Improving Safety on Nebraska Roads During Winter Weather
refer to pages 6-7

NEBRASKA
Good Life. Great Journey.
DEPARTMENT OF TRANSPORTATION

Annual Research Hub

M&R MATERIALS & RESEARCH

2021-2022
Issue 3

Insight into NDOT Research

Materials & Research Engineer's Notes

Brandon Varilek

The NDOT Research Section helps transportation practitioners solve problems through research and innovation. With funding from state, local and federal research programs, we administer more than 50 research projects annually. For the fiscal year 2023, the Nebraska Transportation Research Council (NTRC) prioritized 19 Statements of Need.

The Research Section organized and held 19 frame-work review meetings to place technical experts with the Principal Investigators to develop proposals in support of the Department's mission.

This year, the Research Advisory Committee (RAC) selected 13 new State Planning and Research (SPR) projects with a total budget of $1,730,499. The current FY-22 expenditures are $1,240,536 for all ongoing research projects and provided financial support to the Transportation Research Board (TRB) and the National Cooperative Highway Research Program (NCHRP).

NDOT ensures completed research outcomes are put into practice by completing the Research Readiness Level Assessment (RRLA). The RRLA evaluates a project's readiness for implementation. Since 2019, 50 projects have been completed, 30 research projects have been implemented in the field and are being monitored for successful performance, and 7 research projects have been adopted as standard practice for NDOT.

RESEARCH SECTION MISSION

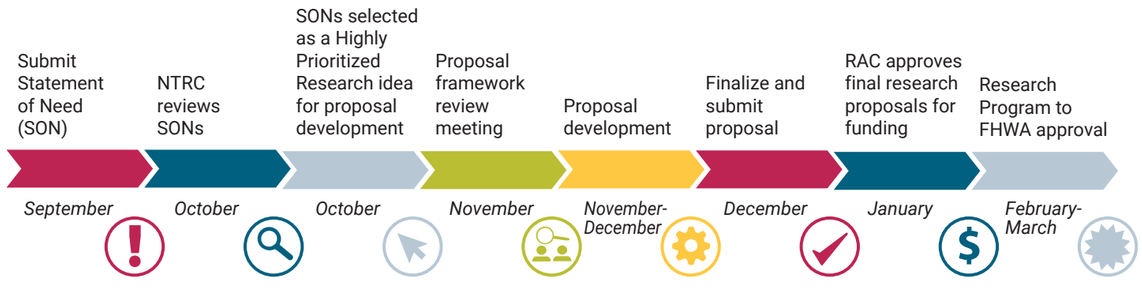
NDOT Goals

- Challenge our business practices.
- Develop our workforce.
- Serve our customers.
- Engage our partners.

The Department's Federally-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.

Typical NDOT Federally-Funded Research Cycle

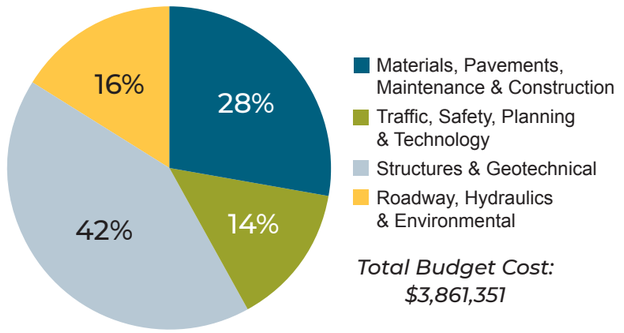


Need a problem solved?
We can help!
Submit a Statement of Need

For more information visit *Nebraska Department of Transportation Research Website*

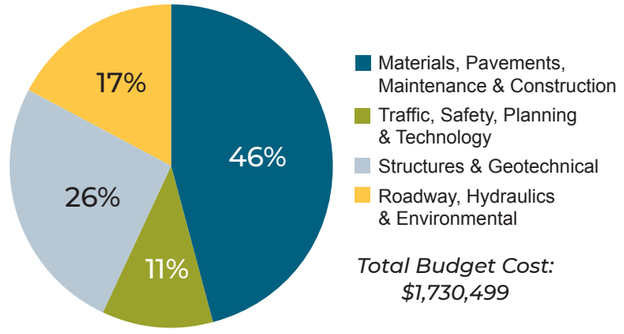
Total Project Budgeted by Topic Area

In-Progress Contracted Research



Total Budget Cost: $3,861,351

New Contracted Research



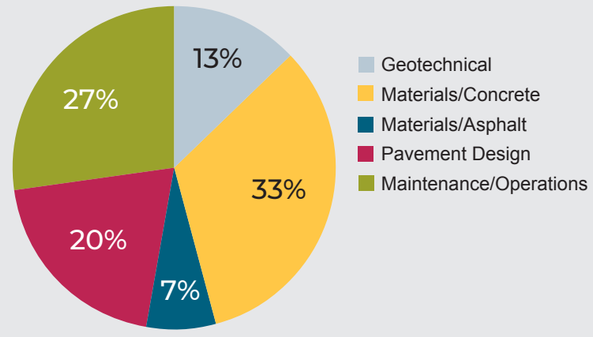
Total Budget Cost: $1,730,499

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 public, cities, counties, consultants, suppliers, contractors, universities, FHWA and within NDOT. 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 & Construction
- Traffic, Safety, Planning & Technology
- Structures & Geotechnical
- Roadway, Hydraulics & Environmental

In-House Research by Topic Area

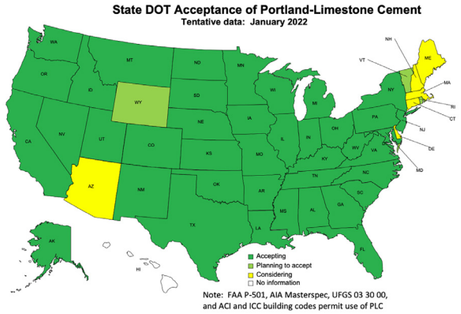


NDOT In-house research differs from contracted research in that the researcher is an employee of NDOT. The in-house researcher often also serves as the Project Manager. In-house research enables NDOT to:

- Assess emerging research 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.

