iMPaCt

2015 Mountain-Plains Consortium
Annual
Highlights

The Mountain-Plains Consortium (MPC) is a competitively selected University Transportation Center, funded by the US Department of Transportation to serve Region 8 – the Upper Great Plains and the Intermountain West. MPC focuses on Transportation Infrastructure and Operations to Support Sustainable Energy Development and the Safe Movement of People and Goods." MPC, through the efforts of its faculty and staff, strives to be a leader in transportation by promoting its critical importance to the nation's infrastructure, energy development, and safety through research, interdisciplinary education, workforce development, and technology transfer while serving the unique and critical needs of the Mountain-Plains Region.

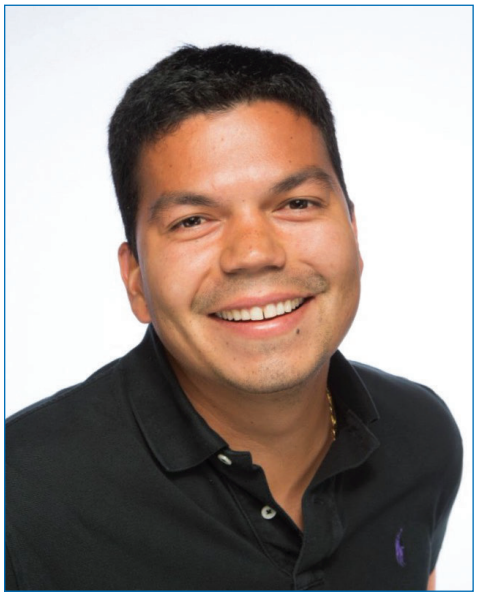
Participating Universities include:

- Colorado State University
- North Dakota State University
- South Dakota State University
- University of Colorado Denver
- University of Denver
- University of Utah
- University of Wyoming
- Utah State University

IMPACT BY THE NUMBERS

30	Undergraduate courses
83	Graduate courses
12	Master's level programs
11	Doctoral level programs
21	Undergraduate students participating in transportation research
169	Graduate students participating in transportation research
51	Master's students earned degrees
9	Doctoral students earned degrees
50	Research Projects
275	Peer-reviewed journal articles and conference papers presented by faculty or students
185	Graduate and undergraduate students participating in MPC research projects
260	MPC supported events (conferences, workshops, seminars, symposia, distance learning classes, etc.)
6,038	Number of transportation professionals participating in those events
$11,646,918	Matching dollars leveraged for research over the life of the current MPC grant

iMPaCt Students



Alejandro Henao: 2015 Student of the Year

Henao is a transportation engineering PhD student in civil engineering at the University of Colorado-Denver. Henao is president of the Institute of Transportation Engineers Student Chapter and student leader of the active communities/transportation research group. For his dissertation, he is evaluating the accuracy of new information technologies and analyzing the travel behavior impacts of such technologies and evolving transportation services. Alejandro holds an MS in civil engineering from CU Denver and a BS in civil engineering from CU Boulder. He received the Eisenhower Fellowship, an NSF Bridge to Doctorate Program Fellowship, and an NSF IGERT Fellowship. Henao worked extensively on the Mountain-Plains Consortium project, "Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit," and has published several papers in peer reviewed journals and presented this work at numerous national conferences. His other research topics include: transportation infrastructure investments, mode share changes, and parking around sporting event stadiums. Henao plans to continue to conduct research focused on creating more sustainable and equitable places with respect to active transportation, multimodal and intermodal options, information technologies, and evolving transportation modes.

The USDOT's University Transportation Centers program recognizes students of the year for each region at the Annual Council of University Transportation Centers Winter Banquet held in conjunction with the Transportation Research Board Annual Meeting each January in Washington, DC. The $1,000 award is based on accomplishments in research, academic performance, professionalism and leadership.

IMPACT THROUGH EDUCATION

MPC faculty members taught 30 undergraduate courses and 83 graduate courses last year at participating universities. Students (21 undergraduate and 169 graduate) were also involved in MPC research projects. MPC funds also support 12 master's level degree programs and 11 doctoral programs. MPC's educational plan is consistent with national goals to:

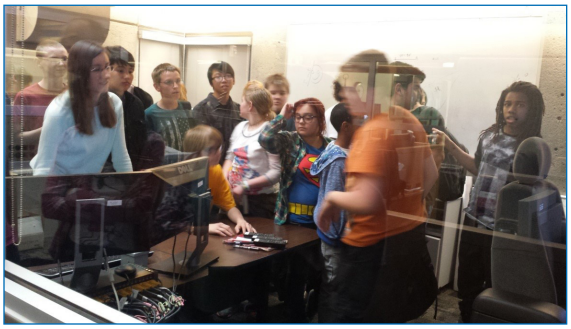
- Introduce transportation concepts in elementary and secondary education
- Provide vocational and technical training
- Build transportation degree programs that are international and multidisciplinary
- Provide mid-career transportation training

