In This Issue

Cheryl Bornheimer is a master’s student with a transportation emphasis at the University of Kansas. Bornheimer is working on calibration of the Interactive Highway Safety Design Model for the State of Kansas as part of her graduate research assistantship. For this project, she has performed speed studies and sorted and analyzed data. As an undergraduate research assistant,

Student Spotlight: Cheryl Bornheimer

MATC Student of the Year: Cody Stolle

MATC is pleased to announce that Cody Stolle has been named the 2010 PhD student of the year. A student at the University of Nebraska–Lincoln, Cody Stolle is a graduate research assistant at the Midwest Roadside Safety Facility. During his time at MwRSF, he has taken on major roles in research projects funded by the National Cooperative Highway Research Program (NCHRP), state departments of transportation, and several private companies. Findings from these research studies are already being implemented by several state DOTs. Stolle has authored more than ten research reports, two refereed journal articles and four conference papers. He is also a member of the Society of Automotive Engineers.

Currently, he is conducting research for his dissertation on the modeling and optimization of cable attachment hardware for cable median barriers, as well as safety improvements for cable

Celebration of Past, Present and Future at Whittier Research Center Dedication and Open House
University Student Spotlights

MATC Student of the Year: Cody Stolle

Cheryl Bornheimer: University of Kansas Student Spotlight

Brandon Bortz: Kansas State University Student Spotlight

Ying Huang: Missouri University of Science and Technology Student Spotlight

Welcome to the first MATC newsletter of 2011. I would like to take this opportunity to discuss the most important resource of MATC—our students. Back in 2006 when the various consortium partners met to plan our program, we decided first and foremost that our program should have a positive impact on our students. As you will see in the accompanying articles, this commitment to our students has yielded wonderful results across all our consortium partners.

In this issue we have highlighted a number of our outstanding students, including Cody Stolle and Ben Grone from UNL, Cheryl Bornheimer from KU, Ying Huang from MS&T and Brandon Bortz from KSU. I should also add that Cody is the MATC Student of the Year and did an excellent job representing MATC at the Institute of Transportation Engineers Transportation Centers award dinner at TRB this past January.

One of the most visible aspects of this commitment was the choice to include at least one graduate research assistant on every sponsored research project. This has allowed our research projects to have a significant education component. The skills our students learn while conducting research is invaluable to their creative and intellectual development. These students are the future transportation professionals who will occupy permanent positions of influence in our region as well as the nation. To date we have had 133 graduate students on 62 projects at five consortium partners.

In addition, internship opportunities for our undergraduate students continue to be expanded at MATC’s consortium schools. Currently, the MATC intern program is functioning in all four states of Region 7. Sponsor agencies include: the Kansas Department of Transportation, Missouri Department of Transportation, Nebraska Department of Roads, City of Lincoln Public Works and Utilities, Johnson County (Kansas) Public Works, Metro Area Planning Agency, Fellabaugh Holt and Lilleston, Lamp Rynearson, George Butler and Associates, I-69, Kaw Valley Engineering, and BG Consultants. Please feel free to contact us if your organization is interested in participating in this program.

Another initiative that I am particularly proud of is our MATC scholars program that was piloted at UNL in 2010 and is highlighted in this issue. Sixteen students and five faculty from HBCU’s came to UNL to participate in a workshop which focused on teaching the students the “ins and outs” of graduate school. Our faculty mentors covered everything from the application process to lessons learned from students of underrepresented groups who have successfully navigated graduate school. I am particularly appreciative of Professor Judy Perkins from Prairie View A&M University who was a co-PI on this project.

It was also decided early on that we would leverage the resources of our partner institutions to broaden and improve the course offerings at each of our campuses. One outcome of this policy is that MATC will sponsor a distance-based graduate railway engineering course that will be offered at our partner schools. The instructors, who will teach in teams, will be Dr. Elizabeth Jones from the University of Nebraska-Lincoln, Dr. Tom Muhlnarcz from the University of Kansas, and Dr. Gene R. Russell Sr. from Kansas State University. The students will benefit by having focused lectures on the various railway topics taught by distinguished researchers who are experts in the field. This type of multi-university collaboration, while involving considerable coordination and dedication, ultimately will benefit all our partners by bringing together motivated students and teams of experts, thereby enriching the educational experience. This initiative will be highlighted in a future newsletter.

Another element of MATC’s strategic plan was the development of a K-12 teachers’ program that will promote transportation engineering education, and will specifically involve students from underrepresented groups. As such, UNL has expanded its summer institute for teachers, held annually since 2006. To date, over 65 middle and high school teachers have come to campus to work with our researchers to develop web-based resources that complement their curriculum. The teachers use these resources with their students as well as during the teaching modules developed by other teachers. Based on student and teacher feedback, the modules are updated and ultimately are published on the MATC website to be used freely by any teacher. We are looking forward to the 6th anniversary of MATC’s summer institute this year.

In summary, I am constantly impressed by the excellence of the students in our program, and proud that we continue to develop and deliver a meaningful and impactful education to them. I anticipate that our program will continue this momentum and I am looking forward to the next few years to see what new and innovative directions our MATC educators will take.

Sincerely,
Larry

Dr. Laurence Rilett

Letter from the Director
RfSCL Lab Interns Sum Up a Great Summer

The RFID Supply Chain Lab (RfSCL), led by Dr. Erick Jones, served as a place of opportunity for undergraduate students in engineering to gain research experience over the summer. Funded by the Mid-America Transportation Center and NASA Nebraska EPSCoR, the research internships provided training for students of diverse populations and backgrounds. Undergraduate and first year graduate students teamed up with PhD student mentors to learn research activities, which provided valuable experience for the students. The diverse group of students came from Prairie View A&M, a Historically Black College and University (HBCU), located outside of Houston. A myriad of students from Nebraska Engineering also participated.

The program allowed the students to rotate between industry and research projects and even included a trip to NASA’s Johnson Space Center located outside of Houston. Students also worked with Werner Trucking, Lancaster County Senior Living facilities, the John Baush Group, the University of Nebraska Computer Store and other groups to perform research activities. The research focused mainly on testing and evaluating Radio Frequency Identification (RFID) technologies in which assets, inventory, and people can be tracked without the need to visually identify the RFID tag. The final presentation event provided many emotional responses as the students parted with their PhD mentors. All described how the research experience as an undergraduate or new graduate student provided valuable insight and motivation for them to invest themselves in graduate study.