Portland-Limestone Cement and Environmental Sustainability

Portland cement manufacturers have developed a modified formula of their most important product to respond to growing calls for reducing embodied carbon associated with construction. As concrete is the most widely used construction material on the planet, the use of portland limestone cement (PLC) concrete has the potential to significantly reduce the environmental impact of the industry. Although portland cement is a relatively minor constituent by volume, its presence can significantly contribute to the carbon dioxide (CO_2) associated with concrete.



Map source- www.cement.org

What is PLC?

Portland-Limestone Cement (PLC) is a blended cement with higher limestone content. It is typically blended at 5% to 15% limestone in portland cement in accordance with ASTM C595 Standard Specification for Blended Hydraulic Cements. The resulting product works measures, and performs the same as ordinary portland cement, but reduces the carbon footprint by 10% on average.

Since 2010, Nebraska has allowed blended cement to include up to 10% limestone. In 2021, Nebraska saw an increased interest in producing PLC cement from cement manufactures. Some manufacturers already produce PLC cement.

Nebraska is now allowing contractors to use up to 12% interground PLC to reduce the CO_2 footprint when producing cement without increasing cost or concrete performance.

Material and Research's Portland Cement Concrete Section completed testing to confirm Type IL Cement meet's the Department concrete specifications to be on the Approved Qualified List (AQL).

UHPC Could Create Lower-Cost Customizable Solutions

What is Ultra-High Performance Concrete (UHPC)?

UHPC is a new class of concrete that has mechanical and durability properties far exceeding those of conventional concrete. The use of UHPC will result in significant improvements in the structural capacity and durability of bridge components.

Nebraska Department of Transportation (NDOT) successfully constructed connections and joints in bridge decks on the Primrose East Bridge in 2013 and Belden-Laurel Bridge in 2018. However, the cost of UHPC used in these two projects was as high as $13,000/CY. The expense was primarily due to the high unit cost of materials, shipping of materials and equipment, and transportation and accommodation for technicians associated with the use of proprietary mixes. Dr. Jiong Hu and Dr. George Morcous of University of Nebraska-Lincoln developed a non-proprietary mix using local materials through a funded NDOT project entitled "Feasibility Study of Development of Ultra-High-Performance Concrete (UHPC) for Highway Bridge Applications in Nebraska" with a unit cost at approximately $740/CY.

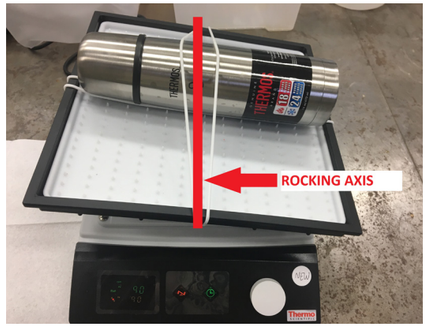
The University of Nebraska recently hosted a hands-on workshop providing technical training for producers, contractors, and NDOT engineers. Drs. Hu and Morcous explained procedures required for batching, mixing, transporting, placing, and testing cast-in-place UHPC for the non-proprietary mix. Attendees had the opportunity to work with fresh UHPC and observe flexure testing in the PKI concrete lab.

NEBRASKA DEPARTMENT OF TRANSPORTATION

COLLEGE OF ENGINEERING

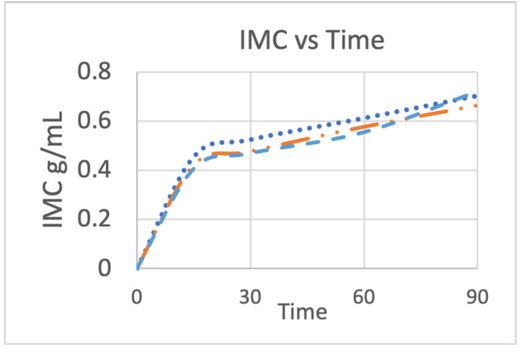
IMPROVING SAFETY ON NEBRASKA ROADS DURING WINTER WEATHER

Winter weather driving is a prominent risk in Nebraska. In a 10-year period from 2009-2019, there were nearly 6,000 crashes. Approximately 2.0% of those crashes resulted in loss-of-life. This highlights the importance of selection and timely application of deicing materials. To support NDOT Maintenance during winter operations, the Research Section began evaluating deicing chemicals using laboratory procedures and deploying instrumentation to monitor field performance.



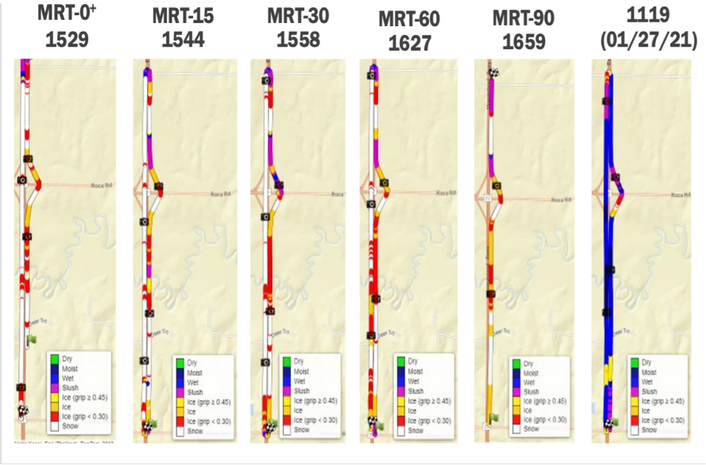
A Mechanical Rocker Test (MRT) sample shakes on the rocking table. The rocking axis shows the orientation of the thermos on the table.

