Union Pacific TRT 909 Tour

University of Nebraska—Lincoln civil engineering students and faculty members took advantage of a unique opportunity to view Union Pacific's track renewal train, the TRT 909, by traveling to the site of its operation on a field trip organized by the Institute of Transportation (ITE) and the American Society of Civil Engineers (ASCE). A total of twenty-one participants, including graduate students, undergraduate students, and faculty members, went on the trip, which took them to an area between the towns of Silver Creek and Clarks in Nebraska.

...continued on page 2

McMillan Middle School Students Visit MATC on Engineering Field Trip

On a recent field trip, forty seventh-grade students from McMillan Magnet Middle School (Omaha Public Schools) visited the Mid-America Transportation Center...

...continued on pages 4-5
Union Pacific TRT 909 Tour

...continued from page 1

The tour, which took place in October 2008, began at a restaurant in downtown Columbus, where Union Pacific’s Kevin Hicks, Jay Farrar, and Drew Bolenkamp gave attendees a brief presentation on the history of Union Pacific and the background of the renewal train. Hicks also provided the students in attendance with information on jobs with Union Pacific that would be available in the future.

After receiving their safety equipment, the party headed out to the 30 site in a bus. Miles before the actual site, train cars full of concrete ties that were to be fed to the TRT announced the proximity of the machine. With their bus driving in the right-of-way of the railroad tracks, participants were able to get an up-close view of the old ties, soon to be replaced by the renewal train.

The TRT 909, which is comprised of 30 rail cars, is about half a mile long. When running, this train can replace the rails and ties in one swoop, presenting an amazing spectacle as the old ties are replaced with new ones in a matter of seconds. Old rails are reused or are replaced with new rails in a matter of minutes. For the participants, this offers an opportunity to view the machine in action.

As I take a moment to reflect on the progress of MATC, I find myself amazed at the progress we’ve made over the past two years. MATC researchers have committed themselves to finding innovative solutions to the challenges that face the transportation industry. To help illustrate some of these accomplishments, we have decided to spotlight individual research projects conducted under the auspices of MATC, which will give readers a more in-depth perspective on some of our initiatives as well as provide an overview of the diverse range of projects that define our ambitious research agenda. I am particularly proud of the fact that we have substantive and important research being conducted by leading researchers in all four states of Region VII, as you will see in the following pages. When this work is implemented, it is sure to have profoundly positive effects on the citizens of Iowa, Kansas, Missouri, Nebraska, and indeed the U.S. as a whole.

In addition to our research, we are also highlighting some of our education-related initiatives in this issue. We have continued to provide outreach to middle and high school teachers and students through our annual summer institute. The attending middle and high school teachers are invited to bring their students to campus in order to learn more about transportation as a career option. This past year we had numerous groups visit our headquarters — one of these visits from McKeeben Magnet Middle School in Omaha is highlighted in this edition. MATC also sponsors a number of undergraduate and graduate students from various consortium universities to attend the Transportation Research Board Annual Meeting in Washington, DC, and we have highlighted their experiences in this issue. Finally, MATC sponsored a technical tour of Union Pacific’s TRT 909, which is part of a major track renewal project in eastern Nebraska. We are appreciative of the work put in by Union Pacific to make the tour a success for the transportation engineering students and faculty who attended.

I hope that in this issue you will find many reasons to join me in my enthusiasm for MATC’s transportation research and education initiatives. I look forward to the coming months as we get ready for our next research selection process, and as always I welcome your feedback and suggestions. Thank you for your interest and continued support.