Introductory Transportation Course Now Requisite for Civil Engineering Students at KU

More engineering students at the University of Kansas now have an opportunity to learn about transportation engineering. Dr. Steven Schrock and Dr. Tom Mulinazzi planned and successfully launched a new required transportation course, CE 480 Introduction to Transportation, for the fall 2010 semester. The junior-level course offers an overview of the various modes of transportation, emphasizing highways, railroads and air transport. Students study the planning, design and operations of the various modes and complete a multimodal project as a culmination of their learning.

Dr. Mulinazzi credits the increased visibility of transportation engineering opportunities through the MATC for the department’s decision to integrate the new course into the curriculum. Particularly since it is offered at a key point, when students are narrowing down career options, this course will facilitate the recruitment of more students into the transportation field.

KU Student Chapter of ITE (Institute of Transportation Engineers) Named Best in Region

The student chapter of ITE at the University of Kansas has been selected as the outstanding student chapter in the Missouri Valley Section of ITE. In the past three years, this marks the second time that the chapter has received this honor. Dr. Steven Schrock is the faculty advisor and MS student Cheryl Bornheimer serves as the president.

Through their leadership, the chapter has received 30 students at their meetings. Recently, Bornheimer brought Deb Miller, the secretary of transportation for the Kansas Department of Transportation, to be a guest speaker at the chapter’s November meeting. MATC salutes the chapter’s commitment to professional development of the region’s future transportation engineers.

MATC Scholars Program Provides Tools for Success in Graduate Study

Students and faculty from Historically Black Colleges and Universities (HBCUs) and other institutions across the country came to the University of Nebraska–Lincoln campus for the MATC’s first Scholars Program Graduate Conference on September 23rd and 24th. Organized by Dr. Erick Jones, associate professor of Industrial and Mechanical Systems at UNL and Dr. Judy Perkins, professor of civil engineering at Prairie View A&M University, this diversity initiative seeks to prepare students from groups that are under-represented in the STEM fields for graduate study at research-intensive universities.

The group was welcomed by Dr. Ray Moore, associate dean of engineering at UNL, and Dr. Larry Rikett, director of the Mid-America Transportation Center. Dr. Moore spoke with anticipation about what the transition to the Big Ten means for research and education potential at UNL. Dr. Rikett gave an introduction to MATC and the Nebraska Transportation Center that emphasized the interdisciplinary nature of the research conducted at this facility and the importance of student contributions to such projects.

During the two-day program, students had an opportunity for networking with one another and with faculty, while also learning skills from targeted seminars given by experienced faculty members and educational administrators. Dr. Jones explained that “the MATC Scholars Program is distinct because it was developed by faculty who know the challenges underrepresented students face in making the transition to graduate school.” The process of choosing, applying for, and entering graduate school can be overwhelming for any student, but the Scholars Program faculty also personally addressed the unique challenges that may face under-represented students in particular.

One of the highlights of the program was a panel of current graduate students in engineering and sciences at UNL who shared their experiences preparing for and adjusting to graduate school. Conference attendees listened attentively as panelists Mauricio Cavitt, a PhD student in industrial engineering, spoke about the importance of developing strong support systems as a graduate student and taking advantage of the resources available. Sarah Asio, a master’s student in industrial engineering, spoke about how she dealt with the challenges of moving to a new place with a different culture, far from family and friends. With no faculty present at this session, students had an opportunity to ask questions in a relaxed environment.

During the tour of the newly remodeled Whittier Research Center, students and faculty members alike were wowed by a presentation from Dr. Dean Sicking. Through video footage of crash testing, he demonstrated how the research conducted at the Midwest Roadside Safety Facility saves lives, and he explained the important roles that graduate students have in this work. Dr. Erick Jones offered students an introduction to the Radio-Frequency Identification (RFID) and Supply Chain Laboratory, where students conduct research on ways to use RFID technology to optimize logistics.

Students left the conference with a renewed sense of confidence in knowing that they have the skills and support needed as they choose, apply for, and transition into graduate school. To encourage students to stay in contact with one another, a MATC Scholars Program Facebook page was created. MATC is committed to mobilizing talented students from all populations in order to strengthen the next generation of traffic engineering professionals.
MATC Seminar Series: Fall 2010 Speakers and Events

Dr. Virginia Baldwin, Head of the Engineering Library, UNL
Dr. Eric Thompson, Director, Bureau of Business Research, UNL
Jim Knott, Design Engineer, Nebraska Department of Roads
Diego Franco, Transportation Analyst, Kittelson and Associates
Monty Fredrickson, Director, Nebraska Department of Roads

MATC Fall Seminar Speaker Series: Monty Fredrickson, Director of Nebraska Department of Roads

Monty Fredrickson, a design engineer at the Nebraska Department of Roads, was the featured speaker on October 1st. Knott discussed the challenges faced by NDOR as their engineers strive to choose the right projects as revenues are declining but costs are escalating.

NDOR confronts these challenges by prioritizing decisions based on a clearly outlined mission with stated values, goals, and performance measures. Based on NDOR’s mission to provide and maintain safe roadways, when the right project emerges for the area, it must be considered. Knott noted that placing rumble strips along the interstate, for example, has proven to be a very cost-effective way of preventing fatalities, considering it has a $1000 per mile. NDOR’s goal is to reduce the statistic to 1.1 fatalities per 1 million miles traveled.

Maintaining existing roadways is also a major priority, deemed so essential that it is required by a recently revised Nebraska statute. Knott stated that “we need to take care of what we have” and must focus on the “3R’s” of “resurfacing, restoration, and rehabilitation” to best serve the needs of the state. It may not always be a clear decision, but when a new project emerges for consideration, Knott explained, it must be “the right project with the right scope at the right time.”

MATC Fall Seminar Speaker Series: Jim Knott, NDOR Design Engineer

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MATC Seminar Event: LOCATE Traffic Forum

During the fall semester, Dr. Anuj Sharma, assistant professor of civil engineering at the University of Nebraska–Lincoln, facilitated the MATC Seminar Series as a one-credit course featuring guest speakers from industry and academia. Talks were open to all interested students and faculty, and were broadcast to students at UNL’s Omaha campus via teleconference.

