news

MISSOURI S&T

CENTER FOR TRANSPORTATION INFRASTRUCTURE AND SAFETY

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New leadership at the helm

As we transition from Fall to Winter here in Missouri, we are also undertaking an exciting transition within our Center for Transportation Infrastructure and Safety (CTIS) at Missouri S&T. After many years serving the center as a Technical Co-Director then Interim Director, our New Vernon and Maralee Jones Chaired Professor will be taking the helm as the new CTIS Director. It has been both a tremendous pleasure and very deep honor to serve the University, the State of Missouri, the United States Department of Transportation (US DOT) and US DOT RITA within this administrative position since 2006. I want to thank all of our research, educational and technology transfer partners, in particular our key partner in the Missouri Department of Transportation (MoDOT), for advancing pressing National and State research needs. I could not be happier transitioning this center to new leadership where our relationship with MoDOT arguably has never been stronger partnering to meet both the state and national transportation needs. I would also be remiss if I did not acknowledge all of the hard work of the University of Missouri System faculty, students and staff that have been the real transportation champions that have made our National University Transportation Center truly shine. Their hard work has produced numerous high quality implementable findings in the field of transportation studies, while continually being good stewards of the trusted resources that US DOT has invested within our CTIS-NUTC. I have little doubt this trend will continue under new directorship. Let me say a few words about our new Center Director.

John Myers, former director of CTIS

Kamal H. Khayat joined Missouri S&T in August of 2011 as the Vernon and Maralee Jones Chaired Professor of Civil Engineering. He specializes in the development of high-performance cement-based materials for structural applications and rehabilitation, particularly focusing on self-consolidating concrete (SCC) and high-performance concrete (HPC) behavior. His pioneering work in the area of SCC, starting in 1991, has contributed to its acceptance world-wide. I invite you to learn more about our new director as this Newsletter's Featured Faculty on page 9.

Warm Regards,
John Myers

In this issue:

PROJECT:

Field evaluation of alternative and cost efficient bridge approach slabs (BAS)

- Ganesh Thiagarajan, Associate Professor, Department of Civil and Mechanical Engineering, UMKC

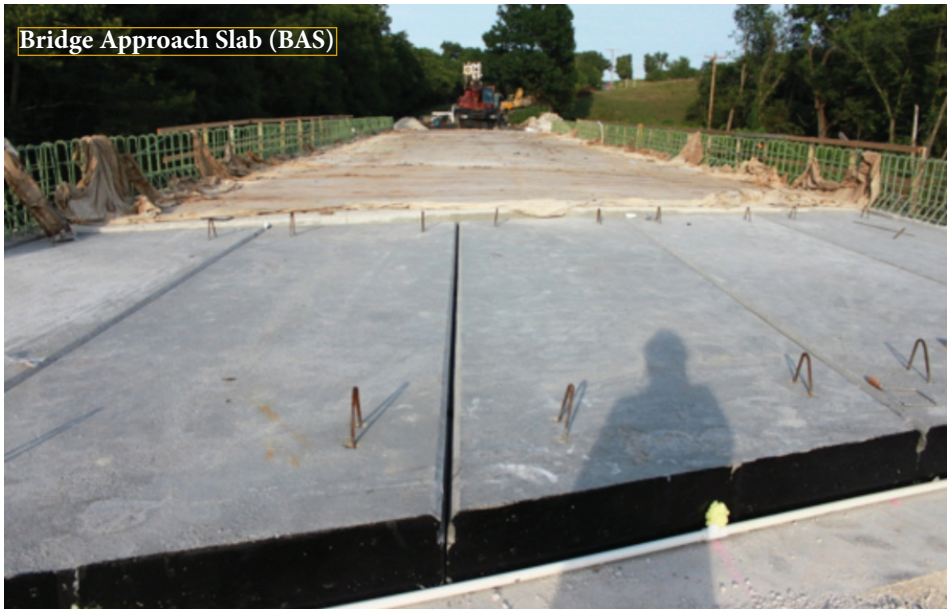
The main objective of the project is to evaluate and compare the field performance of recommended BAS designs, their constructability, and their impact on cost and schedule to the current MoDOT BAS design.

