

NEBRASKA

Good Life. Great Journey.

DEPARTMENT OF TRANSPORTATION



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Research Section Mission

NDOT Goals

- *Safety*
- *Fiscal Responsibility*
- *Environmental Stewardship*
- *Project Delivery*
- *Asset Management*
- *Mobility*
- *Communication, Coordination, Collaboration & Cooperation*
- *Workforce Development*

The Department's Research Federal Funded and In-House Research, will perform the following to match the NDOT Goals:

Reduce the costs of construction and maintenance.

Improve the quality of service to the highway users.

Increase the efficiency of highway planning, operations, and administration.

Reduce crashes and crash severity.

Encompass the interrelationship of socioeconomic, environmental, and technical factors into the transportation system; and implement favorable findings into departmental procedures and processes.

SAFETY

Improving Safety on Nebraska Roads by Breaking the ICE – An Investigation into Winter Maintenance Chemicals and the Validation of an Ice Melting Capacity Test

By David Hansen and Lieska Halsey

Purpose: NDOT is interested in studying deicing materials and developing test methods to improve safety and optimize NDOT winter maintenance practices. The Mechanical Rocker Test for Ice Melting Capacity (MRT) provides the winter maintenance industry an objective, repeatable test procedure for the evaluation and comparison of anti-icing and deicing chemical products. NDOT organized a round-robin Inter-Laboratory study as outlined in ASTM C670 to validate the procedure and develop a precision statement for the MRT-IMC.

The Results: The validation study proved that the MRT-IMC is a valid and repeatable standard test method for assessing ice melting capacity of deicing products. The resulting single-operator coefficient of variation (CV) is 2.66%. The multi-laboratory CV is 5.65%, indicating that the MRT-IMC will provide consistent, repeatable results.

Implementation: The MRT was validated at 15 minutes to be a reliable and consistent test for measuring the melting power of liquid deicers. This provides NDOT a test that ensures the highest quality deicers are delivered to NDOT maintenance forces and will be used in the procurement process for Corrosion-Inhibited Liquid Deicers.

Innovation: This test provides industry with a reliable and meaningful test to measure the capabilities of liquid chemical deicing products.

“The Mechanical Rocker Test (MRT) procedure for measuring ice-melting capacity provides an objective, performance-based metric that will enable the transportation industry to better evaluate the differences in quality between deicing products. While other test methods have been developed for this purpose, these previous methods included many sources of error and were not repeatable between different laboratories. Instead of relying on anecdotal and subjective observations when making product selections, we can now make informed business decisions on which products provide the greatest value based on accurate and empirical data. The MRT truly is a first-in-industry achievement that is sure to improve how agencies procure and vendors market their deicing products.”

– Ty Barger

Former NDOT-Hwy Operations Assistant Division Manager



Research Implementation



Completed Research Readiness Level Assessment (RRL)

- The Research Readiness Level Assessment identifies the immediate next steps for a research or technology development project by assigning an RRL number indicating how close to acceptance as standard practice the project is.
- The RRL provides a systematic method for identifying how NDOT can best support the development of research at various stages in the process.
- The RRL concept is based on the FHWA Technology Readiness Level Guide and was adapted to meet NDOT's specific needs.

Research Readiness Level Assessment Process

- The Research Project Manager and the NDOT Technical Advisory Committee (TAC) lead representative work together to assess the research readiness level (RRL).
- The Research Project Manager prepares a summary report of the area or problem studied, research findings, interpretation of results and recommendations for how NDOT or other organizations should use the research and monitor their expected benefits.
- The assessment provides the means to identify and document the resources, processes, and requirements necessary to progress research from basic research to implementation in standard practice.
- The assessment is designed to be linear process; however, some research may skip levels based on the depth of research required.



Completed Research Readiness Level Assessment

Please note - If a section does not contain a hyperlink in a Focus Group that indicates there isn't a project in that phase currently.

Research Readiness Level Assessment covers projects completed since December 2018.

Research Readiness Level Assessment

NDOT Recommendation Based On Research

Project Number	Federally Funded Projects <u>Completed</u> and <u>Published</u>	Focus Area	RRL
M030	Truck Platooning Effects on Girder Bridges - Phase I <u>NDOT Recommendations Based On Research Project</u>	Structures	Level 3
M050	Preparing for a Driverless Future <u>NDOT Recommendations Based On Research Project</u>	Planning	Level 1
M068	Cost-Efficient, TL-2 Bridge Rail for Low Volume Roads <u>NDOT Recommendations Based On Research Project</u>	Structures	Level 5
M075	Development and Implementation of a Moving Nondestructive Evaluation Platform for Bridge Deck Inspection <u>NDOT Recommendations Based On Research Project</u>	Structures	Level 3
M080	Feasibility and Implementation of Balanced Mix Design in Nebraska <u>NDOT Recommendations Based On Research Project</u>	Materials/ Asphalt	Level 4
M082	Early Detection of Near-Surface Void Defects in Concrete Pavement Using Drone-Based Thermography and GPR Methods <u>NDOT Recommendations Based On Research Project</u>	Construction	Level 4
M084	Evaluation of Mixtures and Pavement Performance for Rehabilitation Methods <u>NDOT Recommendations Based On Research Project</u>	Materials/ Asphalt	Level 4
M086	Prototype System for Implementing the Ultrasonic Guided Wave Method on the Field <u>NDOT Recommendations Based On Research Project</u>	Structures	Level 2
M088	Supporting Bridge Management with Advanced Analysis and Machine Learning <u>NDOT Recommendations Based On Research Project</u>	Structures	Level 4
M091	Nebraska Rail Crossing Safety Research <u>NDOT Recommendations Based On Research Project</u>	Safety	Level 3
M092	Research on School Zone Safety <u>NDOT Recommendations Based On Research Project</u>	Safety	Level 4
M095	A Big Data Approach for Improving Nebraska Cycling Routes <u>NDOT Recommendations Based On Research Project</u>	Planning	Level 2
M097	Research on Weather Conditions and Their Relationship to Crashes <u>NDOT Recommendations Based On Research Project</u>	Traffic/ Operations	Level 3
M098	Investing in Bicycle Infrastructure to Spur Statewide Economic Growth Through Bicycle Tourism <u>NDOT Recommendations Based On Research Project</u>	Planning	Level 2
M109	To Automate Detecting, Quantifying and Mapping of Delamination of Bridge Decks using Aerial Thermographic NDE <u>NDOT Recommendations Based On Research Project</u>	Technology	Level 2
M110	Bio polymerized Slope/Subgrade Stabilization and Advanced Field Monitoring <u>NDOT Recommendations Based On Research Project</u>	Geotechnical	Level 3
M111	High Mast Tower Foundation <u>NDOT Recommendations Based On Research Project</u>	Construction	Level 3
M112	Data Analysis of Nebraska Pavements Containing RAP <u>NDOT Recommendations Based On Research Project</u>	Materials/ Asphalt	Level 5
M113	Detection of Flaws with Asphalt Overlaid Concrete Decks Using Ultrasonic Guided Waves <u>NDOT Recommendations Based On Research Project</u>	Structures	Level 2
M114	Best Practices to Address Issues of Excess Aggregate Dust in Nebraska <u>NDOT Recommendations Based On Research Project</u>	Materials/ Concrete	Level 2