Sincerely,
Larry

MATC Graduate Students Collaborate on Cross-Campus Chapter Activities

On March 31, 2009, MATC-funded student members of ASCE and ITE chapters at UNK, KSU, and KU came together in Topeka, Kansas, to discuss future chapter activities and joint projects. The University of Nebraska-Lincoln was represented by several students attending the meeting, including M.S. student Hao Gao, and Ph.D. students Chi Hsu and Hang Yue. Robert Recoc, a Ph.D. student from the University of Kansas, was also present, as were Kansas State students Nathan Whitcomb, an undergraduate, and Brian Geiger, who is pursuing his M.S. It was an excellent evening full of fun, fellowship, and exciting ideas for future collaboration.
McMillan Middle School Students Visit MATC on Engineering Field Trip

Forty seventh-grade students from McMillan Magnet Middle School (Omaha Public Schools) visited the Mid-America Transportation Center at the University of Nebraska-Lincoln on an engineering field trip designed to familiarize the students with important practical applications of engineering research and transportation technologies. On December 12, 2008, the students traveled to Lincoln and spent half a day visiting the RFID and Structures labs, viewing crash test presentations, and even trying their hand at operating traffic guns in 20-minute rotations. A group photo and quiz bowl with questions on transportation engineering, RFID technology, and structural engineering, in which the students demonstrated what they had learned during the day’s events, concluded the visit.

Dr. Sara Strawn gave an introductory PowerPoint presentation to the McMillan students.

Craig Schlicher, a Ph.D. student at UNL and 2007 MATC student of the year, showed the students video feeds from an Omaha traffic signal at the ITS lab.

McMillan students visited the Structures lab and viewed the steel girders and concrete forms used in the construction of bridges. They also learned to use traffic guns with the help of Zheng Liu, a Ph.D. student, and Tim Foss, an M.S. student.
Transportation Research Board Annual Meeting

I have never attended a conference as large as TRB; therefore, my first experience at TRB was exciting and at times overwhelming. Determining what session I wanted to attend was difficult at times, with so many options to choose from. I found the sessions I enjoyed most were spur-of-the-moment decisions. My favorite part of TRB was having the opportunity to learn about practical advances in engineering and research going on throughout the world. The best session, for me, was on the growth and infrastructure planned for the city of Abu Dhabi. According to the presenters, the city will be tripling its population within the next twenty years. The amount of infrastructure they were planning on building and that will be needed is remarkable. The other session I thoroughly enjoyed was on the new I-35W bridge in Minneapolis. In addition to attending sessions throughout the week, I had the opportunity for a little sightseeing. Donnie (Butler) and I went to the Holocaust Museum, as well as to the National Gallery of Art.

— Nate Burnett, M.S. student, UNL

The 2009 TRB annual meeting was a fourth to attend as a student and was marked by several highlights. The hallmark event for me was attending the Council of University Transportation Centers annual banquet to receive the Student of the Year award presented by TRB upon being selected by MATC. This honor was both humbling and inspiring. The annual meeting also provided numerous thought-provoking experiences in sessions, seminars and poster presentations. While I personally did not present this year, it was exciting to see several colleagues of mine, both past and present, present their work. KU also used TRB as an opportunity to showcase the wide array of transportation research opportunities to several undergraduates who were selected as part of the MATC-funded KU Undergraduate Transportation Scholars Program. When I was not busy attending committee meetings and networking, I spent the majority of my time helping our undergraders scholars navigate the conference hotels, receptions, and the city.

— Robert A. Rescott, Ph.D. student, KU

TRB was an amazing experience for me as a developing professional. I had never before realized how my research related to the transportation industry, and how expansive the transportation field was worldwide. Through my co-workers at MwS, I met many people at TRB, both national and international researchers working on transportation safety. The hospitality suites I visited were from various companies, which had heard about, especially with regards to their safety equipment, but never really knew much about. Meeting new people there was a big advantage for me, since I found many of the presentations even more interesting after meeting some of the speakers in person. I attended committee meetings and also had the opportunity to join one of the committees. This made me realize that, even though I was still a graduate student, my research could play a big part in transportation safety and could be presented at a conference like this someday. While in D.C., I also had the opportunity to visit some of the monuments. I had been to D.C. before, but this year I found it especially interesting because of the set-up and preparations for the presidential inauguration ceremony, which was a week later.