The seminars offered students a look at the diverse nature of the careers available to transportation engineering students and the current issues facing transportation professionals. Students also attended off-campus presentations and demonstrations to get a look at industry leaders in action. These activities offered students a context for their studies that may not be found in the classroom.

Benjamin Gorne, a master’s student with an emphasis in transportation engineering, noted: “It was interesting to hear so many perspectives on traffic incident management and how various metropolitan areas around the country are working to reduce the time required to reopen lanes after a crash. These concepts became most tangible through a presentation by Mike Jackson of the Iowa DOT on the latest TIM plan for the Omaha – Council Bluffs area.” The forum provided an important overview of NDOR from within and an in-depth look at transportation engineers.

Students joined 135 professionals from around the topic area. Rita Brohman of Iteris discussed the development of a regional multi-disciplinary traffic incident management team in southwest Nevada, while also giving students an essential perspective on career opportunities at the organization.
Professor from Korea Speaks about Geomaterials’ Effects on Transportation Infrastructure

Dr. Seong-Wan Park, an associate professor of geotechnical engineering at Dankook University in Korea, spoke to MATC graduate students at the University of Nebraska–Lincoln on November 5th.

Dr. Park discussed his experience in addressing issues that arise when predicting performance of road foundations on major transportation infrastructure in Korea. Dr. Park demonstrated how transportation engineers in all geographic areas can improve their understanding of the geomaterials which constitute road foundations in order to predict the long-term system performance of a roadway. For example, Dr. Park discussed the methods used to test and analyze materials and pavements on the Korean Highway Cooperation’s test roads. He also presented information on laboratory analysis used to collect data for predicting load limits and permanent deformation on conventional pavements.

Missouri S&T Hosts Event for Local Students to Expand Horizons

“Expanding Your Horizons” is a day for seventh and eighth grade girls in the Rolla, Missouri area to experience careers in the math and science fields. This year’s Expanding Your Horizons day was held on Missouri S&T’s campus on October 15th. The middle school students rotated through workshops to learn about a variety of topics including biology, computer science, engineering, mathematics, and many other fields. The workshops emphasized hands-on experience to create excitement about science and technology. Hopefully, this experience will encourage the girls to choose a career in one of these fields later in life.

Laura Rathe, a MATC graduate student, led a workshop that offered an introduction into civil engineering, including an overview of the materials engineers use, the jobs available in engineering and why civil engineering is important. To get the students involved, Rathe asked them to build their own structures using noodles and masking tape. They were only given 20 fettuccine noodles and one yard of masking tape to make the strongest structure possible. After they were finished building, the students tested the structures with a “shock wave” of pasta and a textbook as weights. This was followed by a discussion about which design features added to the strength of the structure and would be good elements in real buildings. The project was challenging, but the girls had fun making and destroying the pasta structures.

Thanks to the energy and creativity of MATC students like Rathe, middle school students had an opportunity to learn, experiment, and build the confidence necessary for someday choosing a career in engineering.

Bryan Middle School Visits MATC Labs at Whittier & Nebraska Hall

Students from Bryan Middle School in Omaha, Nebraska spent Friday, November 5th learning about transportation engineering from MATC graduate students. Tours, activities and presentations were prepared to introduce middle school students to the research conducted in the laboratory facilities.

Students enjoyed the perennial favorite activity of using the LIDAR speed guns. Master’s student Ben Grone explained how researchers use the LIDAR guns to collect traffic data. The students, undeterred by a chilly breeze, then had a chance to measure the speeds of travelling vehicles. In the geographic information systems laboratory, master’s student Walter Moy demonstrated how transportation engineers use maps with GIS data to identify transportation-related needs in certain areas and plan new construction projects. Students (and teachers) enjoyed creating colorful customized maps using the software.

In the Intelligent Transportation System lab, post-doctoral researcher Justice Appiah shared his passion for micro-simulation modeling. Appiah demonstrated how VISSIM micro-simulation software lets traffic engineers solve problems through experimentation with different virtual scenarios. The middle school students said they liked it because it looked “like a video game.”

In the Structures and Pavement Labs, PhD students Thiago Aragao and Marcelo DaSilva performed a stress test on a concrete cylinder. The spectacular shattering of the cylinder amazed the students. DaSilva commented on how impressed he was with the middle school students’ curiosity and thoughtful questions.

The day ended with a presentation from PhD student Cody Skole, a research assistant at the Midwest Roadside Safety Facility. Skole’s presentation discussed the roadside safety implementation that MuRSeS’s research has developed and showed exciting footage of vehicle crash testing. It was a day that opened students’ eyes to the work that goes into the transportation infrastructure we use every day and the many careers available in transportation engineering.

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Azizinamini Receives AISC Achievement Award

Please join MATC in congratulating Alaa Azizinamini, who has been selected by the American Institute of Steel Construction (AISC) to receive the AISC Special Achievement Award for the development of the Folded Plate Girder System for steel bridges. The award will be presented at the AISC National Steel Conference, held on May 11-14, 2011 in Pittsburgh, Pennsylvania.

According to AISC: “A Special Achievement Award provides special recognition to individuals who demonstrated notable singular or multiple achievements in structural steel design, construction, research or education. This award honors living individuals who have made a positive and substantial impact on the structural steel design and construction industry.”

Congratulations, Dr. Azizinamini!

Graduate Student Presents Research in Webinar

PhD student Jennifer Schmidt presented as part of the 2010 Smart Work Zone Deployment Initiative (SWZDI) Research Showcase Webinar on July 26th. This session was the first in a series of webinars highlighting notable SWZDI projects. The webinar was hosted by the Federal Highway Administration, Iowa Division; the Iowa Department of Transportation; and the Institute for Transportation at Iowa State University. Local, state, regional and national work-zone-related researchers and professionals had a chance to experience the latest in new concepts, systems, and information with the potential to enhance work zone safety.

