A NATIONAL UNIVERSITY TRANSPORTATION CENTER
AT MISSOURI UNIVERSITY OF SCIENCE & TECHNOLOGY

CENTER FOR TRANSPORTATION INFRASTRUCTURE AND SAFETY

ADVANCED MATERIALS, TRANSITION-STATE FUELS AND NON-DESTRUCTIVE TESTING TECHNOLOGIES

First and Second Year Combined Annual Report
July 1, 2006 – June 30, 2007
July 1, 2007 – June 30, 2008

PART A: CORPORATE STYLE ANNUAL REPORT

Submitted by
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Interim Center Director

AUGUST 31, 2008

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Part A: Corporate Style Annual Report

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OVERVIEW: CENTER FOR TRANSPORTATION INFRASTRUCTURE AND SAFETY

Introduction

After two years operating as a National Center (NUTC), the Center for Transportation Infrastructure and Safety (CTIS) has become a Center of Excellence on the theme of advanced materials, transition-state fuel vehicle infrastructure and non-destructive testing technologies.

CTIS has provided the faculty, staff and students at Missouri University of Science & Technology (Missouri S&T) with the means for establishing key relationships with transportation-oriented state and federal agencies and industry partners. With NUTC leverage, the research and development (R&D) projects carried out at Missouri S&T have created the critical mass and the track record necessary to establish a Center of Excellence.

In addition to contributing to successful and relevant R&D projects, CTIS has impacted the quality of education available for engineers and transportation professionals with the development of significant educational resources, equipping engineers with interdisciplinary skills and experiences, and by facilitating the transfer of advanced technology developed within our theme areas. As a result of CTIS activities, new academic programs for educating better-prepared engineers have been created at Missouri S&T and the University has become, and continues to be, the provider of the Local Technical Assistance Program (LTAP) for the state of Missouri.

Since its inception, CTIS has performed work in accordance with its strategic plan to accomplish projected goals in the areas of education, research and technology transfer. CTIS has put forth significant efforts in becoming highly visible and credible in order to recruit and retain quality students, faculty and professionals and make significant contributions in transportation-related fields.

Future

The future activities of CTIS will continue to draw on the capabilities and campus expertise in the areas of advanced materials, transition-state fuel vehicle infrastructure and non-destructive testing (NDT). Partnerships with industry professionals and organizations will be continuously sought out and developed.

In particular, CTIS aims to become the point of reference and preferred partner of industry organizations that have not traditionally been directly involved with transportation-related applications and activities. The intention is to improve the quality and lifespan of existing transportation infrastructure using the broadest-based technology possible and to stimulate the economic viability of U.S. corporations.

Mission and Theme

Mission: The mission of the National University Transportation Center (NUTC) at Missouri University of Science & Technology (Missouri S&T) is to advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research, and technology transfer at university-based centers of excellence.

Theme: To address national needs in the areas of transportation infrastructure and safety focusing on the following topical areas:

- **Advanced materials** including constructed facilities security, which will involve several tasks:
    - The development, manufacture, and application of modern construction materials
    - Installation processes and engineering design
    - Standardization and code approval of products and design protocols
- **Transition-state fuel vehicle infrastructure** leading to a hydrogen economy, which will require two critical tasks, as follows:
    - Development of safety codes, standards, and regulations
    - Infrastructure development and deployment
- **Non-destructive evaluation (NDE) technologies and methods** including monitoring and evaluation of new and repaired structures and system components.

Advanced materials developed for use in the transportation infrastructure offer superior mechanical properties, long-term durability, and design flexibility. Research and development (R&D) in advanced materials address the growing needs for strengthening/rehabilitation of aging structures and for the design/construction of new structures to more stringent requirements and for extended service life. These materials apply to all modes of surface transportation.

Alternative fuel vehicles face the same implementation challenges as that of hydrogen vehicles. Research, development, demonstration, and deployment activities of alternative fuel (including hydrogen) vehicles and supporting infrastructure across all modes of transportation address the growing need for a successful transition to a hydrogen economy.

Recent advances in sensor technologies and NDE techniques offer new methods of non-intrusive, in-situ monitoring of the health, geometric, environmental, and structural characterization of civil structures and their supporting systems. NDE sensor technologies and methods enable more accurate, sensitive, cost-effective, rapid, and straightforward evaluations. Integration of NDE technology to existing and future infrastructure systems will improve network evaluation and enhance the safety of the transportation infrastructure.

