

Center for Transportation Infrastructure and Safety  
**NUTC NEWS**  
*at Missouri University of Science and Technology*



NATIONAL  
UNIVERSITY  
TRANSPORTATION  
CENTER

WINTER 2009 ~ VOLUME 4, ISSUE 2

## A MESSAGE FROM THE DIRECTOR — JOHN J. MYERS

Welcome to 2009! We are looking forward to another year of new research, education and technology transfer initiatives at the Center for Transportation Infrastructure and Safety.

We are pleased to feature Dr. Glenn Washer of the University of Missouri – Columbia, one of our key researchers in the arena of non-destructive evaluation (NDE) technologies and methods, in our faculty profile section this issue.

CTIS has recently acquired a new piece of technology for transportation research and non-destructive evaluation: the Leica Scan Station LIDAR unit. This is a state-of-the-art piece of equipment in use by several Missouri S&T researchers and project investigators. Read more about it on page 4.

This issue's "What Are They Doing Now?" series features Ryan McDaniel of the SSR Ellers, Inc. in Memphis, Tennessee. Catch up with Mr. McDaniel on page 6.

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We are happy to announce our 2008 UTC Outstanding Student of the Year: Michael Murphy! Read more about Mr. Murphy and his research on page 8.

Other features include a summary of the Fall 2008 ACI Convention in St. Louis (on page 5) and an overview of two new initiatives in collaboration with MoDOT: MTI/MoDOT Structural Collaborative Research Program and the MTI/MoDOT Transportation Geotechnical Research Program. These two multi-million dollar programs span twenty-two months, involve a total of twelve projects, fourteen researchers and 3 UM system campuses.

The CTIS faculty and staff wish you a happy and productive new year!

Warm Regards,  
John

## UPCOMING EVENTS

### Transportation Seminar Series

Spring 2009  
Rolla, Missouri

More info soon at  
[http://utc.mst.edu/  
events](http://utc.mst.edu/events)

### The Energy Summit

April 22-23, 2009  
Columbia, Missouri

[http://www.  
umsystem.edu/  
ums/news/releases/  
news08121201.shtml](http://www.umsystem.edu/ums/news/releases/news08121201.shtml)

### Missouri Concrete Conference

May 5-6, 2009  
Rolla, Missouri

More info at [http://  
concrete.mst.edu/](http://concrete.mst.edu/)

### GeoMo 2009

May 8, 2009  
Rolla, Missouri

More info at [http://  
geommo.mst.edu/](http://geommo.mst.edu/)

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### MTI/MoDOT STRUCTURAL COLLABORATIVE RESEARCH PROGRAM



**M**issouri Department of Transportation (MoDOT), with administrative oversight from Missouri Transportation Institute (MTI), has collaborated with University of Missouri (UM) Structures faculty to cooperatively conduct research on transportation structures over twenty-two months with a program of six projects.

**T**he two theme areas effectively address MoDOT's and the nation's needs in developing better, faster, and cheaper solutions for transportation structures with superior long-term performance, innovative construction technologies, and effective maintenance and preservation strategies. For MoDOT, emphases will be placed on critical needs, reducing costs of inspection, maintenance and repair, ensuring bridge safety and providing durable solutions.

#### THEME AREAS

**W**ith consideration to the collective expertise of the participating faculty, structures faculty from Missouri University of Science and Technology (Missouri S&T), University of Missouri – Columbia (MU), University of Missouri – Kansas City (UMKC) and MoDOT engineers identified the following two theme areas:

1. Extending service life of MoDOT's existing bridges
2. Optimizing MoDOT's bridge design and construction for effective cost reduction

#### PROGRAM MANAGEMENT

**T**he Structures Research Team will be coordinated by Missouri S&T and geographically distributed with team members from MU and UMKC.

**T**eam members include: Dr. Abdeldjelil "DJ" Belarbi, Missouri S&T; Dr. Richard Brow, Missouri S&T; Dr. Genda Chen, Missouri S&T; Dr. Vellore S. Gopalaratnam, MU; Dr. Oh-Sung Kwon, Missouri S&T; Dr. John Myers, Missouri S&T; Dr. Sarah Orton, MU; Dr. Hani Salim, MU; Dr. Lesley Sneed, Missouri S&T; Dr. Ganesh Thiagarajan, UMKC; Dr. Jeffrey Volz, Missouri S&T; Dr. Glenn Washer, MU.