In 1999, the Midwest States Smart Work Zone Deployment Initiative (MwSWZDI) was created through a partnership between the states of Iowa, Kansas, Missouri, and Nebraska. Through funded studies, researchers investigate better ways of controlling traffic in work zones. Schmidt’s presentation, “Safety Performance of Work-Zone Devices Under MASH Testing,” discussed the results of research conducted with Ronald Faller, research assistant professor at the University of Nebraska–Lincoln, moderated a webinar titled “Highway-Rail Grade Crossing Safety 101: A Primer on Grade Crossing Safety” for the Transportation Research Board. This webinar explored ways for municipal, county, and regional planners to improve safety at highway-rail grade crossings. Session presenters included Dr. Khattak, UNL; Jason Field, Moffatt & Nichol; Terry Byrne, Vanasse Hangen Brustlin (VHB); and Steve Laffey, Illinois Commerce Commission. Panelists highlighted topics including quiet zones, diagnostics, communications and agreements, as well as education and enforcement programs.

Dr. Khattak noted that the webinar was a success and was followed by many questions from the participants. The session was recorded by TRB and those interested in obtaining the link can email Reggie Gillum at RGillum@nas.edu.

TRB Webinar Moderated by Dr. Aemal Khattak

On Thursday, September 16th, Dr. Aemal Khattak, associate professor at the University of Nebraska–Lincoln, moderated a webinar titled “Highway-Rail Grade Crossing Safety 101: A Primer on Grade Crossing Safety” for the Transportation Research Board. This webinar explored ways for municipal, county, and regional planners to improve safety at highway-rail grade crossings. Session presenters included Dr. Khattak, UNL; Jason Field, Moffatt & Nichol; Terry Byrne, Vanasse Hangen Brustlin (VHB); and Steve Laffey, Illinois Commerce Commission. Panelists highlighted topics including quiet zones, diagnostics, communications and agreements, as well as education and enforcement programs.

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Local MOVITE Chapter Visits Whittier Research Center

On August 31st, LOCATE featured MATC Director Dr. Laurence Rillett as a speaker during their monthly meeting. LOCATE, the Lincoln-Omaha-Council Bluffs Association of Civil Engineering and were pleased by the coalition of departments working together under one roof, and the institutional support for transportation engineering indicated by the new space. Mark Messinger, vice president of LOCATE and a transportation engineer for Felsburg Holt & Ullman in Omaha, said: “The new space for NCTC and MATC at the Whitter Building should provide UNL students and faculty resources to continue the nationally respected work that Nebraska has contributed to transportation research. The research labs and office space are extremely nice and should help to recruit the best and brightest minds to the university. As an alum of the program, I am happy to see the progress made and I only wish the facility was in place when I was in school!”

Transportation Career Path

At the end of August, fellow MATC graduate students Anna Rakoczy, Prazymlaw Rakozy, and I had the opportunity to attend the AREMA 2010 Annual Conference and Exposition in Orlando, Florida. AREMA is the acronym for a professional organization whose full name is the American Railway Engineering and Maintenance-of-Way Association. While this may be a mouthful, the roles played by members of this association are fundamental to the success of the railroads in America. Railroading is a potential career that many transportation students overlook when they consider what they want to do with their lives, and I had a chance to learn about many of these opportunities at the AREMA conference.

There were a number of interesting presentations given the first day of the conference that outlined many areas in which AREMA is active, including safety and security regulations for the railroad, automation of track monitoring, high speed rail planning, bridge design and construction, track design, and signaling system standards. After the presentations, there was a session geared toward students in which we had the opportunity to ask questions of a panel of young professionals. The perspective they gave was invaluable, as was the networking session that followed. Tuesday provided an opportunity to gain even more perspective on the industry through six breakout sessions, which included presentations on communications and signals, engineering services, maintenance, passenger and transit, structures, and track. Overall, it was a great experience—I never even mentioned the free time spent in the Florida sun.
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Kansas State University Projects

Effects of Geometric Design Features on Truck Crashes on Limited Access Highways

PI: Dr. Sunanda Dissanayake
DESCRIPTION: Trucks are larger in size and weight and typically have different performance characteristics than passenger vehicles. Meanwhile, more and more freight are transported using trucks, causing the number and percentage of trucks on the national highway system to gradually increase. The safety effect of these large trucks is a major concern as they disproportionately account for traffic fatalities. When trucks are involved in crashes with other smaller vehicles, a majority of the fatalities involve occupants of the other motor vehicle. When looking at the ways of improving the situation, understanding the effects of geometric design features on truck crashes is expected to bring significant benefits as that is the area where transportation engineers have the highest level of influence. Accordingly, this project is expected to study truck crashes in detail by developing models to determine the influence of various geometric design features, traffic and other characteristics on truck crash occurrence.

BENEFITS: Through the findings of this research, it will be possible to identify the most effective engineering countermeasures that would be useful in reducing truck crashes.

Accelerated Testing of Warm Asphalt Mixtures for Safe and Reliable Freight Transportation

PI: Dr. Hosin “David” Lee
Co-PI: Dr. Mustaque Hossain
DESCRIPTION: Warm Mix Asphalt (WMA) is rapidly becoming a mainstream of asphalt pavement construction in the United States due to its many advantages: reduced fuel consumption, less carbon dioxide emission, longer paving season, longer hauling distance, reduced oxidation of asphalt, and early opening to traffic and a better working environment in the field. To overcome the growing demand from the public agencies, NCAT recently proposed a national WMA certification program (Kvasnak et al. 2018). It requires a full-scale test in their test track in Auburn, Alabama, where their full-scale test results may not be relevant to the performance of WMA pavements in the Midwest Region 7 because the climate and soil condition at NCAT test track are different. In previous studies at the University of Iowa, various WMA mixtures were tested in the laboratory for stiffness, rutting, and moisture resistance. To validate these laboratory results and to predict the field performance, it is proposed that select WMA mixtures be tested using the accelerated testing equipment in both a laboratory and an APT facility.

BENEFITS: The results from the accelerated tests will help contractors build safe and reliable WMA pavements for heavier truck traffic with higher tire pressure. Safe and reliable WMA mixtures will contribute to road safety by reducing the number of crashes and fatalities on heavily trafficked roadway system and will minimize the risk associated with increasing freight movements on the U.S. surface transportation system built with WMA mixtures. The main product anticipated from this research is the accelerated performance of WMA materials, and experience building test sections with select WMA additives. This information would be useful in truck engineers in Region 7 interested in WMA.