The choice of the Center theme comes from an analysis of state and national needs/opportunities, as well as strengths/potential of our institution. We are walking the bridge that connects the transportation infrastructure of the second millennium to that of the third millennium. The existing infrastructure was conceived to support vehicular traffic powered by fossil fuel and has

dramatic shortcomings in terms of durability and congestion. But the future will be an intelligent infrastructure incorporating advances in information technology and supporting a new generation of alternative fuels up to an ending point that is conceivably hydrogen with all the associated challenges in terms of safety, deployment, and market acceptance.

Missouri S&T has determined that it is of critical importance to its own mission and future as well as the economical success of the state of Missouri to focus on advanced materials in order to: a) help with the upgrade and maintenance (including security hardening) of the existent infrastructure; and, b) contribute to the development of the new infrastructure. Similarly, NDE methods and techniques are a core area of expertise at Missouri S&T and their development and deployment will help society with the health monitoring of the existing infrastructure and will become integral part of the new infrastructure to ensure its acceptance and safety. Finally, the Center will tackle the challenge of alternative fuels (including hydrogen) in a systematic approach as the only viable methodology for the safe deployment of the new form of transportation.

MANAGEMENT STRUCTURE

This section presents an overview of the Center's management structure and staff, those individuals whom actively contribute to the functioning of Center activities, as well as information about the composition and purpose of the Research Advisory Board.

Center Staff

In addition to the Interim Director, the following individuals have actively contributed to the management/operation of the Center: one associate director, four office staff persons and three laboratory staff persons. The Research Scholar laboratory staff position is currently open.

FY 2: 2007 – 2008

Name	Title	Address/Phone/Fax/E-mail	Responsibilities
Myers, J. J.	Interim Director	325 Butler-Carlton Hall, Rolla MO 65409 573-341-6618/6215 jmyers@mst.edu	Management of the Center
Sheffield, J.	Associate Director	331 Toomey Hall, Rolla MO 65409 573-341-6073/4607 sheffld@mst.edu	Research activities
Spitzmiller, G.	Admin. Assistant	221 ERL, Rolla MO 65409 573-341-7170/6215 spitz@mst.edu	Administration and accounting
Sherman, A.	Senior Secretary	222 ERL, Rolla MO 65409 573-341-7884/6215 abigayle@mst.edu	Clerical support/ student appointments
Geisler, C.	Secretary	223 ERL, Rolla MO 65409 573-341-4497/6215 geislerc@mst.edu	Clerical support
Dafni, J.	Technical Editor	220 ERL, Rolla MO 65409 573-341-7848/6215 dafnij@mst.edu	Publications/website
Open Position	Research Scholar	218 ERL, Rolla MO 65409 573-341-6223/6215	Research activities/mentoring
Cox, J.	Sr. Research Specialist	G-8 ERL, Rolla MO 65409 573-341-6742/6215 coxjn@mst.edu	Laboratory and field testing/coordination
Hernandez, T.	Lab/Research Technician	G-8 ERL, Rolla MO 65409 573-341-7895/6215 travi@mst.edu	Laboratory testing/ equip. maintenance

FY 1: 2006 – 2007

Name	Title	Address/Phone/Fax/E-mail	Responsibilities
Myers, J. J.	Interim Director	325 Butler-Carlton Hall, Rolla MO 65409 573-341-6618/6215 jmyers@umr.edu	Management of the Center
Sheffield, J.	Associate Director	331 Toomey Hall, Rolla MO 65409 573-341-6073/4607 sheffld@umr.edu	Research activities
Spitzmiller, G.	Admin. Assistant	221 ERL, Rolla MO 65409 573-341-7170/6215 spitz@umr.edu	Administration and accounting
Sherman, A.	Senior Secretary	222 ERL, Rolla MO 65409 573-341-7884/6215 abigayle@umr.edu	Clerical support/ student appointments
Geisler, C.	Secretary	223 ERL, Rolla MO 65409 573-341-4497/6215 geislerc@umr.edu	Clerical support
Massmann, R.	Editorial Assistant	220 ERL, Rolla MO 65409 573-341-7848/6215 massmann@umr.edu	Clerical activities/ publications
Galati, N.	Research Scholar	218 ERL, Rolla MO 65409 573-341-6223/6215 galati@umr.edu	Research activities/mentoring
Cox, J.	Sr. Research Specialist	G-8 ERL, Rolla MO 65409 573-341-6742/6215 coxjn@umr.edu	Laboratory and field testing/coordination
Hernandez, T.	Lab/Research Technician	G-8 ERL, Rolla MO 65409 573-341-7895/6215 travi@umr.edu	Laboratory testing/ equip. maintenance