The project team consists of Dr. John Myers on the Missouri S&T campus and Drs. Ganesh Thiagarajan and Ceki Halmen at the University of Missouri-Kansas City campus.

Twenty feet long prestressed precast designs are being tested on one project located on Mo38 near Springfield. Eleven vibrating wire strain gages were embedded in the slab panels during concreting and five moisture sensors were embedded into the subgrade soil below BAS before the construction. The strain and moisture data is being collected at regular intervals using data collection systems installed under the bridge. The collected data is being analyzed at University of Missouri Kansas City (UMKC) and Missouri University of Science and Technology.

Based on collected field data, researchers will recommend improvements in terms of construction practices, sequencing, design details, and other issues for a successful implementation of the new BAS designs in the future.

Strain gage anchored to rebar and moisture gage embedded in subgrade soil



Protecting gage cables from exposure to moisture and Data collection system

Minority Introduction to Technology and Engineering

This program took place on the Missouri S&T campus on June 14-24 and is designed to help the students obtain a clear picture of engineering, science, and technology as a profession and to become acquainted with the various fields. The students have the opportunity to participate in several hands-on activities and to interact with Missouri S&T students, faculty and staff.

Society of Hispanic Professional Engineers National Conference

October 26-30th, 2011

With over 10,000 students attending the event each year this event offeres an excellent opportunity to recruit minority students at both the under-graduate and graduate levels. The goal is designed to increase the awareness, participation, and excitement surrounding graduate school and the pursuit of higher education. Through the careful integration of planned events, students and professionals can learn about higher education opportunities and resources. Several new activities were incorporated into the agenda this year, which were designed to promote higher education, increase student participation, and emphasize academic and technical excellence.

Catching Up With Former UTC Student Jared Brewe

As an Associate with CTLGroup, Jared Brewe's primary responsibilities are project management and project support, although his duties vary with each project. Typical for most projects, he reviews project documentation and performs analysis to determine an appropriate course of action or response for their clients. He enjoys the variety of different projects that he works on, ranging from a multi-million dollar litigation case to crawling into the attics of townhomes. He works and interacts with some of the brightest and most influential people in engineering and the construction industry. His work allows him to travel to interesting locations and see parts of structures that many people do not even know about.

Jared Brewe, former CTIS stduent

Brewe earned a Ph.D. in Civil Engineering in 2009, a M.S. in Civil Engineering in 2006 and his B.S. in Civil Engineering in 2004 from Missouri S&T.

As a graduate student, Jared Brewe was awarded a one-year graduate assistantship from the Center for Transportation Infrastructure and Safety to pursue doctoral studies in a transportation-related field. The award was made based on an exemplary academic career and the merit of his proposed research. Working under the advisement of Dr. John Myers, Brewe's UTC research project provided him the opportunity to pursue a research topic in which he was particularly interested; prestressed concrete behavior. His research investigated both prestress losses and allowable stresses in prestressed concrete members, which are both of importance to the precast industry and transportation infrastructure.

His goals over the next few years are to take the PE exam in the next year and SE exam the following year. He also hopes to serve as an expert witness in an arbitration, mediation, or trial.

His advice to current students is to get involved in everything they can to gain experience, such as going to industry conventions and conferences, particularly ACI, PCI or TRB conventions. He suggests becoming an associate member of a committee which interests you to see how they work and how documents like ACI 318 are developed. Finally, he recommends seeking pofessional advice from anyone who is willing to give it.

Associate Directors Appointed

Two faculty members from Missouri S&T have been appointed as the Associate Directors of CTIS.

Dr. John Myers, Associate Professor of Civil, Architectural, and Environmental Engineering and former CTIS Interim Director (featured on page 1), and **Dr. John Sheffield**, Professor of Mechanical and Aerospace Engineering (featured here) will lead efforts within their respective research areas with all stakeholders on campus and appropriate external agencies to pursue new educational, research and technology transfer opportunities for the CTIS.