Use of High-Volume Reclaimed Asphalt Pavement (RAP) for Asphalt Pavement Rehabilitation Due to Increased Highway Truck Traffic from Freight Transportation

PI: Dr. Mustaque Hossain; Dr. Hosin “David” Lee
DESCRIPTION: The recent spike in asphalt binder prices has forced the state highway agencies and paving contractors to consider the use of high volumes of reclaimed/recycled asphalt pavement (RAP) in hot-mix asphalt (HMA). A national research project (McClain and Anderson 2001) developed the guidelines for the use of RAP in Superpave mixtures adopted by the Kansas Department of Transportation (KDOT). In the recent past, the contractors had been reluctant to use more than 15% RAP in Superpave mixture because of the change in required binder grade (usually more expensive binder). However, due to a recent increase in binder price, the contractors are opting for higher percentages of RAP in the Superpave mixtures.

BENEFITS: The availability of such a technology may potentially improve the comfort level of passengers, the safety of highway operations, and the efficiency of fuel consumptions. It may also reduce the emission of CO2 associated with the poor condition of roadways.

K-State University Projects

Rehabilitation Due to Increased Asphalt Pavement (RAP)

PI: Dr. Mustaque Hossain; Dr. Hosin “David” Lee
DESCRIPTION: Most state agencies and paving contractors are advocating the use of high volumes of RAP in hot-mix asphalt (HMA). However, the use of large percentages of RAP results in nonhomogeneity of Superpave mixtures that may not perform well. This project will study the use of fractionated RAP (FRAP) and/or a combination of RAP and FRAP in different percentages for asphalt pavement rehabilitation, impacts on performance, with differing percentages, on the binder grading, and whether combinations of high percentages of RAP and FRAP in Superpave mixtures designs can meet current mix design requirements, potential impacts on the mechanistic and rutting characteristics of the mixtures will also be studied in detail. The use of RAP/FRAP for shoulder mixtures will also be investigated.

BENEFITS: The study would result in some practical guidelines to be followed by KDOT in specifying RAP/FRAP percentages as well as PG binder selection for Superpave mixtures. The study will promote sustainability in asphalt pavement rehabilitation.

Determining the Transfer Length in Prestressed Concrete Railroad Ties Produced in the United States

PI: Dr. Robert Peterman
DESCRIPTION: Concrete ties have become the preferred choice for many railways in the Midwest, where extremely heavy freight movements occur daily. For those prestressed concrete ties to function adequately over their expected life, and to ensure the safety of freight movements across the Midwest region, the prestressing force must be fully introduced into the railroad tie at a location well before the rail load is applied. The length required to transfer the prestress force into the concrete mixture is referred to as the “transfer length.” This research is aimed at conducting systematic measurements of the transfer length in concrete railroad ties that are produced by all of the major concrete tie producers in the United States. As such, this will be the first coordinated effort to measure transfer lengths of concrete railroad ties that has ever been conducted in the industry.

BENEFITS: This proposed work will provide detailed information about the bond of three different types of prestressing reinforcement used in the manufacturing of concrete ties in the United States. This information will assist in the design of future ties and in evaluating the effectiveness of current designs.

University of Iowa Projects

Monitoring the Effects of Knickpoint Erosion on Bridge Pier and Abutment Structural Damage Due to Scour (UNL and UI Project)

PI: Dr. Thanos Papakonoulou
DESCRIPTION: The goal of this proposed research is to conduct laboratory and field research on knickpoint migration in western Iowa and eastern Nebraska to evaluate whether the streams and prevent future damage to bridge infrastructure. Knickpoints are abrupt drops in the stream bed over which plunges will flow and scour the downstream bed. Streambed lowering creates drain bank height, which facilitates bank failures and stream widening, and damages critical bridge infrastructure. Preliminary studies in western Iowa indicate that geotechnical properties of the knickpoint bed stratigraphy control its migration rate. We propose to conduct state-of-the-art geotechnical analyses and continuous monitoring of knickpoint geometry and hydraulics in order to determine the presence of specific layers of weakness along which the streambed will fail. We believe that slopege is a primary contributor to knickpoint erosion in the Midwest, either through aggregate

Concrete Surface with Nano-Particle Additives for Improved Wearing Resistance in Highway Operation

PI: Dr. Genda Chen
DESCRIPTION: This proposal is focused on a feasibility study on the use of nanotechnology in concrete to improve the wearing resistance of concrete. Three candidates of nano materials are considered: nano TiO2 particles, nano carbon-tubes, and polyurea cross-linked aerogels. The tensile and compressive properties and the wearing resistance of concrete will be evaluated for various mix designs. The optimal amount of nano material additives will be determined following the ASTM standard test methodologies. The test results from three types of materials will be compared for their mechanical behaviors, including wearing resistance. The best practice in concrete application will be recommended in terms of technological, economic, and social benefits.

PI: Dr. David Admiraal
DESCRIPTION: The proposed work will provide detailed information about the bond of three different types of prestressing reinforcement used in the manufacturing of concrete ties in the United States. This information will assist in the design of future ties and in evaluating the effectiveness of current designs.

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BENEFITS: The availability of such a technology may potentially improve the comfort level of passengers, the safety of highway operations, and the efficiency of fuel consumptions. It may also reduce the emission of CO2 associated with the poor condition of roadways.
Bridges - experimental Phase

Truck Traffic on Service Life of Bridges

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2011 MATC Research Projects

detrachment or static liquefaction, which creates layers of weakness. Seepage reduces the effective stress within the soil, thus facilitating failure of the substructure surface.

**Benefits:** This research will assist local government agencies and the USDOT in better understanding the factors that cause knickpoint propagation and identifying appropriate grade control solutions (e.g., gridwalls, geocell structures) to prevent or mitigate crossings to control knickpoint propagation and reduce infrastructure damage.