— Jennifer Schmidt, M.S. student, UNL

I really enjoyed attending TRB this winter. I was able to interact with many of the transportation research professionals with whom I corresponded by email, and the transportation community was very open and accepting of newcomers, welcoming us to the transportation safety group. The part I enjoyed the most about TRB was learning about the different transportation safety projects that were ongoing throughout the nation. Since I am working with a cable modeling study, I enjoyed seeing how others in the field, both at the Texas Transportation Institute (TTI) and the National Crash Analysis Center (NCAC), conducted their experiments with cable barriers. I was able to evaluate their experiences and research against my own, to make comparisons and produce modeling and testing methodology. Also, I really enjoyed the final element section in the development of new models. While it is true that some research labs used TRB as a platform to advertise to state departments of transportation, it was nonetheless very interesting to see how new technology and developing areas of transportation safety are being expanded and advanced by other transportation agencies.

— Cody Stolle, H.S. student, UNL

It became clear, due to the comments of the attendees, that the costs associated with travel and the conventions kept many of the transportation officials from other state departments of transportation away from TRB this year. Many officials were not able to attend because of the reduced budgets of transportation agencies. The impact of financial constraints was further reflected in the research of many of the presenters at the convention, as they considered many of the cost-effectiveness options for new developments in order to maximize the use of transportation safety dollars.

I had a great experience at TRB, and I hope that if I pursue a career in transportation, I will be able to attend future TRB conferences. I am very grateful to MwS for allowing me to attend.

— Cody Stolle, H.S. student, UNL
Research Spotlight: University of Nebraska–Lincoln

Design of High-Tension Cable Guardrail Line Post Bases

Thousands of miles of high-tension cable guardrail are being installed on divided highways across the nation to prevent median cross-over accidents, but evaluation of its in-service performance has generated increasing concern over the current system’s post base foundation designs.

The new generation of high-tension cable systems incorporates concrete post base foundations with steel sleeves to accommodate various proprietary posts. These sleeve post systems are intended to provide the user with a system requiring minimal maintenance after an impact, allowing for a new post to be placed afterward, but many have significant structural inadequacies during impact, resulting in considerable maintenance costs. Additionally, shallow designs in certain areas of the country are subject to significant frost heave, potentially affecting the height of the system and its ability to redirect low-profile vehicles. Therefore, there is a pressing need to develop a structurally adequate post base design that allows it to perform in a variety of in-situ soil conditions and under severe environmental conditions, including those induced from frost heave movements and freeze-thaw cycles.

For this study, a new post base has been designed based on the worst practical impact scenario. To determine the worst impact case, a complete study was conducted on the existing high-tension cable systems, which determined the properties of each proprietary post option and evaluated the reinforcement of current post base designs. Based on these analyses, an initial design of the new post base was determined.

To preclude frost heave of foundation displacement, soil and climatic conditions must be considered when developing an optimal post base design. Testing of the existing foundations has only occurred under controlled impact conditions, as specified by NCHRP Report No. 350. Thus, the structural adequacies in weak and moderately strong soils as well as environmental effects have not been adequately considered in the design of post base foundations to date. Based on these concerns, the new post base design must: 1) sustain the impact load without significant damage; 2) perform with limited rotation/displacement of the foundation and without requiring re-positioning after impact; and 3) be resistant to frost heave.

In the next several months, a series of tests will be conducted to verify the structural capacity of the new design and to determine its rotation/deflection in two extreme soil types. The results from the tests will be used to determine necessary base depth for various in-situ soils. Subsequently, a rational design methodology based on in-situ soil conditions for cable post bases in high-tension cable systems will be developed based on this required capacity as well as potential for frost heave at various geographical locations.

Principal Investigator: Dr. John Rohde.

Research Spotlight: Kansas State University

Assessing the Damage Potential in Pretensioned Bridges Caused by Increased Truck Loads Due to Freight Movements (Phase 1)

This research is aimed at determining the existing stresses in concrete bridge members. The goal is to understand the impact of different loading patterns on the structural integrity of the bridge. The project involves the construction of a test structure that will be loaded with simulated truck loads. The purpose of this research is to identify potential weaknesses in the bridge design and to develop solutions to mitigate these weaknesses.