Research Readiness Level Assessment

NDOT Recommendation On Research Projects Based

In-House Project <u>Completed</u> and <u>Published</u>	Focus Area	RRL
Evaluation of Lightweight Pieces in Aggregates <u>NDOT Evaluation Based On Completed Research</u>	Materials/ Concrete	Level 5
Colloidal Silica: Cement Enhancing Admixture Product Evaluation <u>NDOT Evaluation Based On Completed Research</u>	Materials/ Concrete	Level 2
Influence of Curing Conditions on Concrete Specimens (Cylinders) in Hot and Cold Weather in the Field <u>NDOT Evaluation Based On Completed Research</u>	Materials/ Concrete	Level 5
Utilizing Kryton KIM Technology in Bridge Deck and Rail Construction to Protect Against Chloride Ion Penetration <u>NDOT Evaluation Based On Completed Research</u>	Materials/ Concrete	Level 2
Evaluation of Tie-Bar Anchoring Methods: Non-Shrink Grout vs. Epoxy <u>NDOT Evaluation Based On Completed Research</u>	Materials/ Concrete	Level 5

AT-A GLANCE

2020-2021 Completed Projects

Data Analysis of Nebraska Pavements Containing RAP

Principal Investigator: Jiong Hu-UNL
 Co-Principal Investigator: Young-Rak Kim-Texas A&M University
 NDOT Lead TAC Members: Robert Rea and Bruce Barrett-Materials and Research Division



Materials/Asphalt

Research Readiness Level Assessment (RRL) - Level 5
 Research/Technology fully implemented and understood.
 No follow-up is necessary.

NDOT Recommendations Based on Completed Research

The Nebraska Department of Transportation has used reclaimed asphalt pavement (RAP) materials (in proportions of 20-50% of a mix design) for more than 13 years in pavement construction. RAP maximizes the use of removed or salvaged material, which minimizes the use of virgin material and prevents reclaimed materials from going to landfill.

This research provided validation that NDOT mix designs using a high volume of reclaimed asphalt pavement performed and continue to perform well overall. The research collected 254 data points from projects constructed between

2009 and 2012. The research validated that the use of 45% RAP for the last decade provided not only substantial economic benefits, but a myriad of environmental benefits that need to be quantified to realize all of the benefits from raw material preservation to reduction of carbon footprint in a global scale. NDOT engineers estimated the financial savings on aggregates and petroleum binders alone has been nearly \$500 Million since 2008 (13 years) since implementing high-volume RAP mix designs in paving construction.

As provided by Robert Rea and Bruce Barrett, TAC Lead Members

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

Research on Weather Conditions and Their Relationship to Crashes

Principal Investigator:
Co-Principal Investigator:
NDOT Lead TAC Members:

Mark Andersen-UNL
Aemal Khattak-UNL
Don Butler-Traffic Division
Matthew Baker-Operations Division



Traffic/Operations

Research Readiness Level Assessment (RRL) - Level 3
Research/Technology developed in an operational environment.
(will be followed up in real-world situation).

NDOT Recommendations Based on Completed Research

This research provided the Department the key finding that most winter weather related vehicular crashes analyzed in this study were associated with relatively minimal winter weather conditions. The reported crashes typically occurred either with low snowfall amounts or with residual snowfall on the ground even though it was no longer precipitating. This highlights the need for winter maintenance operations activities to continue well after a storm has left the region and the need for continued messaging of hazardous winter weather road conditions even on seemingly clear roads.



The findings highlighted the need for safety improvements to reduce the severity of crashes on icy pavement. NDOT plans to continue targeted application

of High Friction Surface Treatment, removal of objects near the roadway, and add cable median barrier on I-80 where traffic is heavier, and the median is the narrower. Cable median barrier reduces the severity of vehicle crossover crashes due to icy conditions on roadways with divided medians. The barriers are designed to absorb the impact and stop out-of-control vehicles from entering oncoming traffic.

Research outcomes justify using intelligent transportation system (ITS) devices related to adverse road conditions. This implementation allows a process by which appropriate speeds can be determined and posted on Variable Speed Limit (VSL) signs when lower speed limits are warranted by weather, accidents, or other extraneous situations. The Department will fund

deployment of VSL signs with Federal grant. Research follow up will compare crash data before and after the devices are deployed. Evaluation of the I-80 corridor will take about 4 years. This effort will have a decision support system using weather and traffic



information by maintenance decision support system (MDSS) could prove to be an effective means of providing timely, accurate, and consistent messaging and posted speeds for the traveling public.

As provided by Don Butler and Matthew Baker, TAC Members Leaders

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

High-Mast Tower Foundation



Principal Investigator:

Chungwook Sim-UNL

Co-Principal Investigators:

Chung Song, Brandon Kreling and Jay Puckett-UNL

NDOT Lead TAC Members:

Mick Syslo and Mark Burham-Materials and Research Division

Construction

Research Readiness Level Assessment - Level 3

Research/Technology developed in an operational environment.
(will be followed up in real-world situation).

NDOT Recommendations Based on Completed Research

This research provided the Department an alternative design for the High Mast Tower (HMT) Foundations which can eliminate fatigue-prone details associated with the pole-to-base plate connection where primary failure occurs.



High Mast Tower Base Plate, Anchor, Non-Shrink Grout and Cast-in-Place Foundation



High Mast Tower Failure (Milford, NE, January 2018)

the foundations for these HMT will not be very deep and close to the surface where oxygen content may be higher, anti-corrosion protection measures may be needed.

- An HMT designed to 80 ft since that is the maximum height NDOT is currently considering for future applications. NDOT may consider designs up to 140 ft, if the future presents more of a need for that application
- Check and monitor the computed the loads provided by the study for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
- Monitoring the welding around handholds since it is a stress point.

The Department will consider raising a tower in an operational environment to address the following:

- Ground Effect Corrosion - due to the fact that some districts have corrosive soil, and because

The Department recommends a Phase II proposal and start planning for 2021 September's request for proposals.

As provided by Mick Syslo and Mark Burham, Lead TAC Members

Interested in finding out more?