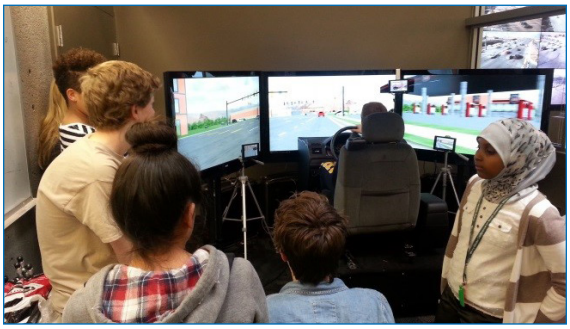
To accomplish these goals, MPC universities incorporate new technology and transportation concepts into programs and coursework to provide tomorrow's transportation professionals key conceptual and practical knowledge. Programs and courses are increasingly offered online, to make them more accessible to those already employed or are looking for mid-career training. Students involved in MPC research provide valuable insight and expertise while gaining experience and exposure to real-world transportation issues.

For more information on educational programs offered by MPC cooperators, visit http://www.mountain-plains.org/education/

Students visit Utah Traffic Lab

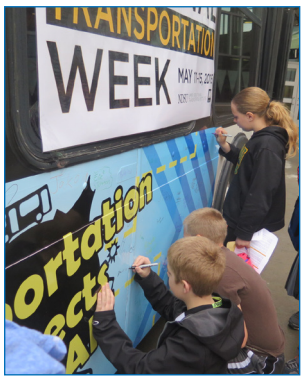
The University of Utah ITE chapter invites groups to visit campus facilities and tour the Traffic Lab and driving simulator. In April 2015, more than 300 potential undergraduate engineering students toured the engineering building and asked questions about transportation engineering and the Traffic Lab. A group of students from Kearns (UT) junior and senior high schools visited the Traffic Lab and learned about transportation engineering and how the work of traffic engineers impact the quality of life of the people and safety on roadways.

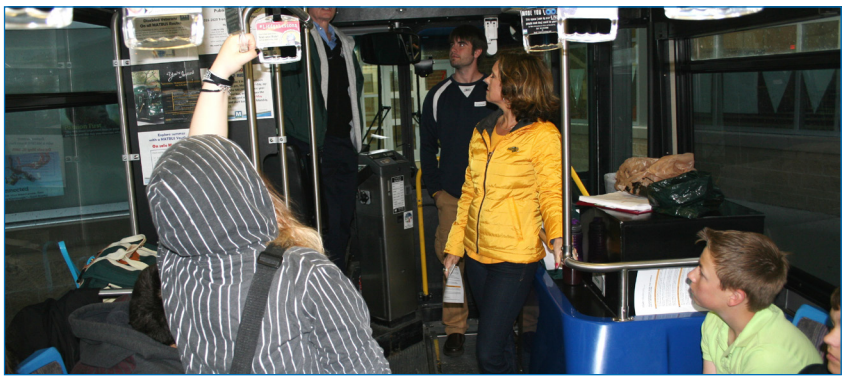




NDSU celebrates National Transportation Week

For National Transportation Week in 2015, staff at North Dakota State University's Upper Great Plains Transportation Institute mailed activities such as coloring pages, word finds and crossword puzzles to elementary schools across North Dakota to teach students about the importance of transportation. Industry experts gave invited lectures on campus to boost transportation awareness among the campus community. Staff members cooperated with Fargo's transit provider, MATBUS, in visiting an area middle school to teach students about the benefits of public transportation and potential careers in transportation.

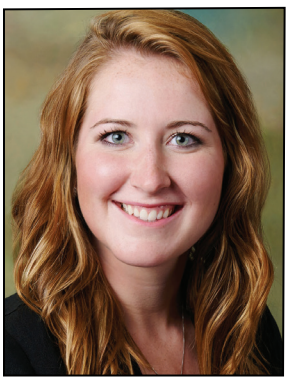




Scholarships awarded

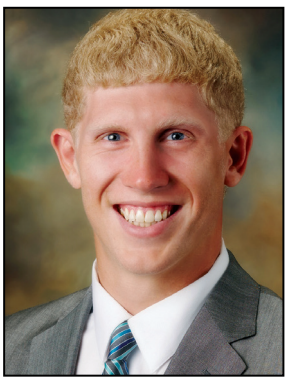
With funding from the MPC, the Upper Great Plains Transportation Institute at NDSU recognized four future leaders in transportation. The Paul E.R. Abrahamson Scholarship recognizes outstanding students at NDSU with an interest in the transportation and logistics of agricultural products. Winners of the $1,500 scholarships in 2015 were Jacob Chisholm, a senior in agricultural economics from Gary, MN, and Molly Collette, a senior in agribusiness from Grafton, ND. The Transportation Engineering Scholarship recognizes academic achievement and promotes the education of transportation students at NDSU. Winners of the $1,500 scholarships in 2015 were Matthew Lee, a senior in civil engineering from Dilworth, MN, and Dylan Dunn, a senior in civil engineering from Fargo, ND.