Research Advisory Board

A Research Advisory Board (RAB) has been assembled to advise the Center director on management procedures and with adherence to a specific merit criteria review in the research project funding selection process. The RAB considers a proposed research project's intellectual merit: to what extent it advances knowledge and understanding within the Center's theme areas; and a proposed research project's potential impacts: how the results will be disseminated and what groups will receive the information.

Members of the RAB were selected based on personal accomplishments, background, and affiliations on a regional and national level. The RAB is representative of all disciplines and departments covered by the Center's theme and can effectively guide the Center's course. The following people comprise the Center's RAB:

- Mara Campbell, MoDOT, R&D Division
- William P. Chernicoff, USDOT-RITA, National Level Hydrogen Rep., ex-officio
- Peter J. Clogston, FHWA Division Bridge Engineer
- William R. Cox, TxDOT State Bridge Engineer

- Mary Davis, Missouri Enterprise, President and Chief Executive Officer
- Dennis Heckman, MoDOT State Bridge Engineer
- John Lapetz, Ford Motor Company, Research Hydrogen Engineer, Industry
- Barney T. Martin, Ph.D., Modjeski & Masters Engineers, Designer, NY Office
- Jim Myers, Coreslab Structures Inc., Fabricator-Producer
- John J. Myers, Ph.D., Center Director, Missouri S&T, ex-officio
- Bonnie Prigge, Meramec Regional Planning Commission, Assistant Director
- Angie Rolufs, Missouri Transportation Institute (MTI), ex-officio
- John Sheffield, Ph.D., Center Associate Director, Missouri S&T, ex-officio

The next meeting of the Research Advisory Board is scheduled for October 24, 2008.

With the objective of further broadening the perspective of the RAB, representatives from a District DOT, the Structures Division at FHWA and a DOT representative from outside the State of Missouri are expected to be added before the RAB's October meeting. The proposed additions are summarized as follows:

- Research Structural Engineer (Structures Division), FHWA, TBA
- State Engineer, Department of Transportation, TBA
- District Engineer, MoDOT, TBA

OVERVIEW OF EDUCATION, RESEARCH, AND TECHNOLOGY TRANSFER PROGRAMS

This section presents a summary and an overview of all projects awarded in Year I (2006-2007) and Year II (2007-2008).

Research Projects: Year II

R231—Graduate Research Training in Transportation Areas: Year 3 funds
[Myers, J., PI- Missouri S&T, new in this reporting period]

The objective of this project is to increase the number of students who will pursue teaching and research careers in transportation areas.

This project is aimed at graduate research training of students interested in pursuing careers in transportation areas. Financial support will be provided to recruit eight new graduate students interested in pursuing their doctoral degrees in transportation areas each year. These students can pursue doctoral studies in any department at Missouri S&T. In departments where a master's degree is the highest degree awarded, students pursuing their master's degree with a thesis option will be considered. Areas of research pertaining to the goals, interests and objectives of State Departments of Transportation and Missouri Department of Transportation in particular will be considered for support in this project.

R230—Coaxial Cable Sensors and Sensing Instrument for Crack Detection in Bridge Structures – Phase 1: Field Qualifications/Validation Planning
[Chen, G., PI- Missouri S&T, new in this reporting period]

The objectives of this project are to pre-test analyze a decommissioned RC bridge, selected in consultation with the New York State Department of Transportation (NYSDOT), and to design and plan field tests of the bridge for performance qualification and validation of distributed crack sensors and a fast Electrical Time Domain Reflectometry instrument.

This project is aimed at developing a field test plan and methodology for the purpose of demonstrating a new structural condition assessment technology. The research tasks are: selection of a decommissioned bridge; pre-test analysis of the selected bridge structure to evaluate its progressive damage and determine the locations for sensor deployment; design and planning of field tests of the select bridge; and a summary of the findings of this study.