**Use of Fiber Bragg Grating (FBG) sensors for performing automated bridge pier structural damage detection and scour monitoring**

Dr. Thanos Papailiou

**Description:** The goal of the proposed research is to conduct laboratory and field research on fully adaptive bridge monitoring using automated sensors. This research will address the problems inherent in human inspections of bridges. We propose a novel integrated condition-based maintenance framework utilizing available sensors and sensing architecture for bridge performance, scour and structural damage monitoring. A fiber-optic pier impact detection system proposed in this research has developed and tested in the laboratory and the field. That system consists of state-of-the-art two-wave mixing (TWM) fiber Bragg Grating (FBG) sensors which can detect impacts with different frequencies. These two-way mixing sensors can detect deformations either in the pier structure and/or within the soil (sediment) river bed due their unique ability to detect different ranges of frequencies. Practical guidelines will be developed on how to use the FBGs to provide real-time state aware information awareness that can be used in real time for down time, repair, and functionality, and bridges.

The research will pave the way for more effective bridge damage monitoring, while providing an open framework to expedite the development of similar systems for other critical infrastructure, such as roads, highways, dams, levees, in order to prevent catastrophic events such as the Minnesota bridge collapse in 2007.

**Benefits:** The proposed methodology will assist engineers in monitoring bridge structures during earthquakes and other extreme events. Moreover, when failure is most likely, thus improving the overall infrastructure safety by offering new opportunities for monitoring high risk structures such as highway bridge crossings where there is frequent traffic.

**Freight Bottlenecks and the Border Puzzle**

Dr. Misa Matsu

**Description:** Our research examines and addresses the border effect, specifically the effects of transportation bottlenecks. Trade data indicate that sixty percent of containerized freight transportation across the US and Canada is concentrated at only thirteen cross-border points around the Great Lakes: Windsor, ON/Detroit, MI; Sarnia, ON/Port Huron MI; and Fort Erie, ON/ Buffalo, NY (Transport Canada, 2003). Traffic concentration is associated with congestion, and capacity expansion is proposed at each site (Bowen and Slaback, 2007). We will first develop panel data of inter-state or province traffic flow from 1990. Then we will look at how much the concentration and the congestion explain the empirically observed border effect by decomposing the border crossing into (i) indirect routing because of the limited number of crossings and (ii) congestion at the crossings using a modified gravity model of trade developed by earlier researchers. In addition, we will develop new data to examine the historical transition of border crossing patterns. Our research would be helpful for federal government to plan a transportation infrastructure investment to achieve seamless freight transport between the US and Canada.

**Benefits:** Our research is useful for a future infrastructure investment plan that the federal government can consider to achieve seamless freight transportation between the US and Canada. Our study on the small number of cross-border points is the source of border effects, it is highly recommended to increase the number of points. If the delay at the border is too great, we strongly recommend expanding the capacity of the gates.

**Freight Bottlenecks and the Border Puzzle**

Dr. Misa Matsu

**Description:** Freight transportation is the backbone of the US economy and is critical to the daily operations of every business in the United States. In 2002, $11,082.859 million worth of goods and services were transported through various modes of transportation. The volume of freight in the United States is expected to rise 70% by 2020. Freight transportation also results in a large toll on the environment: it provides over a million people in the US with work, considerably reduces traffic congestion, and improves the speed of goods to customers. Therefore, it is critical to improve the efficiency of freight transportation. That system consists of state department of transportation (State DOT). We will first develop a plan to adopt a new philosophy to plan and conduct their business.

**Benefits:** The main objective of the proposed research is to develop a sustainable freight transportation framework with the consideration of improving safety and minimizing carbon emission. This framework will increase the utilization of other transportation modes such as rail and intermodal to diversify the methods of freight movements.

**Benefits:** This research will develop a green technology for pavement reconstruction, will reduce construction and maintenance costs, and improve performance of highway pavements for heavy trucks.

**Onsite use of recycled asphalt pavement materials with geocells to reconstruct damaged pavements by heavy trucks**

Dr. Je Han

**Co-PI:** Dr. Robert Parsons

**Description:** Asphalt pavements deteriorate under traffic with especially heavy truck traffic. When a pavement becomes badly deteriorated, reconstruction of the pavement may become economically feasible solution. Reconstruction of a pavement requires removal of the existing surfacing material. The onsite use of recycled asphalt pavement materials has obvious benefits from economic, environmental and sustainability points of view. One attractive option is to use recycled asphalt pavement materials as base courses reinforced by geocells with a thin overlay. This research will utilize the geotechnical test box available at the University of Nebraska to simulate the reconstruction of damaged pavement sections. RAP bases overlaid by a thin asphalt layer and evaluate their performance under cyclic loading. In this research, at least four test sections will be constructed in the geotechnical test box, including control sections and geocell-reinforced sections.

**Benefits:** This research will develop a heavy-duty flexible pavement reconstruction technique, will reduce construction and maintenance costs, and improve performance of highway pavements for heavy trucks.

**Developing a Sustainable Freight Transportation Framework with the Consideration of Improving Safety and Minimizing Carbon Emission**

Dr. Yong Bai

**Co-PI:** Dr. Steven Schrock; Dr. Thomas Mulnazzi

**Description:** The main objective of this research is to develop a sustainable freight transportation framework with the consideration of improving safety and minimizing carbon emission. This framework will increase the utilization of other transportation modes such as rail and intermodal to diversify the methods of freight movements.

**Benefits:** The research of this project will be compiled into a formal written report to share with the engineering community. The report is expected to include a evaluation of the safety data across the state along with identification of critical locations, particularly those where heavy vehicles have been involved.

**Calibration of Micro-Simulation Models for Multimodal Freight Networks**

Dr. Justice Appsiah

**Description:** This research will develop a framework for incorporating the unique operational issues of intermodal freight networks into the calibration process for microscopic traffic simulation models. Because of the nature of heavy freight movements in USDOT Region VII (Nebraska, Iowa, Kansas), this project will focus on commercial vehicles and trains. In particular, a genetic algorithm (GA) based optimization technique will be implemented and used to find optimum parameter values for the multi-modal vehicle performance model used by the microscopic traffic simulation model, VISSIM. The procedure will be implemented using a current micro-simulation model of the Nebraska State Highway System. The current VISSIM model will be expanded to account for both truck traffic and rail networks and will be developed such that the model can readily be updated as new information (such as ITS data) becomes available. As part of this project, the calibrated model will be tested for its suitability for performing operational analysis on urban and rural networks. The research will result in very high vehicle percentages for weight and material parameters. If the model is found to be acceptable, the program will be used to demonstrate the potential usefulness of the model in (i) the Nebraska/Iowa–Nebraska and (ii) a highway-rail grade crossing in Lincoln, Nebraska.