Drs. Myers and Sheffield will also serve on the advisory board to select research projects to be funded by CTIS.

They both bring exceptional leadership skills, expertise and experience to the Center that will enable it to rise to the next level of excellence.

Dr. John Sheffield, Associate Director, CTIS

Fall ¡Sí, Se Puede!

November 10-12, 2011

The Society of Hispanic Professional Engineers (SHPE) annually coordinates ¡Sí, Se Puede!, which is an on-campus visit program for Hispanic and Latino students to explore a future career in math and science. This program helps students to explore the career options Missouri S&T has to offer and gives them an inside look at real college life. During their time at Missouri S&T, the students interact with members of the SHPE and NSBE (National Society of Black Engineering) chapters. Participants also meet faculty and staff that volunteer their time to teach students about degree programs, career options, co-ops and internships, answer all their questions and more.

PROJECT:

Making highway rock cuts safer

- Norbert Maerz, Associate Professor of Geological Engineering, Missouri S&T

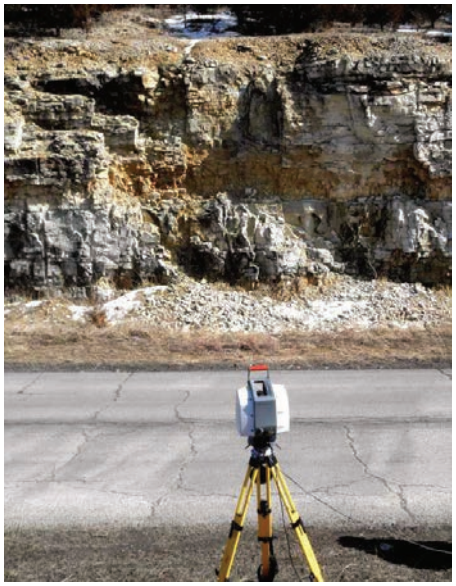


Figure 1:
LIDAR scanner measuring rock cut

Rock falls constitute a significant geological hazard along highways in hilly terrains, causing financial loss, damage to vehicles and infrastructure and even injury and occasional loss of life. By most accounts raveling type rock falls (time dependent regressive displacement failures) constitute better than half of all failures. Yet there is no way to model them or predict their progress or severity. Even the mechanisms are poorly understood.

A new technology called LIDAR (LIght Detection And Ranging) can make very precise measurements of rock slopes and cuts, detecting minute topographical differences over time, that will provide the data needed for developing a model for raveling (Figure 1). As a distance measuring device, LIDAR replaces traditional methods of laser surveying, which take individual measurements, and require reflective targets to measure distances and angles. LIDAR is analogous to radar, in that the scanning laser can make of 50,000 point measurements per second, returning a point cloud, which can be used by sophisticated software to create a very detailed surface map. At Missouri S&T, we have a Leica ScanStation II, and a Leica HDS6000, both terrestrial LIDAR models that are being used for this project. These have a range of over one hundred meters, a sampling resolution of less than 1 mm, and a modeled precision of 2 mm.

Multiple scans over time can reveal the timing, sequence, number of blocks and volumes of material falling off the face and accumulating on the ground below, up to and including the fall of very small individual blocks (Figure 2). Rock fall events can be precisely correlated with external stimuli, such as rainfall, temperature cycling, and seismic activity (Figure 3). In time measurements such as these will allow us to understand the causes and triggers of raveling failures and to learn how to predict and prevent raveling rock falls using new modeling methods.