The Department uses the Mechanical Rocker Test (MRT) which is a laboratory procedure that measures a deicer's Ice Melting Capacity (IMC) and indicates its effectiveness. The procedure is used in procurement and quality assurance testing. The MRT-15 produces a single IMC data-point at 15 minutes and is only validated for MgCl2-based deicers. The Research Section is working to expand the capabilities of the MRT by extending the testing duration and raising the testing temperature. Extending the duration indicates a deicer's effectiveness over time. Raising the temperature gives NDOT the ability to measure deicer performance over a range of temperatures. This effort will also aid maintenance supervisors in material selection, giving them confidence that selected chemicals will be effective in achieving Level-Of-Service requirements and the duration when the deicers are active.



The Mechanical Rocker Test (MRT) taken at four different time intervals yields a curve that shows a deicer's ice melting capacity (IMC) over 90 minutes..

The Research Section has utilized a mobile Road Weather Information System (RWIS), the Teconer RCM411, to measure the performance of a deicer over time in the field. Typically, RWIS is used to identify the condition of a route which provides maintenance crews information on where to treat. The image shows how the RWIS is used to observe the melting of snow and ice on a 6-mile loop every 15 minutes for an hour and a half after deicer application. Researchers observe the road change from an icy and snow packed road, to a wet road, back to an icy road over the course of 90 minutes, and then a wet road 20 hours later. Change in the coefficient of friction indicates a deicer's ability to improve the road condition, the duration of effectiveness, and the working temperature range over that timeframe.



Mobile RWIS produces a map of road conditions. Observing the conditions captured every 15 minutes this figure shows when melting and refreezing occurs.

This information can supplement other tools used by maintenance during winter operations. M&R seeks to collect field data to compare the field and lab performance of different deicing chemicals.

Maintenance operators remove the validation box to weigh salt collected.

Finally, M&R is assisting Operations in assessing the calibration of spreaders through an in-motion validation. Researchers visited three Districts to conduct field experiments of collecting discharged deicing salt at different rates. The goal of the research is to determine optimal calibration parameters and to measure the difference between setpoint vs. actual spreader output. Researchers collected salt discharged from the spreader in a "validation box" and weighed the material collected. By improving the calibration process, NDOT maintenance will save labor and material costs, and ensure the correct amounts of materials are being used to treat the roads.

AT A GLANCE

Research and Education for Optimizing the Development and Implementation of an Unmanned Aircraft Program at NDOT

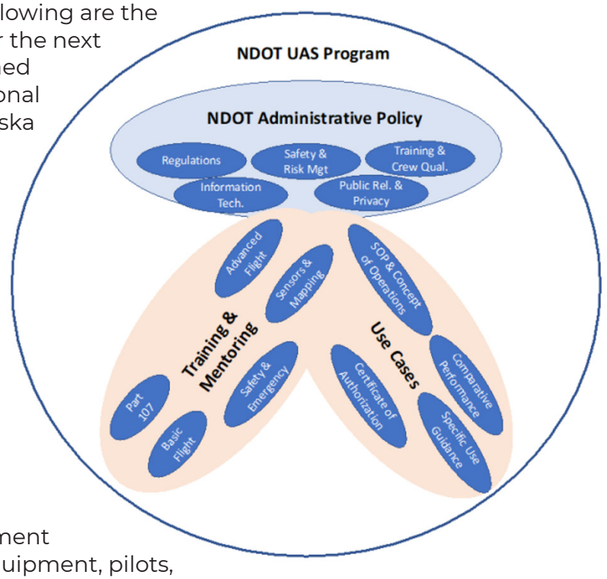
Principal Investigator: Christopher Neale-UNL
NDOT Lead TAC Members: Jon Starr-BTSD Division

Technology

Research Readiness Level Assessment – Level 4
Implementation with Follow-up Research Technology refined and adopted by the Department. Benefits of the implementation will be evaluated for a time frame of four years.

NDOT Recommendations Based on Completed Research

Based on lessons learned during this project, following are the recommendations that NDOT has developed for the next steps of the program: Expanded use of Unmanned Aircraft System (UAS) at NDOT to include additional pilots geographically located throughout Nebraska to better respond to basic UAS operations. Expanded UAS equipment to take advantage of additional efficiency gains:



1. **Thermal Sensor** - Add thermal sensor to M210 package to continue evaluating the use of thermal imagery for detecting bridge delamination, as well as environmental uses in counting/locating bats and birds.
2. **LIDAR** - Obtain a UAS LIDAR system to expand and integrate aerial LIDAR data into our survey practices; allowing for remote sensing and safer operations where this technology makes sense.
3. Pursue and acquire a UAS Program management technology to log and track all UAS assets (equipment, pilots, missions, maintenance, etc.) that can be configured to align with NDOT UAS SOPs.
4. Pursue a waiver to § 107.31 Visual Line of Sight Aircraft Operation to allow for daisy chaining visual observers to make larger, linear missions more feasible to perform.
5. Develop additional case studies to support the NDOT program, such as highway bridge monitoring and wetland habitat mapping for example, drawing from existing expertise at UNL for these applications.