Chisholm



Collette

Lee



Dunn

STUDENT IMPACT

CSU student honored for paper and poster

CSU Colorado State University PhD student Yufen Zhou was selected runner-up in the best student paper competition for a paper about cable loss on long-span bridges during the ASCE Engineering Mechanics Institute (EMI) annual conference at Stanford University in June. She also received the best student poster award from the poster competition held by EMI Experimental Analysis and Instrumentation Committee.

Student is Eisenhower fellow

University of Colorado Denver PhD student Kara Luckey was selected as a Dwight D. Eisenhower Fellow. Her dissertation focuses on the relationship between urban infrastructure and community development. She is also engaged in research related to neighborhood change processes, residential location decision-making, transportation and housing equity, and public transit's role as a community and economic development tool.

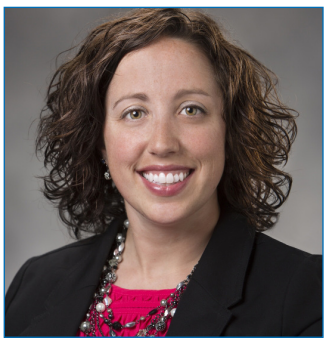
Luckey

University of Utah student named Pikarsky Award winner

Jeff Taylor received the Milton Pikarsky Memorial Award. The award is chosen annually by the Council of University Transportation Centers (CUTC) for the best PhD dissertation and MS thesis in the field of science and technology in transportation studies. Two awards are given for PhD dissertations and MS theses each year (for a total of four awards). MS thesis award recipients receive a $1,500 honorarium accompanied by a plaque. The awards were presented at the CUTC Annual Awards Banquet in January 2015. The title of Jeff's thesis is "Computational Methods for Investigating Intradriver Heterogeneity Using Vehicle Trajectory Data."

Student named to Duluth Port Post

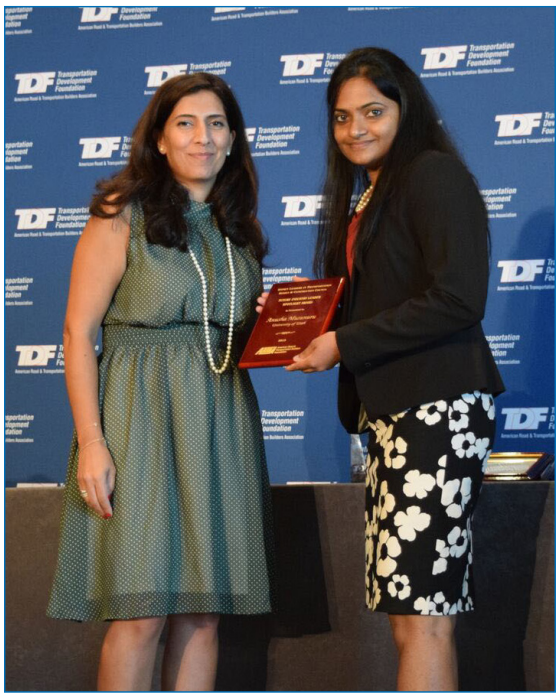
Kate Ferguson, a student in NDSU's Masters of Managerial Logistics Program (https://www.ndsu.edu/transportation/mml/), was recently named Director of Business Development for the Duluth Seaway Port Authority. She is the first point of contact for companies pursuing domestic and international trade opportunities and also coordinates business expansion prospects with industrial development organizations in the region. Prior to her most recent position as supply chain informatics senior specialist for Essentia Health, Ferguson spent nine years working in transportation logistics based in Duluth. For more info, see http://www.duluthport.com/media-news-detail.php?id=81.