Final report is available at:

[NDOT Research Website](#)

Detecting, Quantifying and Mapping of Delamination of Bridge Decks using Aerial Thermography



Principal Investigator:
Co-Principal Investigator:
NDOT Lead TAC Members:

Zhigang Shen-UNL
Ra Na-University of Delaware
Jon Starr-BTSD Division and Fouad Jaber-Bridge Division

Technology

Research Readiness Level Assessment – Level 2

-Research/Technology developed. Integration of components

NDOT Recommendations Based on Completed Research



NDOT's Matrice 210 RTK Drone

The Department will start a validation of the UAV-based Aerial thermographic method by the Department's Matrice 210 RTK Drone in coordination with Engineering Technologies within Business Technology Support Division (BTSD) Division and the Bridge Division forces to address the followings:

This research developed a UAV-based Aerial thermographic method to detect and map the delamination on concrete bridge decks.

- To validate the proposed Aerial IRT approach in detecting, quantifying, and mapping delamination in bridge decks by using NDOT forces. The validation will answer some questions for the Department:
 - Field survey planning, field survey operation, data acquisition, safety considerations, data flow, post-processing of image data, how long the process takes, and accuracy of algorithms output compared to repaired sections.

As provided by Jon Starr and Fouad Jaber, Lead TAC Members

Interested in finding out more?

Final report is available at:

[NDOT Research Website](#)

Nebraska Rail Crossing Safety Research



Principal Investigator:
NDOT Lead TAC Members:

Aemal Khattak-UNL
Jodi Gibson-Local Project Division

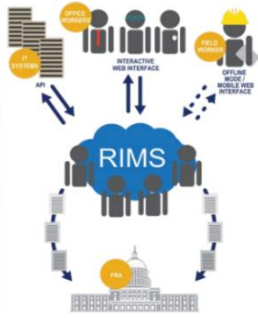
Safety

Research Readiness Level Assessment - Level 3

Research/Technology developed in an operational environment.
(will be followed up in real-world situation).

NDOT Recommendations Based on Completed Research

The research provided a better understanding of what the Department and Nebraska Counties need to update on the statewide Highway Railway Grade Crossings (HRGC) inventory. The research provided a model based on a Poisson regression model with scaled parameters as the Nebraska HRGC Crash Prediction Model. This model will need to be validated after the Department updates the HRGC inventory system for Nebraska's eight Districts, 593 Cities and 93 counties by adding missing values and removing errors in the existing database. This will be a collaboration effort between NDOT, Cities and Counties to complete a developed inventory checklist via field visits, NDOT pathweb (video log browser) and Google Earth when applicable. The



validation of the new crash prediction model for rail crossing safety to assess the safety of rail crossings and for resource allocation among competing rail crossings will be useful for public agencies in Nebraska.



- As provided by Jody Gibson, Lead TAC Member

Interested in finding out more?

Final report is available at:

[NDOT Research Website](#)

Biopolymerized Slope/Subgrade Stabilization and Advanced Field Monitoring

Principal Investigator:

Chung Song-UNL

Co-Principal Investigators:

Yong-Rak Kim-Texas A&M University

Richard Wood-UNL

Jongwan Eun-UNL

NDOT Lead TAC Member:

Nikolas Glennie-Materials and Research



Geotechnical

Research Readiness Level Assessment - Level 3

Research/Technology developed in an operational environment.
(will be followed up in real-world situation).

NDOT Recommendations Based on Completed Research

NDOT will monitor the performance of biopolymer Xanthan, which was utilized on a project in Verdigre, Nebraska. The Geotechnical Engineers will use an inclinometer installed at the site to monitor the movement of the slope. Performance of the field-applied biopolymer treated soil will be followed for two years by measuring the strength and modulus of the shale through lab testing and CPT testing. Performing these tests will provide real world data, such as the strength loss of the soil due to weathering cycles for both the Xanthan treated and virgin material.

After two years the Department will analyze the strength and modulus test data and consider if using Xanthan biopolymer will be a feasible option to add to the toolbox along with the geogrid, geofoam and other methods commonly used by the NDOT with the soil types investigated by this research.

- As provided by Nikolas Glennie, Lead TAC Member

Interested in finding out more?

Final report is available at:

[NDOT Research Website](#)

Truck Platooning Effects on Girder Bridges - Phase I

Principal Investigator:
Co-Principal Investigators:
NDOT Lead TAC Member:

Joshua Steelman-UNL
Jay Puckett-UNL
Daniel Linzell-UNL
Fouad Jaber-Bridge Division

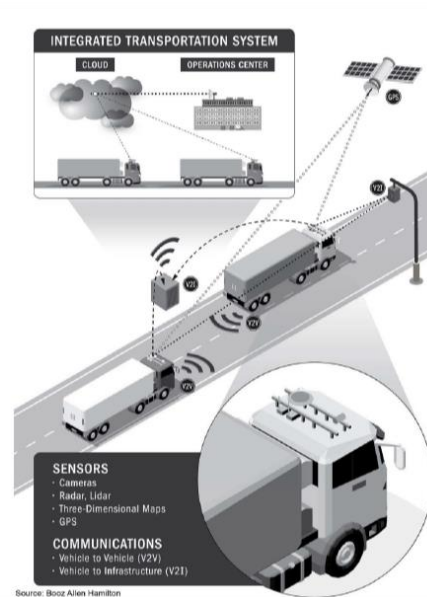


Structures

Research Readiness Level Assessment - Level 3
Research/Technology developed in an operational environment.

NDOT Recommendations Based on Completed Research

This research provided the baseline work for the highly automated vehicle systems that will be forthcoming in the future and informed associated policy decisions to manage and assess this technology. The research provided guidelines for how to manage truck platooning operations, accounting for truck loading for strength and shear magnitudes and distribution factor associated with platooning. The research evaluated the Strength I limit state for steel and prestressed concrete I-girder bridges designed with LRFD and LFD. The research team provided guidelines for safe truck platoon configurations corresponding to the data on I-80 between Nebraska and Wyoming. NDOT will be able to guide and manage the information provided by the trucking company and the structures on the targeted route. Platoons of heavy trucks will be economically advantageous for freight operators in the near future, this research provided information currently is insufficient for bridge Division to establish platoon operation limitations and guidelines ensuring safe and serviceable loading demands in girder bridge structures in terms of vehicle weights, live load uncertainties, and headways.



High-Level Overview of Components of CV and AV Trucking Applications reproduced from NCHRP Web-Only Document 231.

The Department proposed a Phase II- Truck Platooning Effects on Girder Bridges in which the research focus will be to calibrate appropriate live load factors for use with platoons to address the Service III limit state for concrete girder bridges and calibrate appropriate live load factors to address the Service II limit state for steel girder bridges.

- As provided by Fouad Jaber, Lead TAC Member

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

AT-A GLANCE

2020-2021 NDOT In-House Completed Research



Evaluation of Tie-Bar Anchoring Methods: Non-Shrink Grout vs. Epoxy

Based on the results of pull-out testing, NDOT will require epoxy to be used when inserting tie-bars in drilled-holes for both new construction and pavement repairs.

Interested in finding out more?