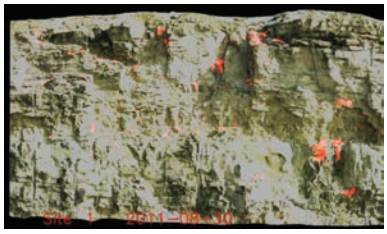


Figure 2:
LIDAR and resulting areas of rock loss painted in red on the image

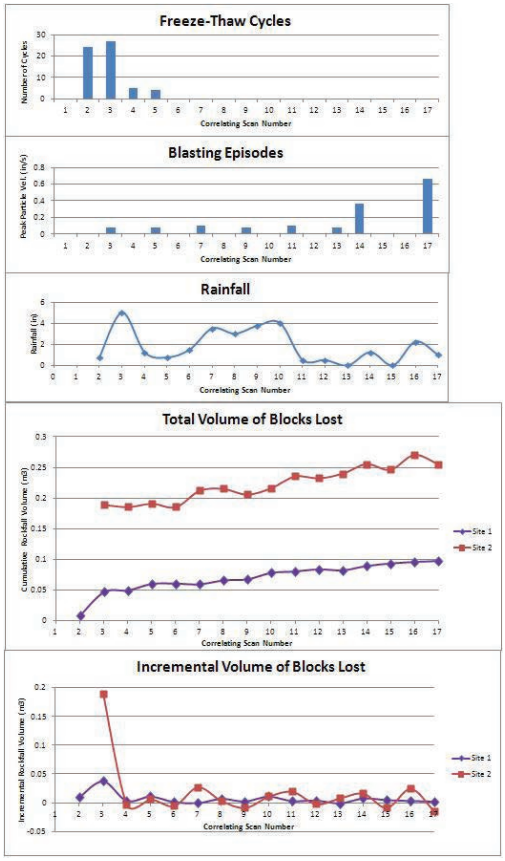


Figure 3:
Results of the pilot study

PROJECT:
Hybrid composite beam research

- John Myers, Associate Professor of Civil, Architectural and Environmental Engineering, Missouri S&T
- Glenn Washer, Associate Professor of Civil Engineering, University of Missouri-Columbia

In July of 2011, researchers from Missouri S&T and the University of Missouri-Columbia initiated a research study with the Missouri Department of Transportation (MoDOT) and CTIS, studying the field behavior of three new innovative bridges to be constructed in Missouri. This new bridge support system involves the use of an innovative Hybrid-Composite Beam (HCB), shown conceptually in Figure 1. These HCB's are comprised of three main sub-components that include a shell, compression reinforcement in the shape of an arch, and tension reinforcement that serves as a tension tie. The outer shell consists of a fiberglass composite which is non-corrosive. Tensile reinforcement includes the use of galvanized high strength steel. Self-consolidated concrete (SCC) is used to form the concrete compression arch. An arch was selected to reduce the overall dead load of the member and only use the concrete where it is most desirable, in the compression and end bearing regions. By minimizing the dead load, more members can be transported to the job-site together and lower rated capacity cranes can be used for field erection compared to traditional concrete girders.