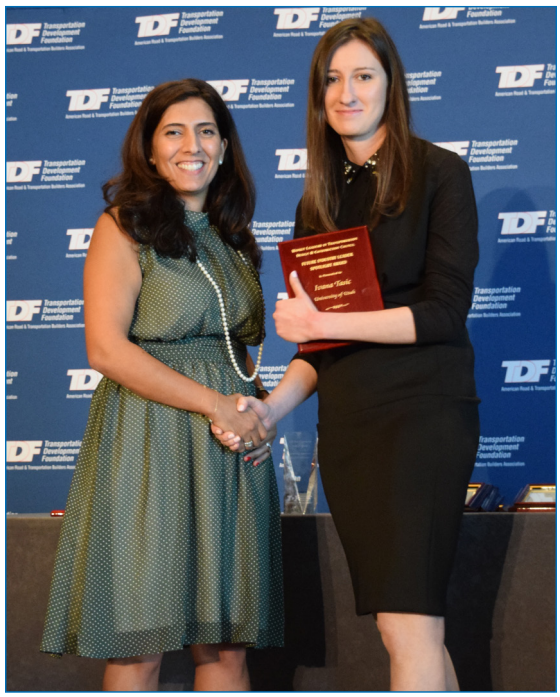
Ferguson

University of Utah students receive Future Industry Spotlight Awards

The Future Industry Leader Spotlight Award, given by the American Road and Transportation Builders Association, recognizes students enrolled in undergraduate or graduate studies at a U.S. college or university who have achieved an outstanding academic record and demonstrated extraordinary leadership skills within and outside of the academic environment. The 2015 winners are both PhD students in civil and environmental engineering from the University of Utah.



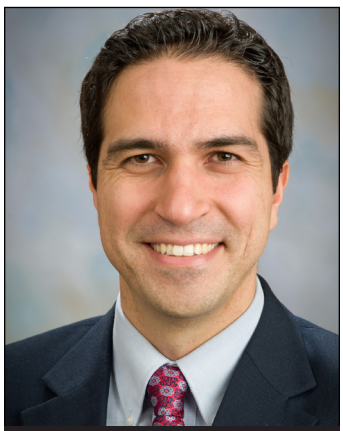
Anusha Musunuru is focused on developing a framework for more reliably informing causation and/or occurrence-mechanism of traffic crashes. She hopes that her research will lead to more appropriate transportation investments and act as a catalyst to create a safe and sustainable multimodal transportation system that contributes to a community's economic health and quality of life.



Ivana Tasic conducts research with a focus on urban multimodal transportation. Her research includes quantifying the traffic impacts of traffic oriented development, crash modification factors for intersections and a light rail transit analysis in Salt Lake City.

FACULTY IMPACT

Atadero



Ozbek

Kim

Paper on Engaging First-Year Engineering Students honored

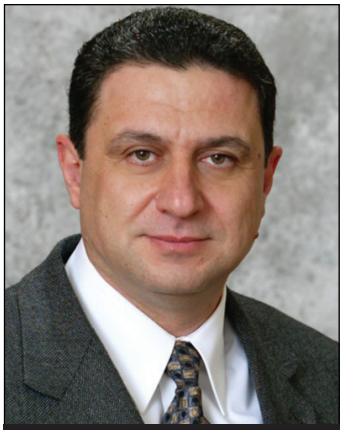
A paper titled "Creating Inclusive Environments in First-Year Engineering Classes to Support Student Retention and Learning" (https://www.asee.org/public/conferences/56/papers/12401/view) by Christina Paguyo, a postdoctoral fellow in the College of Engineering at Colorado State University, and CSU MPC Program Director Rebecca Atadero won two best paper awards at the American Society for Engineering Education Annual Conference in Seattle, in June. Additional authors were West Virginia University faculty member Karen Rambo-Hernandez and WVU graduate student Jennifer Francis. The paper won Best Diversity Paper and Best Paper for the First Year Program Division. The paper addresses the question: How do freshmen engineering students in traditional engineering courses identify with engineering and perceive diversity in engineering?

Ozbek is research coordinator for TRB committee

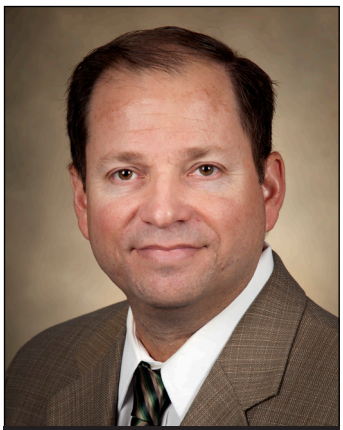
Mehmet E. Ozbek, associate professor of construction management at Colorado State University, was appointed research coordinator for the Transportation Research Board's Standing Committee on Maintenance and Operations Management which is concerned with all aspects of managing the maintenance and operations of highway transportation facilities.