As provided by Jon Starr, Lead TAC Member

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, Richard Wood and Jongwan Eun-UNL
NDOT Lead TAC Members: Nickolas Glennie- Geotechnical Engineer-Materials and Research

Geotechnical

Research Readiness Level Assessment – Level 4
Research/Technology developed in an operational environment. *(Will be followed up in real-world situation.)*

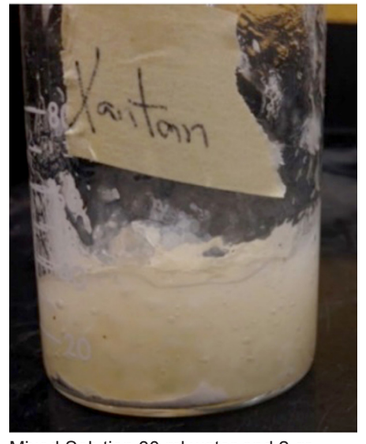
NDOT Recommendations Based on Completed Research

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 Cone Penetration Testing (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

Verdigre slope at Highway 84



Mixed Solution 30 ml water and 2 gr Xanthan

Final report is available at: NDOT Research Website

Measuring Foundation Course Modulus Using Falling Weight Deflectometer, Light Weight Deflectometer and Dynamic Cone Penetration

The Falling Weight Deflectometer (FWD) is a trailer mounted, non-destructive testing device that drops a weight onto the pavement and has sensors that measure the amount of resulting deflection. The slope of the load and resulting deflection is referred to as the modulus.

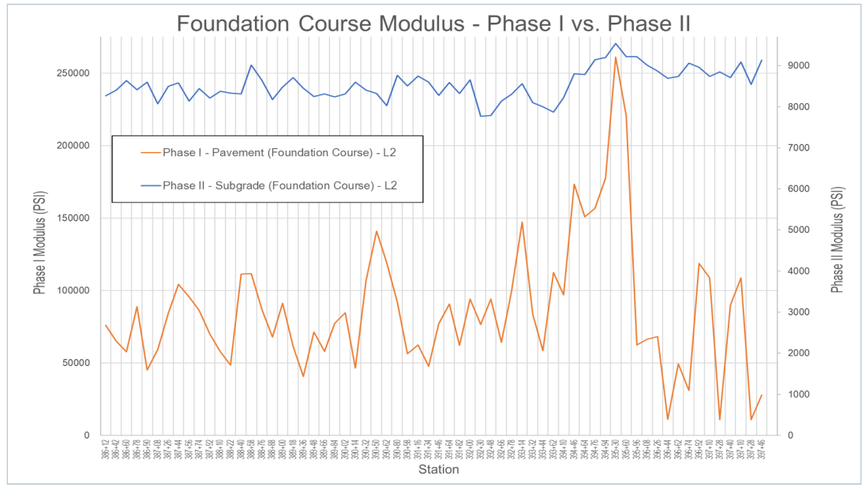
Falling Weight Deflectometer (FWD) measures modulus via deflection with seven sensors and machine-dropped weights.

NDOT has years of experience testing strata beneath asphalt surfaces but because FWD testing of subgrades beneath rigid pavement are not well established, NDOT has not adopted testing of rigid pavements and underlying bases by FWD.

This research tested the modulus of the foundation course before (Phase I) and after (Phase II) placement of the doweled concrete structure. Modulus is a measurement of the strength and uniformity of the foundation course. The values shown in the table are the average modulus (PSI) and statistical analysis of both phases. Phase I data reveals a significantly larger coefficient of variation than Phase II. This proves that uniformity of the foundation course cannot be determined by FWD testing after the concrete pavement is placed, which would require very similar results. Neither can foundation course moduli be reliably calculated by using FWD on top of doweled concrete pavements and back-calculated using Darwin software or ME Design. As a result of this study, NDOT will disallow the use of FWD after paving to confirm foundation uniformity.

Final report is available at: NDOT Research Website

	Phase I Modulus *(72 data points on foundation course)*	**Phase II Modulus** *(72 data points on doweled pavement)*
Average Modulus (PSI)	86,481	8,543
Standard Deviation	45,422	376
Coefficient of Variation	53%	4%



FWD was measured in two phases: Phase I on bare foundation course and Phase II on doweled concrete.

The standard deviation and coefficient of variation (COV) of the Darwin moduli was calculated for the 72 data points common to Phase I and II. The values are shown in Table. Testing directly on top of the foundation course in Phase I resulted in a COV of 53%, while testing on top of doweled-concrete pavement in Phase II resulted in a much lower COV of 4%. Looking at only the Phase II COV falsely implies that the foundation course is uniform and consistent throughout the length of the testing strip, whereas the Phase I results indicate a greater variance of modulus values. Further, the value of moduli is much lower in Phase II then in Phase I. The likely cause of the difference is due to the concrete structure absorbing most of the energy from the blow and therefore is not transferring the deflection to the foundation course.

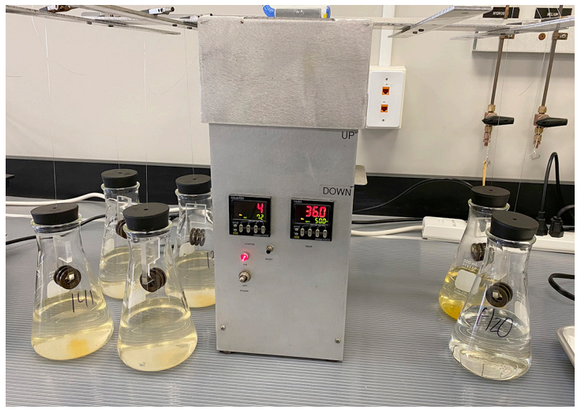
AT A GLANCE — IN-HOUSE RESEARCH IN PROGRESS

The Research Section solicits “statements of need” for proposed research. Some proposals do not require extensive funding and/or special equipment. These projects are usually proposed by Divisions and Sections at the Department and address a business need. Engineers in the Research Section facilitate in-house research projects by providing technical support, project management, and documentation. The following projects highlight current research from each Section.