**Final report is available at:
NDOT Research Website**



Influence of Curing Conditions on Concrete Specimens (Cylinder) in Hot and Cold Weather in the Field

The curing conditions of cylinders was found to have a significant effect on the compressive strength of the cylinders used for acceptance.

Conclusions and Recommendations

Adequate protection of cylinders during the first 48 hours after casting is essential to meet specification requirements. Based on the study, the Department recommended the following:

Cold Weather Conditions: The use of a curing box should be used on a project during cold weather conditions. Other necessary steps may include using a frost blanket and creating heat during initial set with chemical hand warmers.

Hot Weather Conditions: Water should be used in the coolers when ambient temperatures are above 80°F for several days in a row. The water should cover a minimum of 75% of the concrete cylinder.

Interested in finding out more?

**Final report is available at:
[NDOT Research Website](#)**

Colloidal Silica: Cement Enhancing Admixture Product Evaluation

As Class F- fly ash (F-ash) becomes scarce, PCC engineers will look to other supplemental cementitious materials (SCM) to replace F-ash and its ASR mitigating properties. Colloidal silica (CS), or nano-silica, has been shown to mitigate ASR at certain replacement levels; however, CS cannot be a full replacement of F-ash. Engineers at the Nebraska Department of Transportation (NDOT) learned of CS from a presentation given by Intelligent Concrete, Inc. at the 2019 Nebraska Concrete Professionals Association Conference and decided to investigate the potential use of CS in NDOT concrete mix designs.

This research investigated the potential to use colloidal silica as a cement enhancing admixture in NDOT's concrete mix designs. Engineers had two objectives in this study:

1. Determine if CS can enhance high, early strength for use in patching and repairs.
2. Determine if CS can maintain or improve ASR mitigation as F-ash content is decreased.

Colloidal silica shows promise in its ability to mitigate against ASR when used as a replacement of F-ash at both 2% and 3% levels. The 3% replacement of F-ash in a 78% Type I/II and 22% F-ash blended cement showed the greatest reduction in C1567 expansion. This indicates that CS is a viable option for replacing F-ash to mitigate ASR.



Despite CS's successful test results, the cost of CS is too high to use in normal NDOT mix designs and construction activities. Utilizing CS at the 3% level results in about a 66% cost increase for a cubic yard of concrete from \$125/ yd3 to \$195/ yd3. Based on cost estimates provided in the Spring of 2020, 30%-wt. colloidal silica will increase the cost of concrete by \$23 for every 1% replacement of Class F fly-ash.

The NDOT PCC engineer recommends that CS can be a tool for concrete or ready-mix suppliers to remediate F-ash deficient cements, when CS will be more cost effective than transporting a IP cement that fails NDOT specifications and/or if it will prevent the IP cement from being removed from Nebraska's Approved Products List.

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

Typical NDOT Federally Funded Research Cycle



Need a problem solved?
We can help!
- Submit a Statement of Need -







Federally Funded and In-House Research Information

Federally Funded Contract Research

Throughout the year, The Nebraska Department of Transportation (NDOT) Research Section receives and solicits new ideas for research projects for the following year. These ideas can come from the general public, cities, counties, consultants, suppliers, contractors, universities, FHWA and within Nebraska Department of Transportation. Researchers can submit a Statement of Need (SON) to the NDOT Research Section to solve problems or address concerns.

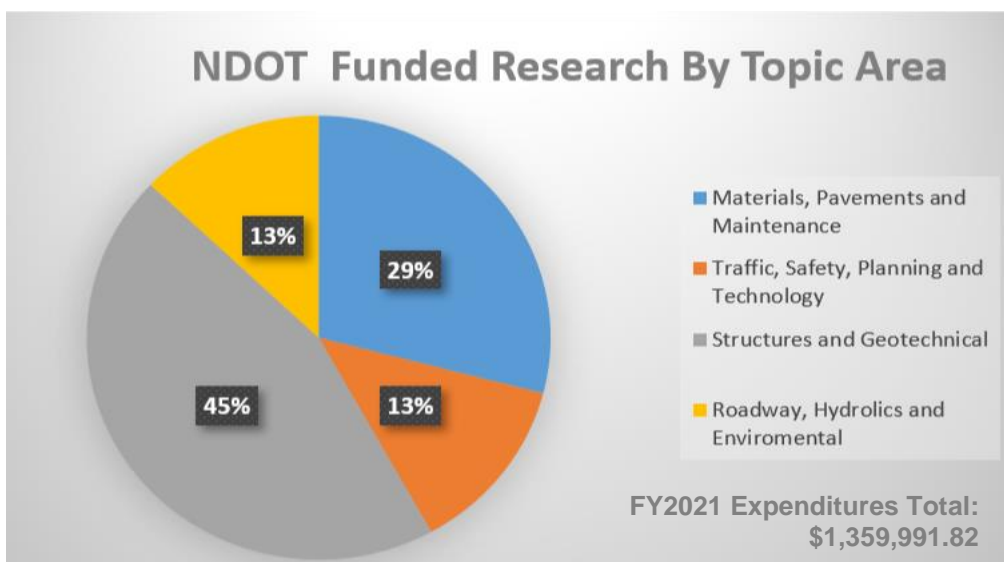
All SONs are compiled and separated into the following four Focus Groups:

-  Materials, Pavement, Maintenance and Construction
-  Traffic, Safety, Planning, and Technology
-  Structures and Geotechnical
-  Roadway, Hydraulics and Environmental

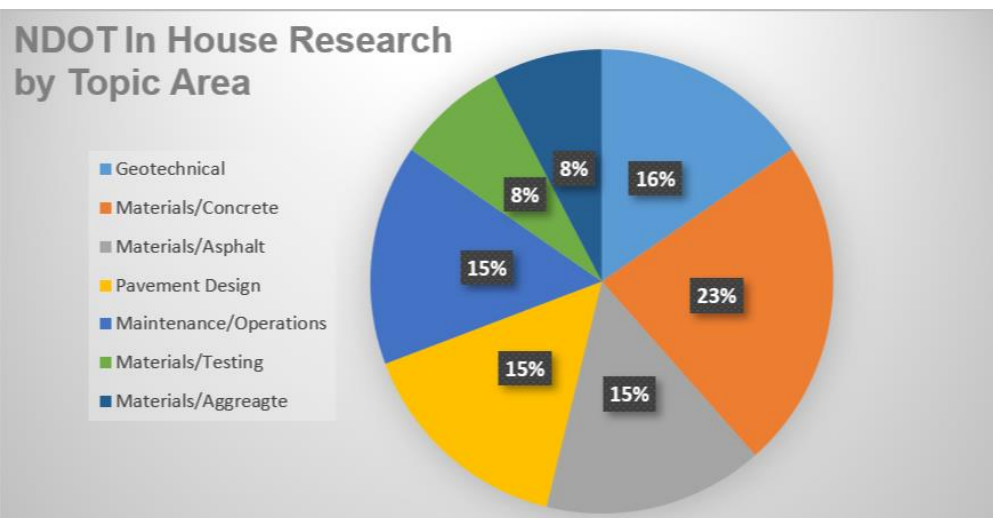
STATEMENT OF NEED
 The form can be found under the information *For Researchers*
<https://dot.nebraska.gov/business-center/research/>

We welcome your feedback, research request and involvement on Technical Advisory Panels.