Kim is outstanding reviewer, twice

An associate professor in the Department of Civil Engineering at the University of Colorado Denver was honored by two peer-reviewed journals in 2015 as an outstanding reviewer. Jimmy Kim was recognized by the American Society of Civil Engineering's Journal of Bridge Engineering and by the Journal of Construction and Building Materials. Kim's expertise is in structural engineering with an emphasis on sustainable structural rehabilitation using advanced composite materials, bridge engineering, emerging materials and computational modeling.



Wehbe



van de Lindt

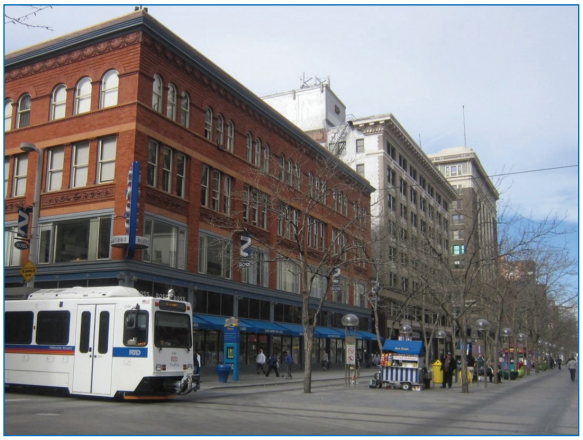
Wehbe elected Fellow of ASCE

Nadim Wehbe, professor of civil and environmental engineering at South Dakota State University was elected fellow of the American Society of Civil Engineers (ASCE). He was recognized with other newly elected ASCE fellows at the ASCE National Convention in New York City in November. Fellow status is conferred upon members who have made celebrated contributions to the society and developed creative solutions that change lives around the world. The prestigious honor is held by less than 3.5 percent of members. Wehbe is also a fellow of the American Concrete Institute (ACI) and the Structural Engineering Institute (SEI).

NIST awards $20M to CSU to study resiliency

The National Institute of Science and Technology recently awarded Colorado State University $20 million to establish the Community Resilience Center of Excellence over 5 years focusing on resiliency to communities affected by disasters. The Center will be led by CSU professors of civil and environmental engineering John van de Lindt and Bruce Ellingwood. van de Lindt is an MPC researcher. They will be working with NIST researchers and partners from nine other universities to develop computer tools to help local governments decide how each can best invest resources intended to lessen the impact of extreme weather and other hazards on buildings and infrastructure systems, including transportation infrastructure. The Center also will address how to maintain social services and institutions — health care delivery, education, social services, financial institutions — as well as economic functions. The Center will investigate multi-mode transportation infrastructure, such as bridge and roadway networks, heavy and light rail, airports and port and maritime systems. MPC researcher Suren Chen from CSU and colleagues from other universities will be conducting resilience research on transportation infrastructure.

iMPaCt Research



Project: Evaluating Transportation Resiliency
PI: Wesley E. Marshall
wesley.marshall@ucdenver.edu

MPC researchers at the University of Colorado launched a three-part research program examining transportation resiliency and the ability for a transportation system to maintain or return to a previous level of service after a disruptive event such a drastic gas price shock. The first part uses a multinomial logistic regression mode choice model to derive resiliency scenarios of various driving cost increases. Modal shifts are based on the supposition that travel behavior will adapt with increased fuel costs to be more like households with a similar percentage of household income being dedicated to transportation. We assess the influence that transit infrastructure, active transportation, the built environment, land uses, and socio-economic status. The second part focuses in on city-scale resiliency by accounting for active transportation infrastructure in a detailed manner not feasible at the regional scale. The research applies a "level of traffic stress" methodology that accounts for both the presence and quality of bicycling, walking, and transit modal options as well as the presence of barrier roads and highways. We measure the resiliency value of these multi-modal transportation infrastructures – even if few people are using those facilities today. The third part develops a Transportation Economic Resilience (TER) rating system. Lead investigator Wesley Marshall says the results illustrate that transportation choice helps create network redundancy and facilitates adaptability under extreme conditions; alternatively, more suburban locations with fewer transportation options are far more vulnerable. While alternative fuels and improvements to the fuel economy of vehicles would help reduce the long-term impacts, the most vulnerable households are already spending more than 30% of their income solely on transportation costs and would be the least likely to benefit from technological improvements. Should an extreme event occur, the most resilient households will live in cities and regions that plan for and invest in diversifying and expanding transportation choice. For more information, search for report MPC-15-279 at www.mountain-plains.org.