#### ANTICIPATED PROGRAM DELIVERABLES

**T**he primary deliverables for the 2008-2010 structures research program will include the following:

- Cost-effective solutions to structural steel corrosion and precast-pretensioned deck spalling with documented performance data based on laboratory and/or field tests
- Cost-effective modular bridge approach slabs for rapid construction
- Recommended material specifications and test procedures for new materials that can ultimately lead to a significant reduction in up front cost of new bridge constructions
- Recommended design specifications for adoption by MoDOT with supporting documentation and justification as well as suggestions for periodic evaluation and update

**T**o learn more about the scope of work and objectives for individual projects and the researchers involved, visit <http://utc.mst.edu/research/2007.html>.



### MTI/MoDOT GEOTECHNICAL TRANSPORTATION RESEARCH PROGRAM



The objective of the Geotechnical Transportation Research program is to achieve significant and recurring cost savings for MoDOT (Missouri Department of Transportation) by developing improved, technically sound design specifications. The new specifications will be based on LRFD concepts which produce consistent and appropriate performance/risk for the local conditions and consequences involved.

This will lead to substantial cost savings by avoiding excessive conservatism in cases where it is not warranted and avoiding excessive maintenance and rehabilitation costs in cases where performance is unacceptable. The execution and completion of this program will address many of MoDOT's most pressing research needs while making notable improvements to the state of the art and practice of geotechnical engineering at a national and international level.

#### PRINCIPAL TASKS

To adequately address the primary sources of risk for foundations and earth slopes, MoDOT leadership and University of Missouri System (UM) Geotechnical faculty have identified the following tasks:

1. Site Characterization for Lowest Cost Transportation Products
2. Bridge Foundation Design Assessment
3. Establishing Acceptable Risk
4. Producing New LRFD Design Specifications

#### PROGRAM MANAGEMENT

The Geotechnical Research Team will be coordinated by MU and geographically distributed with team members from Missouri S&T and UMKC.

Team members include: Dr. John Bowders, MU; Dr. Louis Ge, Missouri S&T; Dr. Bill Likos, MU; Dr. Erik Loehr, MU; Dr. Ronaldo Luna, Missouri S&T; Dr. Norbert Maerz, Missouri S&T; Dr. Brent Rosenblad, MU; Dr. Rick Stephenson, Missouri S&T.

#### ANTICIPATED PROGRAM DELIVERABLES

The principal deliverables for the 2008-2010 geotechnical research program will include:

- An improved LRFD specification for design of bridge foundations
- New LRFD specifications for design of earth slopes and embankments
- Three "commentary" documents providing important supporting documentation for each LRFD specification

To learn more about the scope of work and objectives for individual projects and the researchers involved, visit <http://utc.mst.edu/research/2008.html>.





## TRANSPORTATION TECHNOLOGY: THE LEICA SCAN STATION LIDAR UNIT

With support from CTIS, a Leica Scan Station II LIDAR (Light Detection And Ranging) machine was purchased for highway research by Missouri S&T transportation faculty and project investigators. The device will be used for a number of purposes, including studies on rock cut raveling, movement of highway embankments, architectural reconstruction and the deflection of bridges under load.

This type of LIDAR provides the ability to quickly and accurately generate maps of rock faces and slopes. In a matter of minutes, the LIDAR can scan a target area and return a digital map with a stated modeled accuracy to within 2 mm.

Such a high level of accuracy allows for precise mapping of transportation structures, such as

bridges and slopes, and the measuring of movement over time of structures and slopes as well as a quick and efficient way of measuring bridge load deflections.

