaopeng (Shaw) Li	\$150,000	Stephanie Voller	Pilot Use of Telematics for Traffic Safety Analysis	Develop a model, recommend future studies
Safety First	0092-25-25	Texas A&M TTI	Zhenyu Zhang	\$75,000	Michael Seifert	Work Zone Inspection Review	New design method or guidance
Safety First	0092-25-28	North Carolina State University	Christopher Cunningham	\$150,000	Kristen Sommers	Railroad Crossing Inventory–Safety Data Study	Develop a model, inform policy
Safety First	0092-25-29	University of Wisconsin–Milwaukee	Xiao Qin	\$150,000	Matthew Coupar	Over Height Vehicle Detection System	New product implementation

# Pooled Fund Participation

TPF #	PROJECT TITLE	FFY 2025 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	Mumtahn Hasnat	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(370)	Fostering Innovation in Pedestrian and Bicycle Transportation Pooled Fund	N/A	Christopher Squires	FHWA
TPF-5(382)	Drivers Failing to Yield at Multi-Lane Roundabout Exits	N/A	Kevin Scopoline	FHWA
TPF-5(389)	Connected Vehicle Pooled Fund Study	N/A	David Karnes	Virginia
TPF-5(395)	Traffic Disruption-Free Bridge Inspection Initiative with Robotic Systems	N/A	David Bohnsack	Missouri
TPF-5(399)	Improve Pavement Surface Distress and Transverse Profile Data Collection and Analysis, Phase 2	N/A	Andrew Schilling	FHWA
TPF-5(430)	Midwest Roadside Safety Pooled Fund Program	N/A	Erik Emerson	Nebraska
TPF-5(435)	Aurora Program (Weather Monitoring/ Forecasting in Highway Operations)	N/A	Mike Adams	Iowa
TPF-5(437)	Technology Transfer Concrete Consortium (FY20-FY24)	N/A	Tirupan Mandal	Iowa
TPF-5(438)	Smart Work Zone Deployment Initiative (FY20-FY24)	N/A	Erin Schwark	Iowa
TPF-5(441)	No Boundaries Transportation Maintenance Innovations	N/A	Matthew Thorsen	Colorado
TPF-5(442)	Transportation Research and Connectivity	N/A	John Cherney	Oklahoma
TPF-5(443)	Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)	N/A	Casey Wierzchowski	Minnesota
TPF-5(447)	Traffic Control Device (TCD) Consortium (3)	N/A	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	N/A	Vicki Haskell	FHWA
TPF-5(460)	Flood-Frequency Analysis in the Midwest: Addressing Potential Nonstationary Annual Peak-Flow Records	N/A	Steve Neary	Nebraska
TPF-5(465)	Consortium for Asphalt Pavement Research and Implementation (CAPRI)	N/A	Daniel Kopacz	Alabama
TPF-5(466)	National Road Research Alliance (NRRRA) - Phase II	N/A	Barry Paye	Minnesota
TPF-5(467)	Research Project Tracking System	N/A	Evelyn Bromberg	Kentucky
TPF-5(478)	Demonstration to Advance New Pavement Technologies Pooled Fund	N/A	Casey Wierzchoski	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	Steve Popke	Iowa