Project: Indian Reservation Safety Improvement Program: A Methodology and Case Study

PI: Khaled Ksaibati, khaled@uwyo.edu

Improving roadway safety on Indian reservations requires a comprehensive approach, note MPC researchers at the University of Wyoming. Limited resources, lack of crash data, and a lack of cross-jurisdictions coordination has made it difficult for Native American communities to address their roadway safety concerns. The researchers developed methodology to improve roadway safety and successfully implemented it on the Wind River Indian Reservation (WRIR). Lead investigator Khaled Ksaibati and PhD student Debbie Shinstine say the key to the success of such a process is collaboration among safety stakeholders. With assistance from the researchers, the WRIR has successfully developed a strategic plan utilizing the available crash data, identified ways to improve reporting, and incorporated their safety improvement program into the strategic plan. The report from the project presents programs that are specific to local reservations' needs and culture. For more information, search for report MPC-15-291 at www.mountain-plains.org

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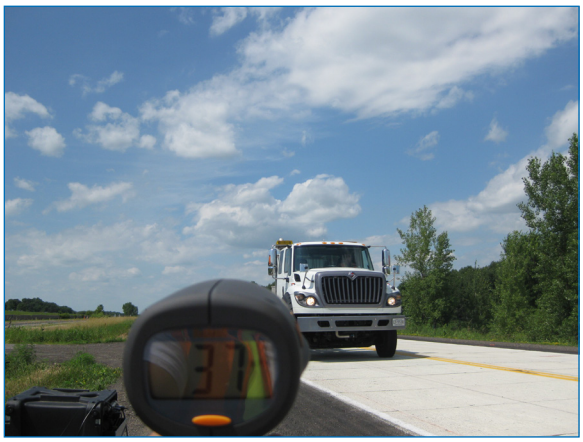

Project: A Sensor Fusion Approach to Assess Pavement Condition and Maintenance Effectiveness

PI: Raj Bridgelall, raj.bridgelall@ndsu.edu

MPC researchers at North Dakota State University developed an approach to enable smart pavements. The embedded sensors report parameters to determine traffic-loading characteristics, structural health, and the ride quality pavements provide to the traveling public. This technology will enable agencies to remotely monitor pavement assets comprehensively, without regularly deploying expensive field equipment and personnel.

In addition to making the sensors more rugged so that they would last throughout the asset life cycle, Raj Bridgelall, a researcher at NDSU's Upper Great Plains Transportation Institute, developed a new method that extended the capability of the sensors beyond an ability to measure just pavement loading and condition parameters. Specifically, the research linked the sensor output to common roughness indices. To maintain a high accuracy of measuring numerous pavement loading and condition parameters throughout the life cycle of the pavement asset, an external method of roughness measurement provided continuous calibration for the sensors. The connected vehicle method is a novel technique that utilizes regular vehicles with wireless connectivity to measure localized roughness.

Field experiments validated the theory of using connected vehicles to measure pavement roughness, and in turn the ability to use those results as a means of calibrating the embedded sensors so that they will maintain long-term accuracy of measuring and reporting a variety of parameters. Through continuous calibration, the embedded sensors will measure and report parameters that allow agencies to characterize traffic conditions and to assess many aspects of pavement structural health. Numerical simulations further revealed that a sensor placement interval of approximately one meter will provide agencies with roughness measurement levels that are most significant in making maintenance decisions. Therefore, agencies can monitor roughness even when connected vehicles are not providing similar information.

Embedded sensors that remain operational throughout the life cycle of pavement assets will provide agencies with a remote means of monitoring the usage characteristics, health conditions, and service level of pavements, without deploying expensive instrumented vehicles that can potentially disrupt traffic. When smart cities design and construct new pavements with the sensors already embedded in the materials, those pavements will save agencies tens of billions of dollars by eliminating the need to regularly deploy expensive probing equipment and personnel.

For more information, search for report MPC-16-306 at www.mountain-plains.org

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Project: Utah State Research Will Help Small Communities Plan for Bicycles

PI: Anthony Chen, anthony.chen@usu.edu

Bicycle mode share has been increasing in recent years because of municipal efforts to promote alternative transportation. However, bicycles are often neglected in the travel forecasting modeling process. MPC research at Utah State University addresses this problem by developing bicycle network analysis tools for estimating bicycle trips in smaller communities with limited resources.

Researcher Anthony Chen developed bicycle network analysis tools that can perform the following functions: initial bicycle origin-destination demand generation, bicycle traffic assignment, and bicycle origin-destination demand adjustment. The analysis tools were used to estimate bicycle demand. First, bicycle data was used to develop an initial bicycle demand matrix. The matrix was then allocated to the bicycle network by bicycle traffic assignment. Finally, the initial bicycle origin-destination matrix was adjusted so that estimated data better matches the observed data. After the development of the network analysis tools, a case study at the Utah State University campus was conducted to demonstrate the applicability of the tools.