The initial laboratory phase has focused on modeling the behavior of concrete bridge members under simulated truck loads. The specimens were loaded axially in a universal hydraulic testing machine, which could easily produce a range of stress levels. Data collected during this phase will be used to enhance the structural integrity of existing bridges.

A quarter-inch hole was drilled through the beam an inch from the edge. The wires soldered to the gages were run through the drilled hole and out the backside of the member (note: this step will be eliminated when the non-contact measurement procedure is used). The beams were axially loaded and the strain readings were recorded. The load was held constant on the member while a concrete casting was placed around the gage and drilled to release the surface strain. A wood jig was clamped to the beam to hold the curing bit in place.

During the casting of the beams, concrete cylinders were made to test the compressive strength and modulus of elasticity of the mortar mix. The compressive strength results were used to calculate the loads placed on the axially loaded beams. The modulus of elasticity results were used to convert the surface strain readings to stress and compare to the average normal compressive stress on the gage cross-section. The initial work has shown that a 3 1/2-inch diameter core bit and a 1 1/2-inch deep core depth produces reasonable results. In Phase 2, the work will be extended to use the technique on full-scale beams.

Principal Investigator: Dr. Robert Peterman.
Research Spotlight: University of Kansas
Evaluating Impacts of Rail-Truck Intermodal Facilities

In early 2006 the small town of Gardner, Kansas, a suburb of Kansas City, was selected by a major Class I railroad as the ideal location for a rail-truck intermodal facility and logistics park. Currently the town’s infrastructure and economy is mostly based on non-industrial occupations and serves as a suburban escape for families from the hustle and bustle of Kansas City. When the railroad’s plan became public in 2006, the town was sharply divided between those in favor of the development (and the jobs that would come with it), and those who feared the facility would ruin the status quo of the city, bringing with it the loud, busy, and fast-paced lifestyle characteristic of larger places like Kansas City, which many residents had tried to escape from by moving to Gardner. The city responded by assembling an Intermodal Review Committee to make recommendations to the city council, and on November 7, 2006 the city let voters decide over the annexation of the parcel of land in question. Voters responded by an almost 3:1 margin in favor of the city annexing the property. Originally the facility was slated to open in the fall of 2009, however due to various permission issues the opening date has been pushed back indefinitely.

The Kansas Department of Transportation has also been involved in this project, recognizing that in order for such a facility to operate trucks must have access to it, and the chosen location must be strategically close to two state maintained highways; US-56 and I-35. For both the city and residents of Gardner, one concern is that US-56 becomes Main Street through downtown Gardner, and an influx of trucks heading eastbound toward Kansas City and I-35 would create congestion and reduce safety, which the city has said would be "unacceptable."

Because of its neutrality as a non-partisan agency not subject to voter demands and without regulatory authority, the University of Kansas was approached with a request for an independent evaluation of evolving traffic patterns and railroad operations. The railroad has now completed a traffic study, and the residents and local governments have expressed their interest in following up on this study to quantify exactly what changes could be attributed to the forthcoming facility. Using MATC funding the university has developed a comprehensive strategic research project that will be able to monitor and quantify these changes, including both vehicular and rail traffic patterns, and related safety statistics. The research team will work with various transportation agencies to establish appropriate extents for the greater Gardner study region. It will catalog e-grade rail crossings in regions of Kansas affected by the intermodal facility including Gardner, and develop and implement a strategic work plan to capture traffic and railroadd data on an alternating monthly basis. After collecting accident reports from the various jurisdictions, researchers will analyze the traffic and railroad data for evolving patterns and develop a methodology to compare impacts to a no-build (all truck) alternative.

Principal Investigator: Dr. Steven Schrock.

Research Spotlight: Missouri University of Science 
& Technology
A Framework for Nationwide Multimodal Transportation Demand Analysis

In the year 2007, it is estimated that about 1.1 billion U.S. citizens made intercity trips longer than 100 miles for their business and leisure purposes, and that the U.S. industry transported approximately 19 billion tons of natural resources and manufactured products to serve markets. These facts indicate that the U.S. transportation system plays a key role in the country’s economic activities, suggesting that an efficient transportation system is vital for the economic development of the country.