**Benefits:** Expected increases in freight carrying heavy truck and rail traffic in the Region are expected to increase safety and operational concerns because of eight distinct time zones, low acceleration and deceleration rates, and the ability to maintain speeds – particularly on steep grades. Therefore, how micro-simulation models may be adapted to (i) serve as useful tools for understanding the issues in this study, (ii) be applied to different volumes, and (iii) assess potential investment and operational alternatives.

**Reducing Impact of Heavy Truck Traffic on Service Life of Bridges - Experimental Phase**

Dr. Alfonso Azinamin

**Description:** The seamless pavement concept, developed by the Italians, is a special deck enhancement that eliminates transverse joints through the entire bridge length and within a transition zone beyond the bridge. The transition zone beyond the bridge is a specially detailed reinforced concrete pavement that results in extended bridge life, improved ride quality for highway users, and minimizes the high service costs that were developed for use with continuously reinforced concrete pavement (CCP). Specifically, longitudinal movement, due to thermal effects, at the transition zone must be limited. The key factor in the development of a complete jointless bridge for US practice is establishing an efficient and sustainable longitudinal force transfer mechanism from the transition zone to the bridge deck. The transition region designed using this force transfer mechanism can be extended with a short length of the transition zone with a very limited end movement and a predictable and controlled crack pattern. The objectives of the proposed research are to evaluate some of the force transfer mechanisms, use of a bottom-up force transfer mechanisms and to compare the current numerical results against the actual field tests. The experimental work will begin with several small-scale, component tests. Based on the results of these tests, a proof-of-concept test will be performed on a larger, isolated bridge transition zone.

**Benefits:** The results obtained from the proposed research will be a comprehensive understanding of the performance of the bridge system, and the effect that various variables have on the design and performance of the bridge system. The final product, together with the results of the other related research activities, will be used to develop a guideline for the comprehensive jointless bridge system.
ReseARCh

16..2011 MATC Research Projects
also develop specific cost estimates based

valuing relevant data for estimating system-

several national railroads and trucking firms,
is a headquarters or major location for

to the transportation and logistics system.

Existing methodologies

such underinvestment may be occurring in

crashes at HRGCs, including the full costs

Existing methodologies

be pursued by focusing on the fracture

analysis tool. Phase III is therefore proposed

system for the future pavement design-

two approaches during FY 2009 and FY

method (FEM)” particularly focusing

approach based on the finite element

mechanistic approaches.

DeSCRIPTION:

Pavement - Phase III

Truck Load Impact on

infrastructure system and they are vulnerable

DeSCRIPTION:

Crash costs at Rail g rade

and continued in FY 2010 to investigate

led by the PI was initiated in FY 2009

responses between two methods need to be

(227x122) The performance of bridges

miles. This research proposes to

constitute of a pole mounted unit and an in-

conditions. This research proposes to

DeSCRIPTION:

The benefits of research are

the development of green roadways.

This will not only reduce the roadway

energy consumer to an energy producer.

The deployment of the

be used as a practical tool for evaluation of

existing bridges. The load rating model and

procedures for determining the remaining life

span of bridges will find important applications

in decision making processes regarding

operation, maintenance, repair, rehabilitation

and replacement. This information will allow

owners to prioritize structures for repair/

rehabilitation or replacement.

Assessing the Structural, Driver and Economic Impacts of Traffic Pole Mounted Wind Power Generator and Solar Panel Hybrid System

PI: Mr. Scott Rosengaun

relationships to existing pavements in Nebraska’s

years to come. Also, the research team plans to get

more rigorous implementation in the current MEPDG,

mislead predictions of pavement cutting.

Further investigations of pavement responses

between two methods need to be conducted to better understand the effects of truck loading on pavement damage, and, consequently, to advance the current MEPDG system for the future pavement design-

analysis tool. Phase III is therefore proposed

herein to extend research efforts conducted during FYs 2009 and 2010. In Phase III, a more detailed investigation of the pavement responses between two approaches will be pursued by focusing on the fracture (cracking) related damage behavior of pavement structure.

BENEFITS: The proposed effort will provide better understanding of the effects of heavy-load trucks on the overall structural performance and life of pavements in Region 7. In addition, more appropriate use and future advancements of the current MEPDG for pavement analysis and design can be achieved based on proper incorporation with mechanistic approaches.

Reliability-Based Evaluation Criteria for Railway Bridges

PI: Dr. Andrzej Nowak

DESCRIPTION: The project will evaluate the feasibility of using existing rail infrastructure to mount wind power generators. Some possible places to mount a light weight wind generator and solar panel hybrid system are: (1) Traffic signal poles and (2) street light poles. Traffic signal poles can themselves have multiple designs depending on the function of the pole (arm versus span wire) and the width of the intersection (load carried, etc.). The close proximity of street light poles and traffic signal poles can make them useful for mounting the hybrid system. This project will assess the structural impacts of the hybrid system on traffic signal poles in Lincoln, Nebraska and city standard plans will be used for identifying the pole and foundation design. Structural analysis will investigate the fundamental period for wind load analysis and an explicit finite

element analysis using LS-Dyna for evaluating fatigue. Driver impacts and economic impacts of such systems will be measured by performing a before and after study at a test location in Lincoln and benefit analysis will be performed to assess the economic impact.

BENEFITS: The deployment of the proposed wind power generator systems will be evaluated through performance simulations for the role of the public right-of-way from an energy consumption, crash and cost perspective. This will not only reduce the roadway agency operating costs, but also generate new revenue for the agency. The use of part of the renewable electric power will also promote the development of green roadways.