The case study revealed that the majority of estimated link flows matched observed link flows. Consequently, the bicycle network analysis tools developed may prove useful for planning applications in communities with limited resources. There were, however, some estimated link flows that were significantly different from its corresponding observed link flows. These deviations are likely due to a data inconsistency problem identified in the original travel survey. With more careful data collection, the tools developed in this research can be used to analyze bicycle demand and bicycle volumes on a transportation network.

The bicycle network tools developed in this study can help governing bodies determine efficient allocation of resources to achieve the regional planning goals. While the study will be relevant to the Utah Department of Transportation (UDOT) and various Metropolitan Planning Organizations (MPOs), smaller communities may benefit most from the work because they typically do not have the resources to develop and maintain a full-scale bicycle planning model.

For more information, search for report MPC-15-285 at www.mountain-plains.org

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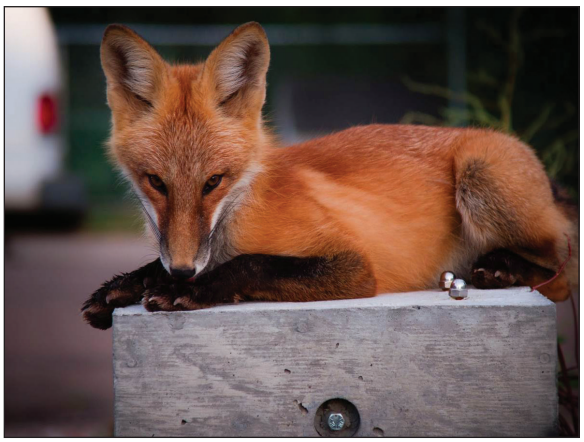
Project: Guidelines for Effective LTAP Course Evaluation
PI: Jim Dorward, jim.dorward@usu.edu

MPC researchers at Utah State University looked at evaluations of the Utah Local Technical Assistance Program to assess how the program could strengthen course evaluation tools and processes to better facilitate effective instruction to meet course objectives for participants.

The National LTAP program funded by the Federal Highway Administration and state departments of transportation provides training for both new and long-term local government employees to help them keep up to date with technologies and regulations encountered in their jobs. It is vital for this training to (1) be accessible to a wide variety of learners and (2) have an immediate impact on the participant's ability to fulfill the essential functions of their job. To achieve the goal, it is necessary to provide training opportunities that directly facilitate that end. Researchers Ann Heaslip and James Dorward developed recommendations for developing and using strong course evaluations that could guide revisions to training programs and help participants feel like they are provided with information that can help them better complete their job functions.

For more information, search for report MPC-16-305 at www.mountain-plains.org.

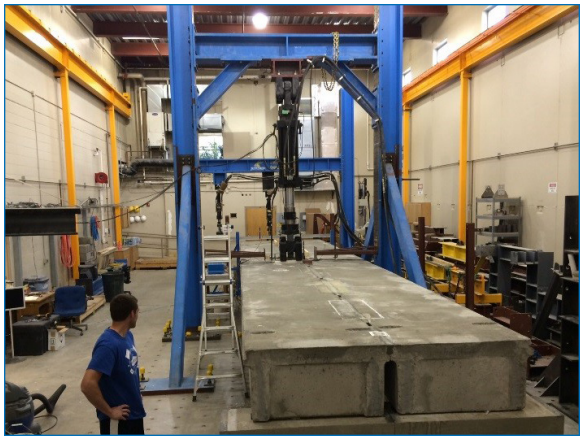


Project: Alkali-Silica Reaction When Using Recycled Concrete Aggregate in New Concrete
PI: Jennifer Eisenhauer Tanner, tannerj@uwyo.edu

Alkali-silica reaction (ASR) is a global concrete durability problem that continues to plague certain aggregate sources. A long-term field site was setup at the University of Wyoming to evaluate ASR and mitigation strategies for local aggregates.

As shown in the photo, Wyoming wildlife made a home on one of the long term field-exposure blocks. While he rests, the research team continues to provide solutions to make high-performance concrete for the state and beyond.

For more information, search for report MPC-15-302 at www.mountain-plains.org.