Contact The Research Section
ndot.research@nebraska.gov



For more information visit
[Nebraska Department of Transportation Research Website](#)



In-House Research

In-house research differs from contracted research in that the researcher is an employee of NDOT. The in-house researcher often also serves as the Project Manager. In-house research enables NDOT to:

- Assess emerging research results and determine appropriate solutions to benefit Nebraska transportation.
- Provide a professional knowledge base to solicit, award, monitor, and evaluate the quality and cost-effectiveness of research.
- Evaluate field-implemented transportation innovations for cost saving implications.

In Progress Federally Funded Research

Materials, Pavement, Maintenance and Construction (MPMC)



Project Number	Research Title	Principal Investigator	NDOT TAC Lead Member	Year Funded	Total Cost
M115	Research on High-RAP Mixtures with Rejuvenators - Field Implementation	Hamzeh Haghshenas	Robert Rea	2019	\$99,950.00
M116	Effect of Antioxidant Additives and Restorators on Performance of Asphalt Binders	Hamzeh Haghshenas	Robert Rea	2019	\$139,788.00
FY21(001)	Analysis of Weather Conditions Causing Water Obstructions on Nebraska Roadways	Mark Anderson	Jesse Schulz	2021	\$164,700.00
FY21(003)	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II	Hamzeh Haghshenas	Robert Rea	2021	\$145,238.00
FY21(006)	Rapid Concrete Bridge Repair Survey and Patch Material Evaluation	Marc Maguire	Wally Heyen & Fouad Jaber	2021	\$93,572.00

Roadway, Hydraulics and Environmental (RHE)




Project Number	Research Title	Principal Investigator	NDOT TAC Lead Member	Year Funded	Total Cost
M100	A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska	Rob Bozell	Stacy Stupka	2019	\$97,398.00
FY21(009)	Energy Dissipation Optimization for Circular Culverts	David Admiraal	Julie Ramirez	2021	\$107,088.00
FY21(011)	Establishment of Wildflower Islands to Enhance Roadside Health, Ecological Value, and Aesthetics - Phase II	John Guretzky	Carol Wienhold	2021	\$171,275.00

Traffic, Safety, Planning, and Technology (TSPT)



Project Number	Research Title	Principal Investigator	NDOT TAC Lead Member	Year Funded	Total Cost
FY21(007)	Intelligent Work Zone Using Automatic Queue Detection Systems	Larry Rilett	Matt Neeman & Matt Baker	2021	\$159,466.0
FY21(008)	Estimating System and Traveler Costs Due to Lane Closures during Construction and Maintenance Operations	Larry Rilett	Matt Neeman	2021	\$179,500.0

In Progress Federally Funded Research

Structures and Geotechnical (SG) 		Principal Investigator	NDOT TAC Lead Member	Year Funded	Total Cost
M087	Design Optimization and Monitoring of Joint-less Integral and Semi-Integral Abutment Bridges in Nebraska	Chungwook Sim	Fouad Jaber	2018	\$142,312.00
M102	Phased Construction Bridges: Monitoring and Analysis for Traffic-Induced Vibration	Christine Wittich	Fouad Jaber	2018	\$117,482.00
M103	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP	Joshua Steelman	Fouad Jaber	2019	\$132,358.00
M104	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP	Richard Wood	Fouad Jaber	2019	\$115,662.00
M107	Outdoor Laboratory and Testbed for Bridge Health	Richard Wood	Fouad Jaber	2019	\$115,074.00
FY21(002)	Development of Guideline for the Use of Geosynthetics in Different Pavement Layered System in Nebraska	Jongwan Eun	Nikolas Glennie & Bruce Barrett	2021	\$106,536.00
FY21(004)	Midwest Guardrail System (MGS) Thrie Beam Approach Guardrail Transition (AGT) Retrofit to Existing Concrete Parapets and Bridges	Scott Rosenbaugh	Fouad Jaber	2021	\$87,978.00
FY21(005)	UHPC Decked I-Beam for Accelerated Bridge Construction	George Morcoux	Fouad Jaber	2021	\$98,250.00
FY21(010)	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support	Bob Bielenberg	Matt Neeman	2021	\$164,927.00

In Progress In-House Research

Research Title	Focus Area
Air Content Requirement for NDOT Concrete Pavement with Reduced Cement Content when Using the Tarantula Curve	Materials/Concrete
Evaluation for the Implementation of the SAM for NDOT Concrete Pavement	Materials/Concrete
Breaking the Ice- Deicers/Mechanical Rocker Field Implementation	Materials/Maintenance
Expansion Joint Research	Pavement Design
Evaluating the Consistency and Reliability of Testing for Modulus Under Doweled Concrete Pavement	Pavement Design
Deflection Target Values - Follow up Implementation	Geotechnical
Erosion Characteristics of Nebraska's Group Index Soils	Geotechnical
Pavement Patching Materials-KMT-2 Asphalt Recycler	Materials/Asphalt



Federally Funded Research Projects Fiscal Year FY22

Project Number	Research Title	Principal Investigator	Focus Area	NDOT TAC Lead Member	Total Cost
FY22(001)	Low-Cement Concrete Mixture for Bridge Decks and Rails	George Morcoux	Materials	Wally Heyen & Fouad Jaber	\$ 111,404.00
FY22(002)	Nebraska Balanced Design Mix	Hamzeh Haghshenas	Materials	Robert Rea	\$ 137,947.00
FY22(003)	Warm Mix Asphalt (WMA) Short Term Aging	Hamzeh Haghshenas	Materials	Robert Rea	\$ 140,617.00
FY22(004)	Erosion Resistant Rock Shoulder	Chung Song	Materials/ Construction	Bruce Barrett	\$ 141,917.00
FY22(005)	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills	Aaron Mittelstet	Hydraulics	Julie Ramirez	\$ 142,176.00
FY22(006)	Evaluation of NDOT's Sediment Barrier Practices Using Performance Data	Mike Perez	Environmental	Ron Poe	\$ 189,999.00
FY22(007)	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support - Phase II	Robert Bielenberg	Structures	Phil TenHulzen	\$ 218,566.00
FY22(008)	Production of Cast-in-Place UHPC for Bridge Applications	Jiong Hu	Structures	Wally Heyen & Fouad Jaber	\$ 83,006.00
FY22(009)	Accelerated Bridge Construction Decision Tool	Phil Barutha	Structures	Fouad Jaber	\$ 89,592.00
FY22(010)	Application of Steel Sheet Piles for the Abutment of Water-crossing Bridges in Nebraska	Seunghee Kim	Structures	Fouad Jaber	\$ 154,314.00
FY22(011)	Truck Platooning Effects on Girder Bridges - Phase II	Joshua Steelman	Structures	Fouad Jaber	\$ 119,853.00
FY22(012)	Inventory, Operations and Safety at Free Right-Turn Ramps	Aemal Khattak	Traffic	Alan Swanson	\$ 197,290.00
Total FY 2022 Program					\$ 1,726,681.00