## Pooled Fund Participation (continued)

TPF #	PROJECT TITLE	FFY 2025 FUNDING AMOUNT	WISDOT TECHNICAL REPRESENTATIVE	LEAD AGENCY/ STATE
TPF-5(486)	Steel Bridge Research, Inspection, Training and Education Engineering Center (SBRITE)	N/A	Jason Lahm	Indiana
TPF-5(487)	Transportation Management Centers Pooled Fund Study Phase 2	N/A	Rebecca Klein	FHWA
TPF-5(490)	Enterprise- Phase 3 (Phase 2 Continuation)	\$30,000	Elizabeth Lloyd-Weis	Michigan
TPF-5(492)	Biennial Asset Management Conference and Training on Implementation Strategies	\$24,000	John VonRuden	Iowa
TPF-5(508)	Concrete Bridge Engineering Institute	\$30,000	Aaron Bonk	Texas
TPF-5(514)	Work Zone Analytics	\$30,000	Erin Schwark	Indiana
TPF-5(516)	Highway Safety Manual 2nd Edition (HSM2) Implementation	\$16,000	Kevin Scopoline	FHWA
TPF-5(517)	Performance Centered Concrete Construction	\$25,000	Tirupan Mandal	Iowa
TPF-5(518)	Implementation of Structural Data from Traffic Speed Deflection Devices	\$55,000	Jhuma Saha	Virginia
TPF-5(519)	Enhanced Traffic Signal Performance Measures	\$40,000	Jeremy Iwen	Indiana
TPF-5(520)	Improving Traffic Detection Through New Innovative i-LST Technology Demonstration Pilot	\$15,000	Russell Lewis	FHWA
TPF-5(523)	Building Information Modeling (BIM) for Bridges and Structures (Phase II)	\$20,000	Josh Dietsche	Iowa
TPF-5(532)	MAASTO Connected Automated Vehicle (CAV) Steering Committee	\$30,000	Brad Basten	Michigan
TPF-5(533)	Midwest Roadside Safety Pooled Fund Program	\$67,500	Erik Emerson	Nebraska
TPF-5(536)	Ahead of the Curve	\$10,000	Evelyn Bromberg	Louisiana
TPF-5(539)	Establishment of a Public-Private Transportation Data Exchange Center	\$50,000	Brad Basten	Missouri
TPF-5(543)	Aurora Program (FY25-FY-29)	\$25,000	Mike Adams	Iowa
TPF-5(544)	Technology Transfer Concrete Consortium (FY25-FY-29)	\$8,000	Tirupan Mandal	Iowa
TPF-5(545)	Smart Work Zone Deployment Initiative (FY25-FY29)	\$25,000	Erin Schwark	Iowa
TPF-5(547)	Traffic Safety Culture Phase 3	\$15,000	David Dahms	Montana
TPF-5(554)	Traffic Control Device (TCD) Consortium (4)	\$10,000	Ryan Mayer	FHWA

# Research Program Committees

## Wisconsin Highway Research Program (WHRP)

### WHRP Steering Committee

**Ethan Severson***Chair*

WisDOT, DBSI, Bureau of Performance Improvement Research and Strategic Initiatives

**Joe Balice**

FHWA–Wisconsin Division

**James Bender**

WisDOT, DTSD, Office of Workforce, Innovation and Budget

**Dave Brose**

American Council of Engineering Companies of Wisconsin

**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, Statewide Bureaus

**Shawn Hoffman**

Wisconsin Earth Movers Association

**Brandon Lamers**

WisDOT, DTSD, Bureau of Project Development

**Bryan Lipke**

WisDOT, DTSD, Regional Representative

**Barry Paye**

WisDOT, DTSD, Bureau of Technical Services

**Dr. Yong Bai**

Academic Representative, Marquette University

**Debbie Schwerman**

Wisconsin Asphalt Pavement Association

**Jackie Spoor**

Wisconsin Concrete Pavement Association

### WHRP Technical Oversight Committee chairs

**FLEXIBLE PAVEMENTS****Casey Wierzchowski**

WisDOT, DTSD, Bureau of Technical Services

**GEOTECHNICS****Sinan Coban**

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

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FHWA–Wisconsin Division

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WisDOT, DBSI, Performance, Research and Library

**Maryne Taute**

WisDOT, DBSI, Bureau of Performance Improvement, Research and Strategic Initiatives

**Stephanie Voller**

WisDOT, DSP, Bureau of Transportation Safety and Technical Services

## Safety First Work Group

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#### *Chair*

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### **Ryan Chaffee**

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### **Kris Sommers**

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### **Logan Zinsli**

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## Research and Library Unit Staff

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WisDOT, DBSI, Supervisor

### **Ethan Severson**

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### **Carter Angelo**

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### **Evelyn Bromberg**

WisDOT, DBSI, National Programs Coordinator

### **John Cherney**

WisDOT, DBSI, Librarian

### **Evan Johnson**

WisDOT, DBSI, Contracts Specialist

### **Joy Loomis**

WisDOT, DBSI, Budget and Research Implementation Coordinator



## WisDOT Research Program

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