Materials & Research – Portland Cement Concrete (PCC) Section

Assessing a Test Method for Corrosion Inhibitor Effectiveness in Liquid Deicers

NDOT conducted a round-robin test to estimate the precision of the industry standard test method, Clear Roads Test Method 5, for measuring the effectiveness of corrosion inhibitors in liquid deicers. Test Method 5 measures corrosion by exposing iron coupons to deicing liquid and air, alternatively. Results are presented as the “corrosion effectiveness percentage” where the maximum passing value of 30% indicates the deicer caused 30% of the corrosion caused by NaCl, adjusted for water. Prior to this study, the variance of the test was unclear. This study provides the industry with confidence in test results. The results also provide a benchmark for comparison as NDOT seeks to develop an alternative test method.



The machine used for Clear Road’s Test Method 5 was custom built for NDOT.

Accelerated Corrosion Test

NDOT is in the preliminary stages of developing the Accelerated Corrosion Test: an alternative test method for corrosion effectiveness. The NDOT Chemistry Laboratory is running a Design of Experiment to determine if a measurable level of corrosion can be achieved in less than 72 hours. The test also uses standard lab equipment instead of specialized machine. This method seeks to improve the testing process by shortening the duration of the test, allowing more flexibility in scheduling, reducing labor costs, and simplifying the equipment used.

Left - NDOT is testing a hypothesized method for accelerating corrosion using standard laboratory equipment.

Utilizing Sealers Technology in Bridge Rail Construction to Protect Against Chloride Ion Penetration

The PCC Section is conducting research to investigate five different products to provide protection to bridge rails. Bridge rails are prone to deterioration due to construction techniques, traffic effects, and deicing chemical exposure. Two products will be used as an admixture and will be placed when the bridge rail is cast.

- Krystol Internal Membrane (KIM), The KIM reacts with water and un-hydrated cement and forms crystals that seal micro-cracks and prevent water and chloride penetration.
- E5® Internal Cure admixture - Works via internal curing, which reduces shrinkage-cracking.

Two products will be applied via sprayer after a bridge rail is constructed and cured.

- PoreShield is a bio-product used for sealing concrete. NDOT tested Pore-Shield using Nebraska’s Wet & Dry Test, which exposes specimens to wet and dry cycles. This allows researchers to observe the effects of wet and dry conditions on concrete. Researchers seal cylinders prior to testing and compare the cracking performance to an unsealed, control cylinder. After favorable results in the Nebraska Wet & Dry Test, Research has designated a structure for field application and long-term monitoring.
- Crete Pavix application provides a formation of hydrophilic crystal addition to moisture repellency action.

Courtesy of https://carboncure.com/

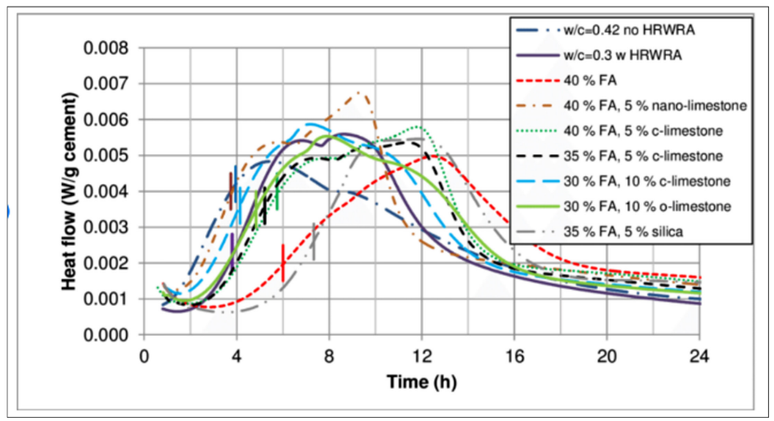
CarbonCure

CarbonCure is a technology installed in ready mix concrete plants that injects CO2 into wet concrete to improve strength and performance. NDOT is testing carbon cure in shoulders on the South Lincoln Beltway. Engineers will monitor the performance for the potential widespread use in NDOT concrete pavements, which could reduce the carbon footprint of NDOT projects.

AT A GLANCE — IN-HOUSE RESEARCH IN PROGRESS

Isothermal Calorimetry as a Tool to Evaluate Early-Age Performance of Supplemental Cementitious Materials (SCM's) Mixtures

Isothermal calorimeters measure the heat generated in chemical reactions. NDOT is using this technology to test the effect of different temperatures and water-cement ratios have on the heat of hydration of the interground and blended portland cements used in Nebraska. Data from this device can be further used to determine the set time of a system and the response of a system to changes in fly ash or admixture types or amounts. This information will provide the PCC Engineer valuable information for mix design considerations.