IntelliDrive Technology based Yellow Onset Decision Assistance System for Trucks

PI: Dr. Anju Sharma

DESCRIPTION: This project aims to develop a prototype Yellow Onset Decision-Assistance (YODA) system for trucks based on IntelliDrive (Vehicle to Infrastructure Communication) technology. Drivers in Nebraska are required to stop or go on the onset of yellow. An error can occur if the driver has been too fast to proceed can lead to severe rear end collisions. Similarly an erroneous decision to stop sooner may lead to congested traffic which can stop to lead red light running incidences and 7-tone collisions. Trucks are relatively less maneuverable and have lower available acceleration and comfortable deceleration rates. The larger vehicle is much higher than passenger vehicles and they may have difficulty in responding to the brake lights of the leading car; hence, trucks are at a higher risk of crashes in such situations. Delinea zone protection systems are used at high speed intersections to enhance the safety of operation. These systems are generally designed based on delinea zone boundaries for cars and are static systems with no intelligence to adapt to existing traffic, weather or visibility conditions. This research proposes to develop a prototype YODA system that would constitute of a pole mounted unit and an in-vehicle unit. The in-vehicle unit would request decision assistance from the pole mounted unit as the truck approaches an intersection. Basing decision-making on traffic, weather and visibility conditions, the pole mounted unit would advise the in-vehicle unit with a recommended course of action.

The benefits of research are threefold: (1) guidelines for construction and design of new cable barrier systems will be created to reduce the propensity for penetrations to occur; (2) models of cable barrier system components and interactions will be refined; and (3) qualitative assessments of cable guardrail systems will enable researchers investigating alternative guardrail system failures to identify critical impact parameters.

Improving the Performance of Cable Median Barrier

PI: Dr. Dean Sicking

Co-PI: Cody Stoly

DESCRIPTION: Cable median barrier has proven to be an effective safety treatment for pavement crashes in rural or suburban areas. A recent study of the effectiveness of cable median barriers in Missouri showed that it reduced fatalities resulting from cross median crashes by approximately 50%. Even though penetrable barriers are 95% effective, the remaining 5% of fatalities in Missouri, when corrected by population to the entire nation, are estimated to represent approximately 230 fatalities annually. Thus, there is still a great opportunity for improving highway safety by improving cable median barrier performance. This project aims to reduce the number of vehicle penetrations through cable guardrail systems. The project consists of three distinctive approaches to improving cable barrier design guidelines: qualitative, analytical or simulation of cable barrier crashes resulting in penetrations; computer simulation of a cable median barrier crash in order to capture the penetration mechanisms of cable barrier systems, and improvement of cable barrier simulation components for future crashes simulations which will better predict penetrations and propensity for penetrability or override. The combination of approaches will provide insight into the mechanisms leading to cable barrier penetrations in order that design modifications and criteria can be recommended to reduce the number of cable guardrail penetrations.

BENEFITS: The benefits of research are threefold: (1) guidelines for construction and design of new cable barrier systems will be created to reduce the propensity for penetrations to occur; (2) models of cable barrier system components and interactions will be refined; and (3) qualitative assessments of cable guardrail systems will enable researchers investigating alternative guardrail system failures to identify critical impact parameters.

Improving the Freight Transportation Roadway System during Snow Events: A Performance Evaluation of Deicing Chemicals

PI: Dr. Christopher Yuan

DESCRIPTION: The ability of state DOT’s to adequately clear roadways during winter weather conditions is critical for a safe and effective freight transportation system. Variables affecting winter maintenance operations include the type of precipitation, air and pavement temperature, traffic, wind, time of day, de-ice equipment, and the state’s overall budget. The main objective of this study is to identify the best practices for normal deicing operations, based on the performance rating of deicing chemicals. Optimum de-ice zone rates and the associated application rates will be determined for various weather conditions. Best practices will ensure effective deicing operation and economical use of deicing chemicals. Although manufacturers provide performance data under specific conditions, a standardized test procedure for acceptance of a new deicing chemical is needed to confirm the manufacturers’ claims and to compare competing products under the same controlled conditions and at various application rates. Several labs will be evaluated and the observation with field performance will be conducted. Based on the results, a performance rating system will be developed. The performance rating system will be developed.

BENEFITS: Nebraska Department of Roads spends over $84 million per year on highway deicing chemicals. A performance rating system coupled with a laboratory analysis will ensure that the best value chemicals are procured and that performance is consistent with requirements. A performance rating system regarding the relative performance of different chemicals at specific environmental conditions will aid in decision-making to optimize the chemical combinations and applications. It is estimated that at least 5% reduction in operating cost ($200,000/year) can be achieved without compromising the level of service for the traveling public. The end result will be clearer roadway during snow events which will lead to a safer and more efficient freight (and passenger) roadway system.
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MATC wishes to congratulate the Master’s Student of the Year, Ben Grone. Grone is a second year student at the University of Nebraska–Lincoln with an emphasis in transportation engineering. As an undergraduate, Grone received the prestigious NU Regents Scholarship and achieved a GPA of 3.96. During this time, he worked on a Nebraska Department of Roads’ stormwater quality study as an undergraduate research assistant. He recently completed work on a study sponsored by the Nebraska Department of Roads investigating non-intrusive detectors.

Grone is certified as a LEED Accredited Professional. He is a member of Chi Epsilon (the civil engineering honor society), the American Society of Civil Engineers, the Institute of Transportation Engineers, and the American Railway Engineering and Maintenance of Way Association.

Celebration of Past, Present and Future at Whittier Research Center Dedication and Open House

The ribbon-cutting and official dedication for the historic Whittier building, MATC and NTC’s new home, took place on September 28, 2010. Faculty and staff of the University of Nebraska–Lincoln, along with community members, and alumni of Whittier Junior High School gathered to celebrate the transformation and the rich history of the building. Opened in 1923 as the nation’s first junior high school, the Whittier building closed in 1977 and was purchased by UNL in 1983. In 2006, UNL Chancellor Harvey Perlman proclaimed his vision to “return Whittier to public use” and, with extensive renovations, the building has become a state-of-the-art research center.

Among the distinguished speakers at the event were City of Lincoln Mayor Chris Beutler, UNL Chancellor Harvey Perlman, UNL Vice Chancellor Prem Paul and former Whittier Principal and retired Lincoln Public Schools Superintendent Dave Myers. Each of the speakers shared his own unique experiences with the building along with optimism for its bright future as the gateway to UNL’s planned Innovation Campus project. The other innovative research initiatives housed by the Whittier Research Center include the Nebraska Center for Energy Sciences Research and the Water for Food Institute. NTC and MATC are proud to be a part of this next chapter of research innovation and excellence in Nebraska and throughout the Midwest.