In-House Research Projects Fiscal Year FY22

In-House Research Project Title	Focus Area
Accelerate Corrosion Test	Materials/Testing
Supplemental Cementitious Materials Heat of Hydration Evaluation by Isothermal Calorimetry	Materials/Concrete
In Motion Validation of Deicer Spreader Calibration	Operations
Infrared Camera – Feasibility Study for aggregate Quality	Materials/Aggregate
Ultra-Thin Hot Applied Armor Coat	Materials/Asphalt

Nebraska's Lead State Pooled Fund

Midwest Roadside Safety Pooled Fund

Background

In 1990, the University of Nebraska-Lincoln collaborated with the States of Nebraska, Kansas, and Missouri to form the Midwest States Regional Pooled Fund Program, a program dedicated for sponsoring roadside safety research.



In the 30 years since it was established, the program has grown to 21 participating states including California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Minnesota, Missouri, New Jersey, North Carolina, Ohio, South Carolina, South Dakota, Utah, Virginia, Wisconsin, Hawaii and Wyoming.

Lead State *The State of Nebraska Department of Transportation is the lead agency for the program* and participates in 16 other projects. As the Lead Agency, the State administers pooled fund contributions, both Federal and non-Federal, and review and pay expenses related to the project.

The Midwest Roadside Safety Pooled Fund Program is a collaborative program between state DOTs and the UNL Midwest Roadside Safety Facility (MwRSF) dedicated to sponsoring roadside safety research.

Largely due to the support from the Midwest Pooled Fund Program, MwRSF has come to be recognized as a global leader in the development of crashworthy safety structures. Numerous safety features have been developed through the Midwest Pooled Fund Program and have been adopted nationwide with several systems adopted internationally. These new safety features have saved the lives of countless motorists across the nation over the last decade.

The Transportation Pooled Fund (TPF) Programs allows federal, State, and local agencies and other organizations to combine resources to support research into shared transportation Priorities. Currently Nebraska participates with 100% Federal Funds into the following Pooled Funds.

TPF – 5 (430) Midwest Roadside Safety Pooled Fund	
Program Research Project Title	Total Cost
Annual Consulting Services Support	\$60,647.00
Pooled Fund Center for Highway Safety	\$14,330.00
LS-DYNA Modeling Enhancement Support	\$30,616.00
Further Evaluation of the End Terminals Adjacent to Curb	\$257,208.00
MGS with Reduced Embedment and Post Spacing over Low-Fill Culverts	\$185,912.00
Additional Retrofit Options for Post Conflicts within AGTs	\$251,429.00
Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase II	\$302,783.00
Development of a Short-Radius Guardrail for Intersecting Driveways or Roadways	\$251,032.00
Total Program	\$ 1,353,957.00

The Midwest Roadside Safety Facility (MwRSF)

[MwRSF's Lusted Published Research](#)

National Partnerships – Research Dollars in Action



TRANSPORTATION POOLED FUND PROGRAM

The Transportation Pooled Fund (TPF) Program allows federal, state, and local agencies and other organizations to combine resources to support research into shared transportation priorities.

Pooled Fund <u>NATIONAL</u> Participation Summary (100% Federally Funded)			
Study Titles	Expenditures FY 2021	Required Commitments FY 2022	NDOT Technical Representatives
TPF-5(301) Support Services for Peer Exchanges	\$4,078.00	-	Mark Fischer
TPF-5(317) Evaluation of Low-Cost Safety Improvements	\$5,000.00	\$5,000.00	Dan Waddle
TPF-5(326) Develop and Support Transportation Performance Management Capacity Development Needs for State DOT's	\$147,000.00	\$147,000.00	Tom Sands
TPF-5(347) Development of Maintenance Decision Support System	\$35,000.00	\$30,000.00	Mike Mattison
TPF-5(353) Clear Roads Phase II	\$25,000.00	\$25,000.00	Mike Mattison
TPF-5(372) Building Information Modeling (BIM) for Bridges and Structures	\$20,000.00	\$20,000.00	Fouad Jaber
TPF-5(430) Midwest Roadside Safety Pooled Fund Program	\$65,000.00	\$65,000.00	Phil TenHulzen
TPF-5(432) Bridge Element Deterioration for Mid-west States	\$20,000.00	\$20,000.00	Fouad Jaber
TPF-5(437) Technology Transfer Concrete Consortium	\$12,000.00	\$12,000.00	Wallace Heyen
TPF-5(438) Smart Work Zone Deployment Initiative	\$25,000.00	\$25,000.00	Dan Waddle
TPF-5(447) Traffic Control Device Consortium	\$15,000.00	\$15,000.00	Dan Waddle
TPF-5(448) Improving Specifications to Resist Frost Damage in Modern Concrete Mixes	\$20,000.00	\$20,000.00	Wallace Heyen
TPF-5(451) Western Road Usage Charging Consortium	\$25,000.00	\$25,000.00	Ryan Huff
TPF-5(456) EconWorks - Improved Economic Insight	\$4,000.00	\$4,000.00	Ryan Huff
TPF-5(465) Consortium for Asphalt Pavement Research and Implementation (CAPRI)	-	\$10,000.00	Robert Rea
TPF-5(467) Project Management Software for Research	-	\$3,500.00	Mark Fischer
Solicitation 1536-Guidelines for Determining Traffic Signal Change and Clearance Intervals	-	\$30,000.00	Dan Waddle
Expected Commitment for FY 2022: \$456,500.00			

Track National Trends



Track National Trends Get the latest research news in your subject area from across the country by searching the national database (trid.trb.org), watching webinars (webinar.mytrb.org) or getting regular alerts via a trb.org RSS feed.