Heat Flow Vs Time

Courtesy of https://www.researchgate.net/figure/Isothermal-calorimetry-curvesvs-time-for-the-nine-cement-pastes-For-each-curve-the_fig2_234154830

Reapplication of Penetrating Concrete Sealers on Median Barriers

In 2013, concrete median barriers along I-80, I-480, and I-680 in Omaha, and Lincoln, Nebraska were sealed with penetrating concrete sealer (PCS). Pavement Design plans to reapply PCS to provide additional protection to the barriers. However, the Pavement Design Engineer expressed the need for more information about surface preparation before the Lincoln and Omaha median barriers get programmed for the reapplication of sealer. The Pavement Design Engineer identified a control section with no surface preparation and a test section which was power washed. Cores were taken from each section before and after PCS application and examined for depth of penetration. The PCS showed the best performance when the surface was power washed and therefore power washing is recommended prior to reapplying PCS.

Pavement Design investigated the importance of power-washing vertical structures prior to reapplying penetrating concrete sealers.

Materials & Research – Pavement Design Section

Investigation of Poor Performing 4' x 4' Repair Patches on Nebraska Highways

Pavement Design observed 4'x4' patches failing prematurely.

Pavement Design personnel observed faulting and pumping in 4'x4' repair patches in several locations on Nebraska highways. The faulting and pumping occurred despite the patches including dowels. In some instances, pumping caused the failure of the hot-pour sealant. Several mechanisms could cause faulting including sub-base and foundation course failure, tie-bar and dowel bar failure, or weak concrete. The failure of patch repairs could lead to further damage in the road structure and cause unsafe and undesirable driving conditions. This project will inform Pavement Design the best practices for repairing concrete with small patches.

Hot-Pour Joint Sealant in Narrow Saw-Cut Joints

Specially designed concrete blocks allowed Pavement Design to study the bond of hot-pour sealant in narrow saw-cut joints.

Pavement Design is investigating sealing narrow saw-cut joints with hot-pour sealant. There is no data that indicates whether sealing joints is possible and effective. Narrow joints provide several challenges including getting sealant to flow to the bottom of the saw-cut and whether the bond between the sealant and the remains intact. Specially designed blocks were made in-house to test the sealant bond through extension testing. Researchers found that certain sealants could flow to cover the entire joint, however, the extension test failed when pulled to extension and contraction levels experienced in the field. Research continued with reducing the extension distance and widening the joint to represent actual field conditions. The bond held without issue.

This investigation will move forward to follow up with projects this 2022 construction season. Researchers plan to take cores at different joints and monitor the sealant performance for three years after construction.

AT A GLANCE — IN-HOUSE RESEARCH IN PROGRESS

Materials & Research – **Flexible Pavement Section**

Cold-weather Patching

The Flexible Pavement Section is researching a new method of patching asphalt pavements during cold weather. The method involves mixing a binder pod with recycled asphalt millings in a portable asphalt recycling machine. The binder pods are made up of rejuvenators, recycling agents, and fresh binder.

The Flexible Pavement Engineer has coordinated with Maintenance to use this patching method during winter months. The patches will be observed for performance over the course of a winter season to determine if the patch method is successful. If the method succeeds, it will drastically reduce the cost of materials used in patching.

Flexible Pavement Section uses a portable asphalt recycling machine to patch asphalt pavements during cold weather.

Materials & Research – **Geotechnical Section**

Research Erosion Characteristics of Nebraska's Group Index Soils

The pin-hole test is known to simulate run-off induced surface erosion phenomenon. The pin-hole test, a robust device commonly used to evaluate the internal and surface erosion indices, is employed to evaluate the performance of Nebraska Group Index (NGI) soils. Evaluating Nebraska's soils and their susceptibility to erosion by NGI soil types will provide engineers erodibility measurements and inform them of benefits found using cement, fly ash and lime to improve the ultimate soil characteristics. The results from this investigation will also provide erosion control guidance to Pavement Design and the Environmental Section, and scour-susceptible soils to the Bridge Division.

Left - Former Geotechnical Engineer Mark Lindemann demostrating the pin-hole test.

Contracted and In-House Projects Completed and Published

Project Number	Projects Completed and Published	Focus Area	Completed
M105	Report: Low-Cost Modal Identification Sensors of Bridge Field Testing NDOT Recommendations Based on Completed Research	Structures	2021
M106	Report: Feasibility Study Alternatives to Prevent Settlements and Bumps at Bridge Approaches in Nebraska NDOT Recommendations Based on Completed Research	Structures	2021
M108	Report: Design and Detailing of Cast-in-Place and Precast Concrete Approach Slabs NDOT Recommendations Based on Completed Research – In Progress	Structures	2021
M115	Report: Research on High-RAP Mixtures with Rejuvenators - Field Implementation NDOT Recommendations Based on Completed Research – In Progress	Materials	2021
M117	Report: Research and Education for Optimizing the Development and Implementation of an Unmanned Aircraft Program at the Nebraska Department of Transportation NDOT Recommendations Based on Completed Research	Technology	2021
FY21 (012)	Report: Field Demonstration of GPR and UAV Technologies for Evaluation of Two US75 Bridges NDOT Recommendations Based on Completed Research – In Progress	Technology	2021
In-House	Report: Measuring Foundation Course Modulus Using Falling Weight Deflectometer, Light Weight Deflectometer, and Dynamic Cone Penetration NDOT Recommendations Based on Completed Research	Pavement Design	2021