As a first step for devising the future U.S. transportation system, the nationwide transportation demand needs to be forecast in a systematic way. Several nationwide multimodal transportation demand models are available, but it is hard to find a comprehensive framework that simultaneously analyzes both traveler trips and freight flow. Thus, the primary intent of this research is to develop a modeling framework that estimates the nationwide multi-modal transportation demand for the U.S. transportation system, one that considers both intercity passenger flow and truck flow on the multimodal transportation system including the national highway system and the air transportation network.

By working closely with other research teams at Virginia Tech and Battelle, project leaders Hjoring Baik and Yuaping Cui from Missouri University of Science and Technology are able to integrate existing intercity transportation demand models that have been developed in different areas, such as the Transportation System Analysis Model (TSAM), which analyzes intermodal intercity traveler demand, and the Freight Analysis Framework (FAF), a nationwide freight demand model developed by FHWA. Selected models are then proposed for integration into a single framework using TransCAD, a transportation demand analysis tool. The information we expect to gain from working with this framework includes, for instance, congestion delays and level of service on the national highway system, total time traveled, and total distance traveled, as well as figures for fuel consumption and emissions caused by traffic.

As part of the economic stimulus plan, President Obama and new leaders in more than 30 states are considering constructing a high-speed rail system that would connect major cities in the U.S. This proposal has raised a couple of fundamental questions that need to be answered, such as: how many people will use the new rail system? And what impact will the new system have on the existing highway and aviation traffic? The proposed methodology developed from this research project is expected to answer these and similar questions by providing an analytical tool to estimate the multimodal transportation demand and to assess the impact of proposed multimodal transportation improvement plans. By providing a consistent and comprehensive planning tool, the developed framework will assist in the improvement of linkages among all modes of the transportation system, which is one of the focus areas of the Mid-America Transportation Center.

Principal Investigator: Dr. Hjoring Baik.

1 TSAM has been co-developed by Missouri University of Science and Technology and Virginia Tech.
Research Spotlight:
University of Iowa
Performance Measures of Warm-Mix Asphalt (WMA) for Safe and Reliable Freight Transportation

Warm-mix asphalt (WMA) is an emerging technology that can allow asphalt to flow at a lower temperature for mixing, placing and compaction. The advantages of WMA include reduced fuel consumption, less carbon dioxide emission, longer paving season, longer hauling distance, reduced oxidation of asphalt, early opening to traffic and a better working environment in the field. However, it is difficult for pavement engineers to select a proper WMA product or equipment because there are a large number of them marked without a guarantee for an equal or better performance compared to the Hot Mix Asphalt (HMA). To provide a safe and reliable highway for truck traffic, WMA mixtures must meet requirements for wear and frictional characteristics, as well as rutting and moisture resistance. Therefore, it is critical to evaluate WMA for its long-term frictional and wear characteristics, and for its rutting and moisture susceptibility.

The main objective of this research is to evaluate various WMA products with respect to their fundamental engineering properties and performance-related characteristics. As shown in Figure 1, seven commercially available WMA products were evaluated in the laboratory: Advenir WMA, Asphalt-mix®, CECABASE RT®, Evotherm JL, Kumho KIL, Rediheat WMX and Sassoill®. These seven WMA mixtures, along with a WMA mixture and an HMA mixture, were evaluated for their fundamental engineering properties by performing the indirect tensile strength test and the moisture sensitivity test. To ensure a reliable long-term WMA mixture performance over a wide range of traffic and climatic conditions, the dynamic modulus and the repeated load test were conducted using the simple performance testing equipment shown in Figure 2. Figure 3 shows a post-doctoral scholar, two graduate students and three undergraduate students who have actively participated in this research.

Upon completion of this research, we will identify reliable WMA technology that would contribute to the road safety by minimizing the accident risk caused by unsafe road surface conditions for increasing freight movements on the U.S. surface transportation system.