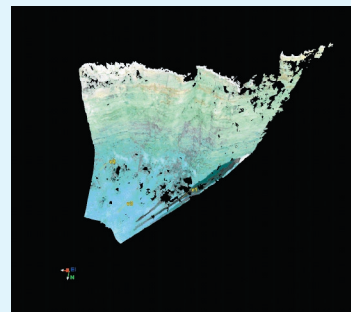
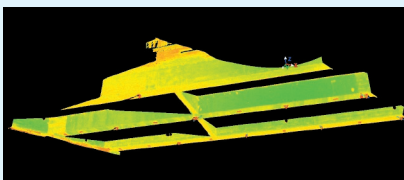
The LIDAR unit can perform scans shooting either straight up or obliquely. When shooting straight up, each scan takes about 4 minutes and consists of millions of data points. Scans can be analyzed immediately and the level of error between two scans is a mere 0.5 mm or less. When shooting obliquely, each scan takes about 8 minutes and consists of thousands of data points. The level of error between two scans is 0.3 mm or less.

In the future, the LIDAR unit is expected to be put to use in projects measuring the blast resistance of bridges and tunnels and in forensic investigations of transportation infrastructure damaged by natural hazards.

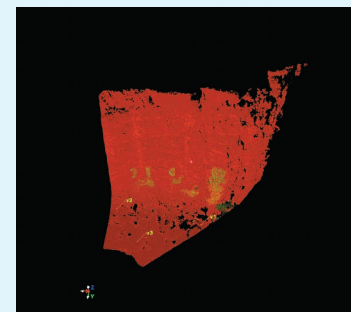


### BRIDGE LOADING MEASUREMENTS

The LIDAR unit was used to measure bridge loading on two bridges in Missouri: Iron County Bridge and Dallas County Bridge. The images on the left show the setup for shooting obliquely at the Iron County Bridge. Precise mapping, as shown in the bottom left image, makes measuring bridge load deflections quick and efficient.



Scan of rock face



Second scan of rock face superimposed over first. Yellow areas show where rock has been removed.

### A PRELIMINARY STUDY ON ROCK FACE

In a preliminary study, a scan and analysis of a rock face was conducted. A scan was completed and then a construction machine was used to scrape a small amount of rock off the rock face. A subsequent scan was then performed and the two scans were overlapped in software to identify the areas and volumes of rock removed.



## FALL 2008 ACI CONVENTION IN ST. LOUIS, MISSOURI

Missouri S&T UTC students and faculty past and present came together November 2-6, 2008 in St. Louis, Missouri at the Renaissance Grand & Suites Hotel for the Fall 2008 American Concrete Institute Convention, themed "The Spirit of Concrete."



CTIS-NUTC students Kurt Bloch and Youske Tanizawa at the CTIS exhibitor booth.

The Fall 2008 ACI Convention not only provided an opportunity for current and former students and faculty of Missouri S&T to reconnect, but a forum for engineers, architects, contractors, educators, manufacturers and material representatives from all over the world a chance to network, exchange expertise, learn about new advances in the field and to give input on concrete industry codes, specifications and guides. The ACI Convention attendees are some of the most well-informed individuals in the concrete industry.

Since the first convention held in 1905, each ACI convention has been dedicated to improving the design, construction, maintenance and repair of concrete structures by offering over 300 committee

meetings, 35+ technical and educational sessions, a number of social events and a large group of exhibitors, including the Center for Transportation Infrastructure and Safety.

Some of the technical tours and special events offered at the Fall 2008 ACI Convention included an Architectural Walking Tour, a Concrete Structures of St. Louis Bus Tour and a Concrete Mixer social event. Some of the technical and educational sessions offered included: The Spirit of Structural Concrete in Performance-Based Seismic Design of Bridges; Advances in Fiber-Reinforced Concrete; Emerging Technologies in Civil Infrastructures Applications; Concrete Bridge Design for Extreme Events and Concrete Bridges along the Mississippi River.



CTIS-NUTC students, faculty and alumni dinner.

Upcoming ACI conventions include the Spring 2009 Convention in San Antonio, Texas and the Fall 2009 Convention in New Orleans, Louisiana. For more information, visit <http://www.concrete.org>.