R228—Structural Assessment of Highway "N" Power Substation Under Earthquake Loads
[Chen, G., PI- Missouri S&T, new in this reporting period]

The objective of this project is to evaluate the seismic vulnerability of the highway "N" power substation under earthquake loads, through both numerical analysis and experimentation. The results derived from the study will be applicable in the performance assessment of other substations.

Tasks include two major components: seismic analysis and evaluation of substation performance and shake table tests of critical non-structural components such as rigid bus connectors. Each major task can be completed in approximately one year.

R227—A Laboratory Investigation on Three-Sided Structures
[Belarbi, A., PI- Missouri S&T, new in this reporting period]

The objective of this project is to assess the new design of a three-sided bridge structure, such as a culvert, through laboratory and analytical investigation.

Egyptian Concrete Co. has recently developed three-sided precast concrete box culverts which adopted the advantages of flat-top and arch-top box culverts: (1) easy and low cost of manufacturing of flat-top culverts and (2) capability of relatively long span of arch-top culvert. The walls and slab of the three-sided culverts have been designed to resist the bending moment and shear force developed by the following loads: (1) dead load of soil top cover, (2) self-weight, (3) lateral earth pressure and (4) live load from traffic. However, the structural performance and efficiency, as compared to other types, has not yet been evaluated. Therefore, the structural performance of the three-sided box culverts developed by Egyptian Concrete Co. will be evaluated in this research project through experimental and analytical investigations.

R225—Adding Faculty in Transportation Areas: Year 2 & 3
[Collier, H., PI- Missouri S&T, new in this reporting period]

The objective of this project is to increase the number of faculty performing research and teaching in the broad areas of transportation.

Over the course of five years, departments at Missouri University of Science & Technology will build a strong base of faculty in the transportation field. Broad, interdisciplinary areas relating to the NUTC mission, research areas and theme as well as other areas that relate to State Departments of Transportation, and MoDOT in particular, as stated in their goals, interests, and objectives will be considered as new faculty are recruited.

R223—Geophysical Investigation of Seepage Associated with the Lake Sherwood Earth Fill Dam
[Anderson, N., PI- Missouri S&T, new in this reporting period]

The objective of this project is to use electrical resistivity tomography and self-potential tools to characterize select areas of the earth fill dam/roadway. The electrical resistivity tool will be used to map the top of bedrock, especially in proximity to the key on the east side of the dam, where seepage is believed to be occurring.

Missouri S&T will acquire electrical resistivity tomography data and self-potential data at selected locations on the Lake Sherwood earth fill dam. These geophysical data will be processed, analyzed and interpreted with the objective of locating and mapping seepage pathways that might compromise the integrity of the earth fill dam. The main project deliverable will be a map showing the location of the key and identified seepage pathways.

R222—Rolla West Task 2, I-44 Interchange Master Plan – Sub consultant services to HNTB
[Rolufs, A., PI- MTI, new in this reporting period]

The objective of this project is to provide support to HNTB as they complete Task 2 – I-44 Interchange Master Plan for the City of Rolla.

Investigators will provide support to HNTB as they complete the following tasks: data collection, including aerial photography, zoning and real estate assessment information; alternatives workshop, including stakeholder input on alternatives, land use recommendations and conceptual transportation infrastructure recommendations; identification of funding sources, including government agencies, local businesses and developers; and final plan preparation based on the information received through these processes.

R221—Investigation of subsidence along segment of MO Rte 65, Springfield, Missouri
[Anderson, N., PI- Missouri S&T, new in this reporting period]

The principal objective of this project is to determine whether the roof rock beneath the affected segment of roadway failed along a pre-existing clay-filled solution-widened joint. If so, MoDOT will probably inject grout into the solution-widened joint in order to stop the piping of fine-grained sediment from beneath the roadway. Injection boreholes will be cited on the basis of geophysical interpretations.

Gradual roadway subsidence has been observed along a segment of MO Route 65 in Springfield, Missouri. The affected segment of roadway overlies an underground limestone mine. The roof of this limestone mine, immediately beneath Route 65, has partially collapsed along what has been interpreted as a solution-widened joint. Ground water, with significant quantities of clay, is currently entering the mine through exposed fractures in the roof rock. This piping of fine-grained sediment is thought to be responsible for the observed roadway subsidence. Further non-invasive investigation of the roof rock in the affected area is required in order to determine if failure did in fact occur along a solution-widened joint.