For more information on the Transportation Pooled Fund Program and how to participate, please click on Pooledfund.org



U.S. Department of Transportation
**Federal Highway
Administration**

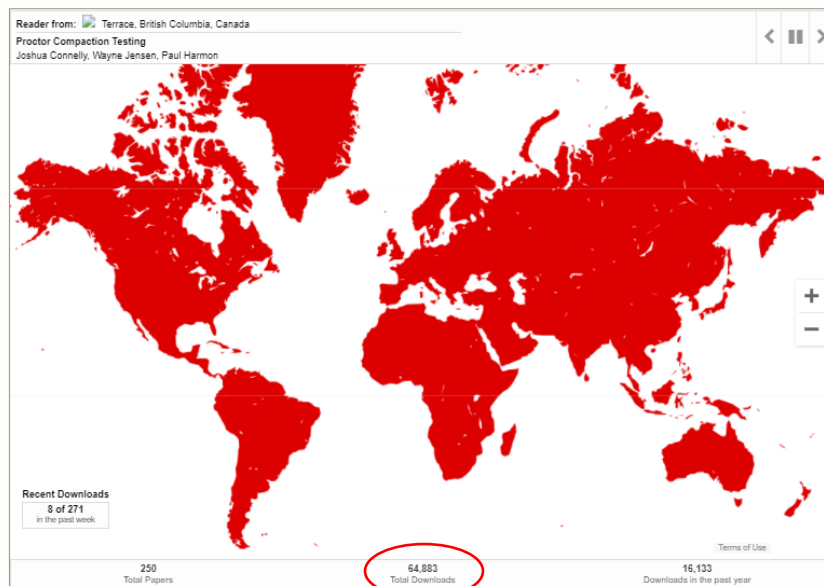
Technology Transfers

Nebraska Local Technical Assistance Program (LTAP)

The University of Nebraska houses a complete archive of Nebraska Department of Transportation research reports in their [digital commons](#). The research reports go back as far as 2003, since then there have been a total of 64,883 research reports downloaded from this site from all over the world, as today of this publication. This site is updated every minute.



DigitalCommons@University of Nebraska - Lincoln



Educational Research Site- UNL

The University of Nebraska in conduction with the Nebraska Department of Transportation houses a field site (for a total of three bridges) into a national research and educational facility for bridge health and testing.

This allows access for nondestructive evaluation and destructive test verifications. Furthermore, this site is set up to permit future research projects and identify strategic directions for this first-of-its-kind facility on realistic aging infrastructure. This involves using decommissioned and under-used steel and concrete bridge structures in Nebraska.

Welcome to the **Nebraska Outdoor Bridge Laboratory Webpage!**



[Nebraska Outdoor Bridge Laboratory Webpage!](#)

In the Know Highlights



Robert Rea and Dr. Hamzeh Haghshenas - Corn Oil and Resurfacing Roads

Interview with the Nebraska Corn
<https://www.youtube.com/watch?v=Ye4YTL63G4>

Rejuvenating properties of the aged binder. ... an economical resurfacing, preservation, and renewal paving solution for roads. Using Corn Oil for Improving Performance of Asphalt Pavements.

Interested in finding out more?
In Progress Project details is available at:

- Phase I- Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures
- Phase II-Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures

Using Binder Pods and Green Rejuvenators to Improve Maintenance Patching

The new patching process has several advantages. The patch material works in all potholes, large or small, in every pavement type, concrete or asphalt, at a cost that is approximately one-fifth the cost of other patching materials. Overall, it is expected to save the department a minimum of \$200,000 per year in material and labor costs. It is also expected to be well received by the traveling public, because patches will be permanent and not have to be repatched, improving safety and reducing wear and tear on vehicles. *Please see page 13 for the whole article.*

A demonstration of the improved maintenance patching process can be seen at:

- [Hot Mix Patch Testing - Innovation at NDOT | 2020](#)



Research on School Zone Safety

- *Project by Dr. Aemal Khattak in coordination with Former City of Lincoln's LTU manager of Traffic Engineering, Mark Lutjeharms*

Dr. Aemal Khattak's research project with the help of NDOT and FHWA assisted with giving guidance to the City of Lincoln's project. The multi-year project, that began implementation in August 2020, is the result of a Lincoln School Zone Study completed this year and is designed to improve the safety and function of school zones at all 83 public and private schools in Lincoln.

Please see links below for more information on implementation and timeframes.

- [Lincoln school zone improvements projects to begin in August](#)
- [New school zone speed limits begin December 2020](#)

Nebraska's Pollinators

Wildflowers are crucial in the ecological function of the low-input roadside plant communities in terms of water and nutrient cycling, nutrient inputs such as nitrogen, total plant canopy cover, stand longevity, and provision of habitat for numerous small animals. Please watch this short video to see what Nebraska is doing to help pollinators thrive.

- [Nebraska's Pollinators](#)







Nebraska Transportation Research Council (NTRC) 2020 Virtual Meeting

What is the NTRC-

The NTRC aims to bring together people from various areas of transportation industry (public and private) and use their knowledge and experience to prioritize statewide research. During the annual NTRC meeting, each Focus Group reviews the ideas received throughout the year.

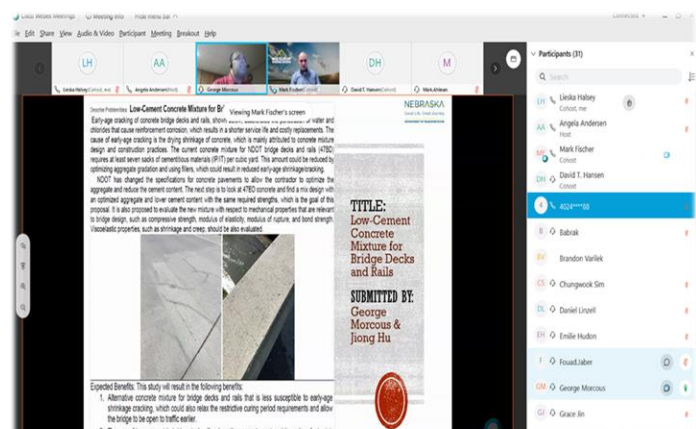
Four Focus Groups Meetings –

-  Materials, Pavement, Maintenance and Construction
-  Traffic, Safety, Planning, and Technology
-  Structures and Geotechnical
-  Roadway, Hydraulics and Environmental

Due to the unique circumstances from COVID-19, this year's annual meeting was held virtually. The four meetings were held via WebEx with over 130 attendees including Nebraska Department of Transportation personnel, industry leaders in their fields, city and counties representatives and the Statement of Need presenters. There were over 50 Statement of Need submissions. The submitter of each research project's Statement of Need had an opportunity to present their idea to the attendees and answer any questions at the end of their presentation. Once the presentations were completed, the voting members and ex-officios had a chance to discuss each project amongst the group. Another new addition due to the virtual nature of the meeting was a Survey Monkey link that was provided to each voting members to rate each Statement of Need. The ratings were then compiled to decide which ideas will be highly prioritized to be presented to the Research Advisory Committee meeting in January.