## CATCHING UP WITH FORMER UTC STUDENT RYAN McDANIEL, P.E.

**A**s a Structural Design Engineer and Project Manager with Smith Seckman Reid (SSR) in Memphis, TN, Ryan McDaniel is responsible for the management of projects, project designs and client contact. He writes proposals, handles contracts and coordinates work between SSR's engineering disciplines and consultants. He works on a variety of projects with individuals of diverse expertise and backgrounds from all over the world.

**M**cdaniel earned a M.S. in Civil Engineering from the University of Missouri – Rolla (now Missouri University of Science and Technology) in 2004 and a B.S. in Civil Engineering from the University of Tennessee at Martin in 2003.

**A**s a graduate student working with the UTC, McDaniel worked with Dr. Genda Chen on the development of coaxial sensors for the detection of cracks in concrete. "The research will lead to improvements in the way our highway bridges are monitored and maintained," says McDaniel.

**M**cdaniel's research with Dr. Chen involved Embedding sensors in bridge decks, girders and bents, including the installation of two sensors in the deck of an existing bridge in Dallas County, Missouri. There, the Missouri Department of Transportation allowed UTC researchers to load test an in-service bridge.

**A**t SSR, McDaniel works as a structural engineer on many of the transportation division's design and inspection projects. "Although it may not happen in the near future, I expect that our designs will incorporate several types of health monitoring technology...as part of a regular maintenance plan," says McDaniel.

With his UTC work behind him, McDaniel feels "prepared to take on that challenge when it presents itself."

**I**n the meantime, McDaniel plans to help grow SSR's structural services related to highway and rail bridges and to help expand marine engineering services. He plans to extend his own credentials and continue learning by taking the NCEES Structural II exam so that he can become a registered Structural Engineer in the applicable states. Additionally, McDaniel plans to pursue LEED accreditation in the future.

**M**cdaniel lives in the Memphis-area with his wife April and their two children, 2-year old Madelyn Leigh and 10-month old Jackson Davis. He enjoys sports and wood working and is active with his local congregation. To current students, McDaniel gives the following advice: "Be ready and looking for opportunities. Set goals based on your definition of success and set out to reach them."





### GLENN WASHER, PH.D.

ASSISTANT PROFESSOR OF CIVIL & ENVIRONMENTAL ENGINEERING

**D**r. Glenn Washer is an Assistant Professor of Civil & Environmental Engineering at the University of Missouri – Columbia (MU). Dr. Washer's current research program at MU includes the development of thermographic methods for the detection of subsurface defects in concrete, acoustic methods for detection of corrosion damage in highway bridges, and health monitoring systems for asset management.

**B**efore joining MU in 2004, Dr. Washer worked with the Federal Highway Administration (FHWA) at the Turner Fairbank Research Center (TFHRC) where he served as the director of the FHWA Nondestructive Evaluation (NDE) program. Dr. Washer has expertise in a wide variety of NDE technologies for the condition assessment of highway bridges, including ultrasonics, thermography, ground penetrating radar, radiography and the visual inspection of bridges.



**H**e has published more than sixty conference and journal papers on the development of NDE technologies and their application to bridge condition assessment. Dr. Washer was awarded the George Washington University's Flemming Award for outstanding accomplishments in applied science for his role in developing new NDE technologies for highway bridges.

**A**n active leader in the technical community, Dr. Washer has chaired several committees related to condition assessment of highway bridges.

He is chairman of the Transportation Research Board's (TRB) AFF40: Committee on Field Testing and Nondestructive Evaluation of Transportation Structures and he is the past chairman of both the TRB Subcommittee on the Nondestructive Testing of Structures and the ASCE committee on Bridge Management, Inspection and Rehabilitation. Dr.

Washer also works with NASA engineers to address inspection challenges and NDE for space vehicles.

**S**ponsors of Dr. Washer's research include the U.S. Department of Transportation (USDOT), the National Cooperative Highway Research Program (NCHRP), Missouri Department of Transportation (MoDOT), Texas Department of Transportation (TxDOT), New York State Department of Transportation (NYSDOT), Tennessee Department of Transportation (TDOT) and NASA.