R219—Concrete Durability Factor Estimation
[Richardson, D., PI- Missouri S&T, new in this reporting period]

The objective of this project is to establish a relationship between the concrete Durability Factor (DF) and various quickly-determined factors of which DF is a function, such as aggregate characteristics, mix proportions, as-delivered w/cm, air content, air void system, and early-age strength.

Current testing procedures to ensure concrete pavement meets acceptable specifications can take 75 days or more. The lengthy testing process and on-site sampling procedures in place have the potential to either dramatically slow the construction process while waiting for results or the risk of completing a portion of the project with concrete which is out of specification. This project proposes to develop a simple equation which would allow construction inspectors to compute an approximation of the DF within a short time after sampling. The approximation would alert the inspector when concrete might have durability problems.

Research Projects: Year I

R218—Quick Test for Percent of Deleterious Material
[Richardson, D., PI- Missouri S&T, new in this reporting period]

The objective of this project is the establishment of a relationship between MoDOT's Deleterious Materials Test (TM 71) and various quickly-determined objective tests which would cover the controlling behavior factors that the deleterious materials method represents.

MoDOT has expressed interest in replacing its deleterious materials test method (TM 71) with something more objective. In response to an RFP issued by MoDOT, it is proposed to develop a system of standard tests which would replace the deleterious test. The system would be comprised of one or more aggregate tests, depending on the outcome of the testing.

R214—Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Construction: Year 2 Funds
[Wang, J., PI- Missouri S&T, new in this reporting period]

The overall objective of this project is to help the construction industry and the energy industry in selecting the appropriate types of fly ashes for road construction and other beneficial use applications. Specifically, this research will: (1) generalize the leaching behavior of major oxyanionic elements for various fly ashes (generated from different coal sources and/or different power generation process – NOx and mercury control); (2) understand the leaching mechanisms of oxyanionic elements for different ashes (as effects of pH, ash type, ash composition, ammonia, activated carbon, presence of other trace elements, etc.; and (3) quantify the leaching behavior of oxyanionic metals under various leaching conditions.

The use of coal fly ash in road base and sub-base applications can provide better properties and performance, and is superior to it being otherwise disposed of and becoming a possible environmental liability. Understanding the metal leaching behavior for various fly ashes can help the construction industry and the energy industry in selecting the environmentally benign fly ash for road construction and for other beneficial use applications, and determining the long term environmental impact of fly ash during road construction. This research will focus on the leaching behavior of 6 major oxyanionic elements, antimony, arsenic, boron, chromium, molybdenum, and selenium, for various fly ashes under different management scenarios, using both batch and column experiments. Mathematical models will be developed to quantify the leaching behavior of these elements. Speciation of these oxyanionic elements will be determined using the most advanced Perkin-Elmer HPLC-ICP-MS system available at Missouri S&T.

R213—Structural Assessment of Highway "N" Power Substation under Earthquake Loads
[Chen, G., PI- Missouri S&T, new in this reporting period]

The objective of this project is to evaluate the seismic vulnerability of the highway "N" power substation under earthquake loads, through both numerical analysis and experimentation. The results derived from the study will be applicable in the performance assessment of other substations.

Tasks include two major components: seismic analysis and evaluation of substation performance and shake table tests of critical non-structural components such as rigid bus connectors. Each major task can be completed in approximately one year.

R211—Pultruded Composites Using Soy-Based Polyurethane
[Chandrashekhara, K., PI- Missouri S&T, new and completed in this reporting period]

The objective of this project is the development and performance evaluation of pultruded soy-based polyurethane composite panels.

Fiber Reinforced Polymer (FRP) composites offer inherent advantages over traditional materials with regard to high strength-to-weight ratio, design flexibility, corrosion resistance, low maintenance, and extended service life. FRP materials can be used to replace traditional building materials like steel and wood. Application of composite materials will reduce cost and improve durability. One of the major cost drivers for composites is raw materials. Use of soybean-derived materials offers low cost raw materials. Soy-based polyurethane (PU) resin offers several benefits such as improved properties, faster production, and reduced VOC emissions. Missouri University of Science and Technology (Missouri S&T) is collaborating with United Soybean Board (USB) to develop soy-based PU pultruded products for affordable housing and other commercial applications. Solid and core-filled pultruded parts will be manufactured at Missouri S&T and the performance of these products will be evaluated. Based on the test results, the resin chemistry will be modified to achieve improved structural performance and also to incorporate more soy content in the formulation without property degradation.