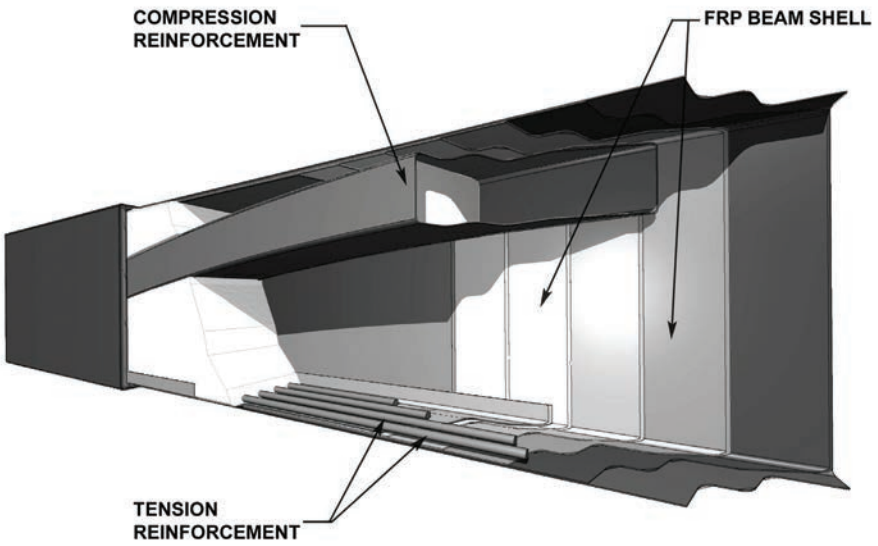


Figure 1: Fragmentary Perspective of Hybrid-Composite Beam

Dr. John J. Myers heads the Missouri S&T research team which is evaluating the in-situ structural behavior of the bridges including behavior during fabrication, transportation and service, displacements under controlled loads, component strains, and thermal behavior as well as examining performance within the bearing-strand anchorage regions. The research team will also be studying the long-term durability of the system as a whole in addition to accelerated durability evaluation of the fiberglass shell component that serves to help protect the internal structural system. The target service life is for this innovative bridge system to have a minimum service life of 100 years. To date, beams for the first HCB Bridge have been successfully fabricated and erected (see Figure 2) on the first bridge in southern Missouri followed by the construction of the bridge deck.

(continued on next page)

Figure 2: Erection of Hybrid-Composite Beams in Douglas County, Missouri

Dr. Glenn Washer leads the Mizzou research team. The objective of the MU research portion is to develop tools for quality control and in-service inspection of the HCB's. The primary nondestructive evaluation (NDE) technology being investigated in the research is infrared thermography, to evaluate the integrity the embedded concrete arch. The cast-in-place concrete arch is a critical load-carrying element of this innovative beam design. However, it is entirely embedded within the composite box section of the beam, and as such is inaccessible for visual inspection. Thermography is being utilized to measure the surface temperatures along the web of the HCB during early concrete hydration, to assess if the thermal signature of the concrete arch, indicates embedded defects. The SCC placed in the arch may be susceptible to voids caused by air entrapped in the narrow arch during the placement process or unanticipated obstructions in the arch void. These voids could reduce the load-bearing capacity of the beam. Voids may also affect the thermal signature of the arch imaged at the beam surface, resulting in anomalies in the thermal image.

Figure 3 shows a thermal image of the end section of a HCB following recent fabrication. The thermal image was taken 24 hours after concrete placement, when the heat of hydration from the concrete creates a thermal signature at the surface of the HCB. The image shows the concrete end block and initial portion of the arch. Safety caps placed on the end of rebar extending out from the beam appear as dark squares on the end block. As shown in the figure, the thermal signature of the embedded arch can be clearly seen.

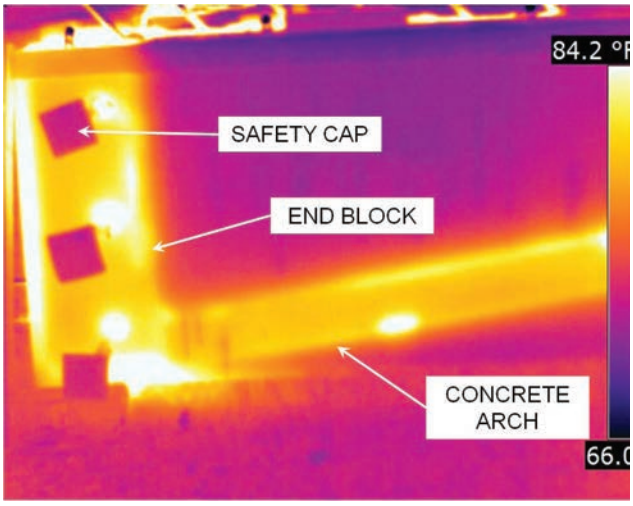


Figure 3: Thermal Image of HCB Showing Concrete Arch and End Block

Tap testing and visual inspection will also be utilized as tools for assessing the condition and performance of the composite shell. Tap testing and infrared thermography are both being utilized to detect delaminations in the composite shell. Visual inspections will be utilized to assess the HCB in service and following planned load testing.
For questions related to this article, please contact the authors, Drs. John Myers and Glenn Washer, at JMyers@mst.edu and Washerg@misouri.edu, respectfully.