Project: Development of an Alternative to the Double Tee Bridge System
PI: Nadim Wehbe, nadim.wehbe@sdstate.edu

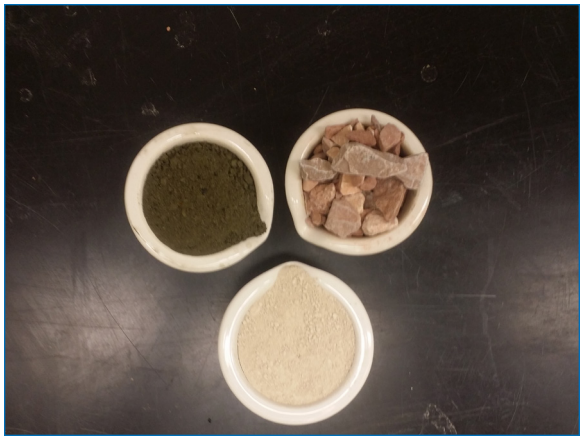
Many bridges on the South Dakota local highway system need replacement due to deterioration or increased traffic demands. Local governments rely on the South Dakota Department of Transportation (SDDOT) to help replace them but, with limited resources, SDDOT can only help replace about 30 bridges statewide each year, causing a backlog of local bridges in need of replacement.

Some commonly built bridges on the South Dakota local highway system need replacement far before their expected design lives. MPC researchers are looking for alternative bridge designs and developing repair techniques that may extend the lives of those bridges well beyond their expected life spans.

Most replacement bridges on the South Dakota local highway system are double tee precast girder bridges because they have a relatively low construction cost, an outsourced design, and a short construction duration. The bridges are expected to last 50 to 70 years, but some built less than 40 years ago already need replacement. Longitudinal joints in the bridges become damaged over time, most likely due to inadequate shear transfer between the girders, allowing water and debris to enter the joints. The joints begin to spall, creating a path for moisture to reach the prestressing steel, initiate corrosion, and degrade the structural capacity of the bridge.

Routine maintenance of these bridges does increase the life span, but is not a feasible long-term solution. The amount of routine maintenance required to keep the joints sealed is too costly for local governments. Other methods, such as asphalt overlays, are also expensive and can cause increased damage over time by trapping moisture that eventually reaches the prestressing steel.

South Dakota State University researchers led by Nadim Wehbe are investigating the performance of the currently used longitudinal joint detail and to assess the adequacy of a proposed new joint detail for use with double tee girders and are looking at alternatives to the double-tee precast bridge. In their research, they conducted fatigue and strength testing of two full-scale girders, one representing the as-built conditions and the other representing a modified joint detailing. Results revealed that the current joint detailing is severely inadequate if the bridge is to last for 50 years or more, while the modified joint detail provided adequate performance under fatigue loading equivalent to more than 70 years of service.



Project: Re-Use of Mine Waste Materials Amended with Fly Ash in Transportation Earthwork Projects

PI: Christopher Bareither
christopher.bareither@colostate.edu

Waste-products from mining and burning coal may be valuable as a base material for building or repairing roads MPC research at Colorado State University indicates. Lead investigator Christopher Bareither is evaluating the mechanical, hydraulic and environmental behavior of mixtures of mine tailings, mine waste rock, and fly ash to assess potential applications in transportation earthwork material. They hope to develop recommendations for using the materials that will enhance the durability of transportation infrastructure, reduce disposal concerns, and reduce the amount of soil and gravel that must be mined and moved for road construction. The researchers are using tailings from a Colorado garnet mine and fly ash collected from coal-fired power plants in Colorado and North Dakota. Additionally, a synthetic mine tailings blend was created from commercially produced materials (silica sand, silica flour, and Kaolinite) to compare mixture behavior to specimens with actual mine tailings and also to results on fly ash-amended soils in literature. Samples are being subjected to various mechanical tests to determine strength and durability. Preliminary results support the test methods and show good comparison to previous research.

OUTREACH/WORKFORCE DEVELOPMENT

Technical Training

MPC's technical training program is having a major impact in the region. Online modules, short courses, webinars, and on-site/videoconferencing events are reaching state and local transportation department employees and tribal transportation planners. By harnessing the capabilities of the four LTAP centers located at the MPC universities and the multimedia capabilities of the Transportation Learning Network (which was founded and is partly funded by MPC) more than 76 technical training events were offered in the second half of 2015. These training modules and short courses are critical to transportation agencies that need to improve or renew the skills of engineering technicians and other frontline workers. Many MPC courses or training events result in the certification of workers. Even when certification is not required, TLN's online learning management systems allow employees and employers to set learning goals and monitor progress towards these goals.

Graduate Students

Altogether, 185 undergraduate and graduate students are working on MPC research projects under the tutelage of faculty researchers. These graduate students represent the researchers and technical analysts of tomorrow. Without the MPC program and the stipend funds that it provides, these students may not be specializing in transportation; but, instead would be seeking career opportunities in other fields. The MPC research program allows faculty to mentor graduate students while allowing the students to work on projects for federal and state transportation agencies—thereby, gaining valuable practical experience.

For more information regarding Mountain-Plains Consortium, contact Jody Bohn Baldock at jody.bohn.baldock@ndsu.edu or (701) 231-7938.

MPC
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