Principal Investigator: Dr. Hosin "David" Lee.

MATC Advisory Board Members

Dr. Ray Krammes
Technical Director, Research and Development, Turner-Fairbank Highway Research Center

Mr. Richard Reiser
Executive Vice President and General Counsel, Werner Enterprises, Inc.

Mr. Ed Trout
Chairman, American Trucking Association; President, Conshuhk Trucking; Conshuhk Motor Lines, Omaha

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Mr. John Craig
Director, Nebraska Department of Roads

Mr. Judy Perkins
Chair and Department Head, Department of Civil and Environmental Engineering, Prairie View A&M University
### MATC Funded Research Projects

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<td>Design of High Tension Cable Post Bases</td>
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<td>Haulage Route Development for Wire Rope used in Safety Cables to Banners to Contain Passenger and Commercial Vehicles</td>
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<td>Impact of Truck Loading on Design and Analysis of Asphalt Pavement Structures</td>
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**Upcoming 2009 MATC Events:**

- **May 18-Aug. 14**: MATC Summer Intern Program
- **June 17-19**: Math and Science Professional Development Summer Institute for Teachers
- **July 1**: FY10 MATC Research Projects Announced
- **July 15-17**: Engineering Excellence Experience: Days for Junior High and High School Students
- **Oct. 28-29**: MATC Freight Summit

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Picture credit to: Jordan Rilett, Anthony Cahill, Jordan Pokorny, Geoffrey Priester, Paul Kopping.
Dr. Elizabeth G. Jones
Associate Professor, Civil Engineering;
Associate Director, Mid-America
Transportation Center, University of
Nebraska—Lincoln
Dr. Elizabeth “Libby” Jones is an
associate professor in the Department
of Civil Engineering at the University
of Nebraska-Lincoln (Omaha campus).
She directs and oversees the MATC
Intelligent Transportation Systems Lab at
the University of Nebraska’s Peter Kiewit
Institute. Dr. Jones has been a principal
investigator or co-principal investigator on more than 15 research
projects. She has authored or co-authored 18 journal papers and
served as committee chair for 18 masters’ students. Currently she
is supervising five masters’ students and one Ph.D. student.
Dr. Jones will serve as the MATC Associate Director for UNL.

Dr. Genda Chen
Professor, Civil, Architectural and
Environmental Engineering
Associate Director, Mid-America
Transportation Center, Missouri
University of Science & Technology
Dr. Genda Chen is a professor in the
Department of Civil, Architectural, and
Environmental Engineering at the Missouri
University of Science & Technology
(formerly, University of Missouri-Rolla)
and the interim director of the Center for
Infrastructure Engineering Studies (CIES).
He is a registered professional engineer in
the state of California. Dr. Chen has been
principal investigator and co-principal investigator on over 40
research projects, totaling more than $6 million for his teams
and approximately $2 million for his share. He has supervised 13
doctoral students and 11 masters’ students, and has published
over 35 peer-reviewed journal papers and an additional 100
conference papers. Dr. Chen will serve as the MATC Associate
Director for the Missouri University of Science & Technology.

Dr. Linda Boyle
Assistant Professor, Department of
Mechanical and Industrial Engineering
and Public Policy Center;
Associate Director, Mid-America
Transportation Center, University of
Iowa
Dr. Linda Boyle is an assistant professor
in the Department of Mechanical and
Industrial Engineering at the
University of Iowa. She holds a Ph.D.
in civil and environmental engineering
and a M.S. in inter-engineering from the University of Washington.
She is on the editorial board of the Accident Analysis and Prevention
journal and is the recipient of the NSF Career Award. Her research
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Dr. Mustaque Hossain is a professor
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Dr. Paul Hanley is an associate professor
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engineering, planning, and economic policy analysis. In general,
his work focuses on assessing the impacts of policy changes
on transportation behavior and on infrastructure provision as
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Dr. Tom Mulinazzi is a professor and former
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