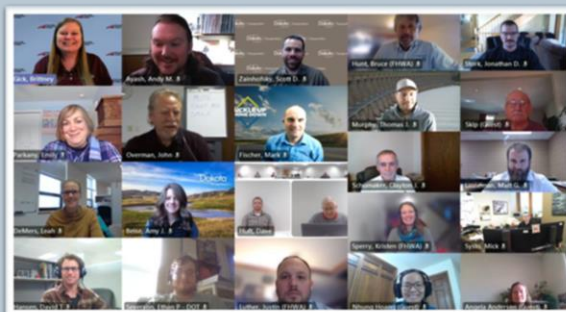


Program Manager, Mark Fischer, hosting the Structures and Geotechnical NTRC Virtual Meeting



Dr. George Morcoux presenting his Statement of Need

2020 North Dakota, South Dakota, and Nebraska Departments of Transportation Peer Exchange



2020 ND-SD-NE Research Peer Exchange Day 1 Participants reproduced from the summary report published on the AASHTO RAC site in January 2021.

For more information on the 2020 North Dakota, South Dakota, And Nebraska Departments of Transportation Research Peer Exchange Please, Click [Summary Report](#)

"The transportation research programs at the North Dakota, South Dakota, and Nebraska Departments of Transportations (DOTs) hosted a peer exchange to discuss the fundamentals of State Planning and Research (SPR) Part B funding and how DOTs can best encourage and implement staff development and research program engagement. The peer exchange was conducted virtually November 3–5, 2020, using Microsoft Teams. The virtual nature of the peer exchange allowed for additional participants from the DOTs". Stated on the summary report published on the AASHTO RAC site in January 2021.



A LEADER IS ONE WHO

**Knows the Way,
Goes the Way,
And
Shows the Way**

John C. Maxwell



Technical Adviser Committed (TAC)

The Technical Advisory Committee (TAC) advises the research team through the life of the project on objectives, tasks, and priorities, recommends and guides the research toward the expected benefits and potential implementation.

Expertise and Input for the Department Funded Research Projects by the numbers
 19 In-Progress
 12 New Projects
 31 Total Projects

NDOT TAC Members Participation
 103 members

FHWA Members Participation
 6 Members

Industry TAC Members Participation
 24 Members



2020-2021 NDOT, FHWA, and Industry TAC Members

NDOT			Industry Members
Abdul Sidiqi	Jesse Schulz	Mike Reynolds	Bryan Guy - City of Omaha
Alan Swanson	Jim Knott	Mike Vigil	Cameron Whitney - Jungbunzlauer, Inc.
Alex Duryea	Jodi Gibson	Nathan Sorben	Dale Burkhead - Simon
Alex Silvey	Jody Paul	Nick Burnham	Dave Hartman - Owens Corning
Andy Dearmont	John Gude	Nick Soper	Emilie Hudon - Olsson
Asadullah Sahak	John Linbo	Nikolas Glennie	Gregg Leber - Constructors Lincoln
Babrak Niazi	John Swigart	Noah Pitts	Jason Henderson - GreenThumb LLC
Barbara Gerbino-Bevins	Jon Soper	Paul Wisnieski	Jesse Sire - JEO Consulting Group
Ben Fischer	Jon Starr	Phil Tenhulzen	Jodi Kocher - Felsburg, Holt, & Ullevig
Ben Ptacek	Jordan Wipf	Ray Trujillo	Julie Harris - Bike Walk Nebraska
Bob Carnazzo	Julie Ramirez	Robert Rea	Kevin Piper - Simon
Brandon Varilek	Kar Sia	Robert Specht	Larry Legg - Lancaster County
Brian Anderson	Kellie Troxell	Ron Poe	Maher Tadros - eConstruct LLC
Bruce Barrett	Kent Miller	Ryan Huff	Mark Deetz - Lyman Richey Corp
Cameron Craig	Kevin Wray	Scott Fisher	Mark Lafferty - Concrete Industries Inc.
Cara Roesler	Kirk Harvey	Scott Milliken	Mark Lutjeharms - JEO Consulting INC
Carol Wienhold	Kpandji Lakmon	Shelley Schulte	Mark Mainelli - Mainelli Wagner and Associates
Chris Ford	Kris Fornoff	Stacy Stupka	Mike Steenhoek - Soy Transportation Coalition
Claire Inbody	Kyle Christensen	Steve Sabra	Mike Willman - GCP Applied Technologies
Craig Wacker	Kyle Zilig	Tim Krason	Nick Collins - JEBRO
Curt Mueting	Lieska Halsey	Tim Weander	Randy Hoskins - City of Lincoln
Curtis Nosal	Lorraine Legg	Todd Hill	Roger Figard - City of Lincoln
Dan Waddle	Lynden Vanderveen	Todd Palmer	Terry Rogers - Martin Marietta Inc.
David Hansen	Mark Ahlman	Tom Renninger	Todd Culp - Coreslab Structures Inc.
David Schoenmaker	Mark Burham	Tom Sands	
Devin Townsend	Mark Fischer	Travis Haberman	
Dillon Dittmer	Mark Kovar	Vladimir Zhuromski	
Don Butler	Mark Lindeman	Wally Heyen	
Eric Klein	Mark Osborn	Wayne Patras	
Fouad Jaber	Mark Traynowicz	FHWA	
Jake Blessen	Mary Schroer	Abe Anshasi	
Janie Vrtiska	Matthew Baker	Andrew Heuerman	
Jared Kreher	Matt Eames	David Mraz	
Jasmine Dondlinger	Matt Neemann	Justin Luther	
Jason Dayton	Mercy Manzanaras	Melissa Maiefski	
Jeremy Weigel	Mick Syslo	Shin-Che Huang-Former FHWA	
Jesse De Los Santos	Mike Owen	Zach Kresl	

JOIN A TECHNICAL ADVISORY PANEL

You can help shape research and innovation projects in your subject area by serving on a Technical Advisory Committee (TAC).

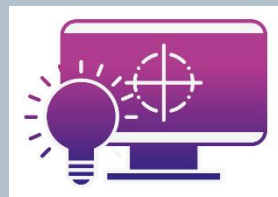
The Hub Corner

Completed Research Readiness Level (RRL) Assessment

<https://dot.nebraska.gov/business-center/research/summaries/>



**Need a problem solved?
We can help!**
- Submit a Statement of Need -



Research Projects



Find Active and Completed NDOT Research under "Research"

<https://dot.nebraska.gov/business-center/research/>



Technical Advisory Committee

You can help shape research and innovation projects in your subject area by serving on a Technical Advisory Committee (TAC). Involvement may include meeting throughout the life of the research project assisting developing work plans and reviewing final deliverables impacting the Nebraska's transportation. Please contact the research section at ndot.research@nebraska.gov



Publications

[Annual Research Program](#)
[Completed Research Executive Summary](#)
[Completed Research Readiness Level \(RRL\) Assessment](#)
[Digital Commons @ University of Nebraska- Lincoln](#)
[NDOR Research Hub](#)
[NDOT Library](#)

CONTACT

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Email: ndot.research@nebraska.gov

Phone : (402) 479-4697

Website: [NDOT Research](#)

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NEBRASKA

Good Life. Great Journey.

DEPARTMENT OF TRANSPORTATION