CONTRACTED RESEARCH - IN PROGRESS

Project Number	Research Title	Principal Investigator	NDOT TAC Lead Member	Year Funded	Total Cost
Materials, Pavement, Maintenance and Construction (MPMC)					
M116	Effect of Antioxidant Additives and Restorators on Performance of Asphalt Binders	Hamzeh Haghshenas	Robert Rea	2019	$139,788
FY21 (003)	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II	Hamzeh Haghshenas	Robert Rea	2020	$145,238
FY21 (006)	Rapid Concrete Bridge Repair Survey and Patch Material Evaluation	Marc Maguire	Wally Heyen & Fouad Jaber	2020	$93,572
FY22 (001)	Low-Cement Concrete Mixture for Bridge Decks and Rails	George Morcous	Wally Heyen & Fouad Jaber	2021	$111,404
FY22 (002)	Nebraska Balanced Design Mix	Hamzeh Haghshenas	Robert Rea	2021	$137,947
FY22 (003)	Warm Mix Asphalt (WMA) Short-Term Aging	Hamzeh Haghshenas	Robert Rea	2021	$140,617
FY22 (004)	Erosion Resistant Rock Shoulder	Chung Song	Bruce Barrett	2021	$141,917
Roadway, Hydraulics and Environmental (RHE)					
FY21 (009)	Energy Dissipation Optimization for Circular Culverts	David Admiraal	Julie Ramirez	2020	$107,088
FY21 (011)	Establishment of Wildflower Islands to Enhance Roadside Health, Ecological Value, and Aesthetics - Phase II	John Guretzky	Ron Poe	2020	$171,275
FY22 (006)	Evaluation of NDOT's Sediment Barrier Practices Using Performance Data	Mike Perez	Ron Poe	2021	$189,999
FY22 (005)	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills	Aaron Mittelstet	Julie Ramirez	2021	$142,176
Traffic, Safety, Planning, and Technology (TSPT)					
FY22 (012)	Inventory, Operations and Safety at Free Right-Turn Ramps	Aemal Khattak	Alan Swanson	2021	$197,290
Structures and Geotechnical (SG)					
M087	Design Optimization and Monitoring of Jointless Integral and Semi-Integral Abutment Bridges in Nebraska	Chungwook Sim	Fouad Jaber	2018	$142,312
M102	Phased Construction Bridges: Monitoring and Analysis for Traffic-Induced Vibration	Christine Wittich	Fouad Jaber	2018	$117,482
M103	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP	Joshua Steelman	Fouad Jaber	2019	$132,358
M104	Data-Driven Prioritization and Empirical Predictions for Bridge Scour in Nebraska	Richard Wood	Fouad Jaber	2019	$ 15,662
M107	Outdoor Laboratory and Testbed for Bridge Health	Richard Wood	Fouad Jaber	2019	$115,074
FY21 (002)	Development of Guideline for the Use of Geosynthetics in Different Pavement Layered System in Nebraska	Jongwan Eun	Nikolas Glennie & Bruce Barrett	2020	$106,536
FY21 (004)	Midwest Guardrail System (MGS) Thrie Beam Approach Guardrail Transition (AGT) Retrofit to Existing Concrete Parapets and Bridges	Scott Rosenbaugh	Fouad Jaber	2020	$87,978
FY21 (005)	UHPC Decked I-Beam for Accelerated Bridge Construction	George Morcous	Fouad Jaber	2020	$98,250
FY21 (010)	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support	Robert Bielenberg	Matt Neemann	2020	$164,927
FY22 (007)	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support – Phase II	Robert Bielenberg	Phil TenHulzen	2021	$218,566
FY22 (008)	Production of Cast-in-Place UHPC for Bridge Applications	Jiong Hu	Wally Heyen & Fouad Jaber	2021	$83,006
FY22 (009)	Accelerated Bridge Construction Decision Tool	Phil Barutha	Fouad Jaber	2021	$89,592
FY22 (010)	Application of Steel Sheet Piles for the Abutment of Water-crossing Bridges in Nebraska	Seunghee Kim	Fouad Jaber	2021	$154,314
FY22 (011)	Truck Platooning Effects on Girder Bridges – Phase II	Joshua Steelman	Fouad Jaber	2021	$119,853

NEW – Contracted Research Projects FY-23

Project Number	Research Proposal Title	Principal Investigators	NDOT TAC Lead Member	Total Cost
Materials, Pavement, Maintenance and Construction (MPMC)				
FY23 (013)	High-Mast Tower Foundation – Phase II	Marc Maguire	Mick Syslo	$153,428
FY23 (014)	Gravel Road Performance Enhancements	Bora Cetin	Bruce Barrett	$166,064
FY23 (015)	Application of Cementitious Materials and Fiber Reinforcement to Enhance Lime Stabilization for Nebraska Shale Soils	Jongwan Eun	Bruce Barrett & Nikolas Glennie	$142,129
FY23 (016)	Nebraska Balanced Mix Design – Phase II	Hamzeh F. Haghshenas	Robert Rea	$141,914
FY23 (017)	Development of the Nebraska Department of Transportation Winter Severity Index – Phase II	Mark R. Anderson	Jesse Schulz	$183,603
Roadway, Hydraulics and Environmental (RHE)				
FY23 (018)	Updating rainfall zones and intensities in Nebraska for improved design of non-bridge sized drainage structures: Phase I	Rezaul Mahmood	Julie Ramirez	$120,000
FY23 (019)	Minimizing take of threatened rattlesnakes and optimizing project review in SE Nebraska	Shawn Dunn	Jeff Hartman	$62,238
FY23 (020)	A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: (Phase III – The Sandhills Region)	Rolfe Mandel	Stacy Stupka	$120,130
Traffic, Safety, Planning, and Technology (TSPT)				
FY23 (025)	Modeling Pedestrian and Bicyclist Crash Exposure with Location-Based Service Data	Yunwoo Nam	Don Butler	$184,629
Structures and Geotechnical (SG)				
FY23 (021)	Impacts of Stream Bed Adjustments on Local Stream Morphology at Bridge Crossings	David Admiraal	Harvey Kirk & Fouad Jaber	$134,860
FY23 (022)	Air-coupled GPR and HD Imaging for High-Speed Evaluation of Concrete Bridge Decks with Asphalt Overlays	Jinying Zhu	Fouad Jaber	$166,897
FY23 (023)	Regression Equation Update	United States Geological Survey (USGS)	Harvey Kirk	$74,600
FY23 (024)	Repair/Preservation of Concrete Bridges Using Ultra-High-Performance Concrete (UHPC)	George Morcous	Wally Heyen & Fouad Jaber	$80,007
			Total FY-2023 Funded Projects	**$1,730,499**