Alumni Spotlight:

Vernon Jones

honored by Missouri S&T

On November 12, 2011, more than 300 alumni and friends returned to the Missouri S&T campus for a celebration of its most distinguished graduates. The Miner Alumni Association hosted the event as part of the preparations for the 140th anniversary of the University. A panel of distinguished alumni and campus representatives reviewed more than 300 nominations of alumni who have had the greatest impact on the world.

Mr. Vernon Jones was one of 28 that made the final Alumni of Influence list and was honored at this prestigious event for his lifetime achievements. Mr. Jones endows the Vernon and Maralee Jones chair that the new CTIS Director, Dr. Kamal Khayat, now holds. Mr. Jones endowed the Chair in 1997 as part of the University's Full Circle Campaign. He earned a degree in Civil Engineering from the University in 1953 and is the former president of The Williams Company, an energy and communications company in Tulsa, Oklahoma.

Dr. Khayat attended the Alumni of Influence celebration with Mr. and Mrs. Jones and thier family, including their eldest son,Vernon, Jr. They discussed Dr. Khayat's future plans for leading collaborative research efforts and his vision for expanding the facilities available to researchers on campus in the area of transportation infrastructure.

To read more about the Alumni of Influence event, please visit the Miner Alumni Association's webpage at: http://influence.mst.edu/. Additional background information on Mr. Jones can also be found there.

Taking *the reigns*

Kamal H. Khayat

Dr. Kamal Henri Khayat joined Missouri S&T in August of 2011 as the Vernon and Maralee Jones Professor of Civil Engineering and Director of the Center for Infrastructure Engineering Studies and the Center for Transportation Infrastructure and Safety (CTIS).

Dr. Khayat received his Ph.D. in civil engineering with an emphasis in civil materials from the University of California at Berkeley. He served as Director of the Center of Excellence on Concrete Infrastructure Engineering and Head of the Integrated Research Laboratory on Materials Valorization and Innovative and Durable Structures at the Université de Sherbrooke in Canada. He led a team of 10 researchers to secure the University's largest grant (C$16M) to construct a state-of-the-art research laboratory which was inaugurated in 2009.

He was named the National Science and Engineering Research Council (NSERC) Chair on High-Performance Flowable Concrete with Adapted Rheology in 2008, a consortium re-grouping 17 industrial partners from Canada and the US to develop a new generation of construction materials.

Dr. Khayat has authored and co-authored over 200 technical publications and received several awards for his research and services. He is an active member of ACI, RILEM, and CSA technical committees and chairs ACI 237 (SCC) and RILEM 228 (Mechanical Properties of SCC). He has been involved in organizing and chairing major international conferences in Canada, China, France, Poland, and the United Arab Emirates.

Since his arrival at Missouri S&T, Dr. Khayat has coordinated a major effort involving two partner universities, the University of Illinois at Urbana-Champaign and University of Miami, and a multi-disciplinary research team of 27 faculty members with expertise in eight engineering disciplines. The $3.5M proposal aimed to build upon the past success of CTIS by creating a collaborative vehicle for addressing the complex and growing needs facing the transportation industry, with the ultimate goal of ensuring a sustainable, reliable, and safe national transportation infrastructure.

Dr. Khayat's main goal over the coming years is to foster an atmosphere of inter-disciplinary collaborative research efforts in the field of transportation that will further Missouri S&Ts position as a national leader.

Dr. Khayat would like to recognize the leadership and achievement of Dr. John Myers as the former Interim Director of CTIS. Dr. Myers' knowledge of the CTIS will continue to be a valuable resource to the Center via his new role as Associate Director. Dr. Khayat would also like to acknowledge Dr. John Sheffield, who has agreed to continue his role as Associate Director of CTIS. Dr. Khayat looks forward to working with Drs. Myers and Sheffield to build upon and ensure the continued sucess of this well-established research Center.