**D**r. Washer received his Ph.D. in Materials Science and Engineering from the Center for Nondestructive Evaluation (CNDE) at the Johns Hopkins University in 2001. In 1996, he received a master's degree in Structural Engineering from the University of Maryland and in 1990 a bachelor's degree in Civil Engineering from Worcester Polytechnic Institute.

**V**isit <http://web.missouri.edu/~washerg/Pages/bio.htm> to learn more about Dr. Washer and his research group.





MICHAEL S. MURPHY

2008 OUTSTANDING MISSOURI S&T UTC STUDENT OF THE YEAR

Michael S. Murphy has been named Outstanding Missouri S&T UTC Student of the Year. The award was made based on his excellent academic performance, the technical merit of his research topic and his service to both Missouri S&T and the surrounding community.

Murphy earned a B.S. degree in Civil Engineering with Summa Cum Laude honors from the Missouri University of Science and Technology (formerly University of Missouri-Rolla) in December 2006. During his undergraduate career, Murphy was a member of the Missouri S&T chapters of American Society of Civil Engineers (ASCE), Chi Epsilon National Civil Engineering Honor Society and the Missouri S&T Concrete Canoe Team. He served as both Secretary and Treasurer for Associated General Contractors of America (AGC) and Secretary of the American Concrete Institute (ACI).

As a graduate student, Murphy was involved with the Missouri S&T PCI Big Beam Competition Team, helping the team secure a 2nd place regional finish. The contest involved designing, fabricating and testing a prestressed beam that needed to carry a load between 16 and 19 tons.

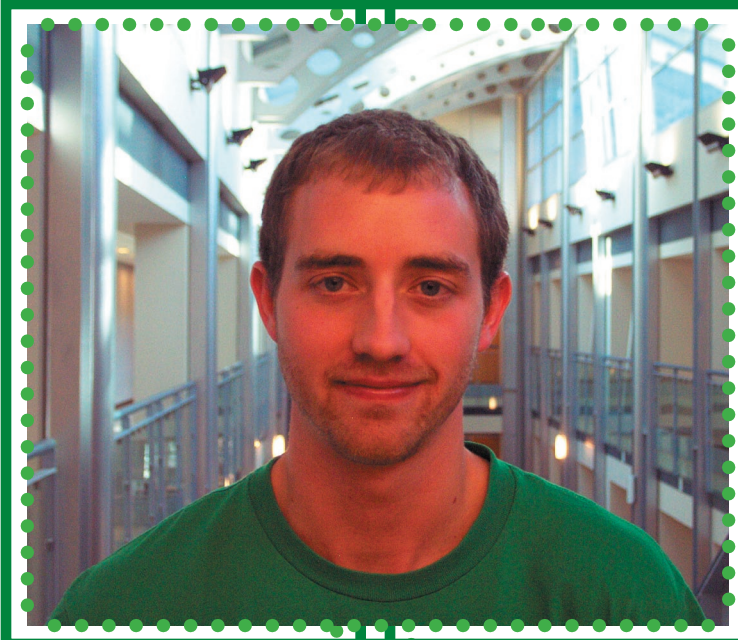
Civil Engineering appealed to Murphy's interests in both design and problem solving; he chose Missouri S&T because of "a great reputation for producing quality engineers." Of the chance to work on Fiber Reinforced Polymer (FRP) strengthening of concrete bridges, he

says: "I saw it as an exciting opportunity to study a relatively new material...[and] to get involved in full-scale testing of concrete beams."

Murphy has been advised by Dr. Abdeldjelil Belarbi during his graduate career and received financial support from Graduate Assistance in Areas of National Needs (GAANN). He has studied and made technical contributions

to the understanding of FRP applications for shear strengthening of concrete bridge girders, including: experimental testing of full scale reinforced concrete and prestressed concrete bridge girders strengthened in shear with FRP. In his research work, which is sponsored by TRB and the CTIS-NUTC, he has been responsible for writing several progress and quarterly reports.

Murphy anticipates graduating from Missouri S&T with his M.S. and Ph.D. degrees in Civil Engineering in December 2010 and plans to work in industry as a structural engineer.







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**PROSPECTIVE AUTHORS ARE ASKED TO  
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