In-House Research – In Progress	
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
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
Investigation of Poor Performance 4'x4' Repair Patches on Nebraska Highways	Pavement Design

NEW – In-House Research	
Sealers Application - Vertical Surfaces	Materials/Concrete
Carbon Cure	Materials/Concrete
Capillary Pressure Sensor System	Materials/Concrete
Spreader Validation	Materials/Maintenance
Accelerated Corrosion Testing	Materials/Maintenance
Mechanical Rocker Test – Expansion of Test Parameters	Materials/Maintenance
Hot Pour Sealant in a Narrow/Deep Saw Cut Joint	Pavement Design

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. 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 – FY2023 Program	
Program Research Project Title -	**Total Cost**
Annual Consulting Services Support	$65,000.00
Midwest Pooled Fund Website	$12,111.00
LS-DYNA Modeling Enhancement Support	$40,000.00
Surface Mounted Strong-Post MGS	$217,840.00
MASH TL-3 Portable Barrier System – Phase II	$331,619.00
Median Approach Guardrail Transition to Concrete Median Barrier	$233,888.00
Evaluation of Increased Blackout Depth with the Midwest Guardrail System	$262,851.00
Midwest PCB – Anchored Median Installations - scores	$155,232.00
Total Program	**$1,318,541.00**

The Midwest Roadside Safety Facility (MwRSF)

MwRSF's Latest Published Research

PARTNERSHIPS - RESEARCH DOLLARS IN ACTION

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.

Study Title	Expenditures FY 2022	Required Commitments FY 2023	NDOT Technical Representatives
TPF-5(317) Evaluation of Low Cost Safety Improvements	$5,000	$5,000	Dan Waddle
TPF-5(326) Develop and Support Transportation Performance Management Capacity Development Needs for State DOT's	$147,000	—	Tom Sands
TTPF-5(347) Development of Maintenance Decision Support System	$30,000	$30,000	Mike Mattison
TPF-5(353) Clear Roads Phase II	$25,000	$25,000	Mike Mattison
TPF-5(372) Building Information Modeling (BIM) for Bridges and Structures	$20,000	$25,000	Fouad Jaber
TPF-5(430) Midwest Roadside Safety Pooled Fund Program	$65,000	$65,000	Phil TenHulzen
TPF-5(432) Bridge Element Deterioration for Midwest States	$20,000	$20,000	Fouad Jaber
TPF-5(437) Technology Transfer Concrete Consortium	$12,000	$12,000	Wally Heyen
TPF-5(438) Smart Work Zone Deployment Initiative	$25,000	$25,000	Dan Waddle
TPF-5(447) Traffic Control Device Consortium	$15,000	$15,000	Dan Waddle
TPF-5(448) Improving Specifications to Resist Frost Damage in Modern Concrete Mixes	$20,000	$20,000	Wally Heyen
TPF-5(451) Western Road Usage Charging Consortium	$25,000	$25,000	Ryan Huff
TPF-5(456) EconWorks - Improved Economic Insight	$4,000	$4,000	Ryan Huff
TPF-5(465) Consortium for Asphalt Pavement Research and Implementation (CAPRI)	$10,000	$10,000	Bob Rea
TPF-5(467) Project Management Software for Research	$3,500	$46,000	Mark Fischer
Solicitation 1536 - Traffic Signal Change and Clearance Intervals	$30,000	$30,000	Dan Waddle
TPF-5(480) Building Information Modeling (BIM) for Infrastructure	$60,000	$30,000	Lorraine Legg
Expected Commitment for FY 2023:		**$382,000**	

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

THE HUB CORNER

BY THE NUMBERS

Technology Transfer and Accomplishments by Principal Investigators in 2021.

12
Journals/ Papers Submitted

8
Completed Research Pojects

10
Conferences/ Webinars

1
Innovation/ Patent

UNL CIVE 361 Course
Civil Engineer Class-After Funded Completed Project

KEEP UP WITH NDOT RESEARCH

Completed Research Readiness Level (RRL) Assessment

https://dot.nebraska.gov/business-center/research/research-readiness-level-rrl/

Research Projects

Find Active and Completed NDOT Research under "Research"
https://dot.nebraska.gov/business-center/research

Technical Advisory Committee

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.
Contact the research section at ndot.research@nebraska.gov

NEW

Research Pays Off
Webinar Series Internally to NDOT

Professional Development Hours (PDH) for NDOT Professional Engineers, every 3rd Wednesday of June and September, 10:00-11:00 a.m. CT, covering one topic via WebEx. Webinars will be recorded and archived.

University of Nebraska Lincoln — DigitalCommons@University of Nebraska - Lincoln

Nebraska Local Technical Assistance Program (LTAP)

The University of Nebraska houses a complete archive of NDOT research reports in their digital commons. The research reports go back as far as 2003. As of June 2022, there have been 79,029 research reports downloaded from this site from all over the world. This site is updated every minute.

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M&R MATERIALS & RESEARCH

NEBRASKA
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DEPARTMENT OF TRANSPORTATION