R210—Freight Optimization & Development in Missouri – Waterways and Ports Module
[Grasman, S., PI- Missouri S&T, new and completed in this reporting period]

The ultimate objective of this research is to develop a freight and logistics development model for Missouri that initially focuses on ports and waterways but then is transferable to other modes. This model will reflect commodity and goods movements and needs, port infrastructure and resource needs, and structural and business relationships necessary to further capture waterway potential. The model is expected to provide decision support for prioritized investment and development decisions related to the increased freight and logistics development in Missouri.

The stage is set for Missouri to become a national freight center. The geographic centrality of the state; the transportation system including waterways, rail, air and highways; along with the presence of major commodity production and transfer systems beg the questions: “What can Missouri and MoDOT do to ensure that we capitalize on these resources and circumstances? How can Missouri become the national freight center that the state appears ready for?” And considering the international dynamics, “What should Missouri do to position itself to ensure we can link to and draw from international changes? Where should Missouri position itself to capitalize on the recently approved expansion of the Panama Canal, increasing manufacturing capability and freight movement from India, and severe congestion issues impacting deep-water ports such as Long Beach, California? Further, what can we learn from these international developments and use in Missouri?”

R209—Serviceability and Prestress Loss Behavior of SCC Prestressed Concrete Girders Subjected to Increased Compressive Stresses at Release
[Myers, J., PI- Missouri S&T, new in this reporting period]

The objective of this project is to examine the serviceability and prestress loss behavior of self consolidated concrete (SCC) members subjected to increased compressive stresses at release. The effects of variable stress levels on losses and camber prediction will be investigated both experimentally and analytically.

There are limited measurements documented in literature related to long-term prestress losses in SCC members. Recorded test data has shown variations in mechanical property behavior of SCC compared to conventional high strength concrete (HSC) mixtures in the 8-12 ksi range. Over the past year, precast manufacturers such as Coreslab Structures, Inc., in Marshall, MO have experienced inconsistencies in camber behavior with SCC which may be attributed to mechanical property variations, but variation in stress may also be a contributing factor. Additionally, increasing the allowable fiber stress limit is desired for full utilization of materials and members, as long as structural performance is maintained. Accurate prediction of time-dependant prestress losses is essential for determination of the effective prestress force, which effects serviceability prediction and structural performance.

R208—Mechanical Characterization of Enamel Coated Steel Bars
[Chen, G., PI- Missouri S&T, new in this reporting period]

The objectives of this study are to demonstrate that enamel-coated steel bars are comparable to conventional steel bars in mechanical properties and that they are superior to epoxy bars in field handling and less susceptible to impact damage.

Steel bars can be coated with enamels or glass to reduce or eliminate the tendency of steel corrosion in various applications, such as reinforced concrete (RC) decks, beams and columns. The chemical bond between enamel and steel materials is a key to making an enamel-coated steel corrosion free. Therefore, it is essential to characterize the mechanical and bonding properties of enamel-coated steels. To show competitiveness, the performance and cost of enamel-coated steel bars must be comparable with those of current technology, such as epoxy reinforcing steel bars.

R207—Concrete Crack and Spalling Detection in a 6.1-meter Precast RC Piles with Novel Distributed Cable Sensors and ETDR Measurement
[Chen, G., PI- Missouri S&T, new and completed in this reporting period]

The objective of this project is to field validate the effectiveness of distributed crack sensors for concrete crack and spalling detection and to further develop distributed cable sensors for real-time crack monitoring of structures. The project will also serve as a demonstration of new technology to practitioners.

Five sensors will be designed, fabricated and installed into five full-scale precast piles. Tests will be conducted at the University of California, San Diego and afterwards, data will be processed and interpreted, resulting in a final report.

R204—Show Me the Road to Hydrogen
[Sheffield, J., PI- Missouri S&T, new in this reporting period]

The objective of this project is to tackle the challenge of safe deployment of alternative fuels (including hydrogen) through a broad research, training, and education agenda to develop a rural hydrogen transportation test bed for developing, demonstrating, evaluating, and promoting hydrogen-based technologies in a real-world environment.

The Missouri University of Science and Technology (Missouri S&T) and Ford Motor Company will demonstrate a commuter bus service and hydrogen refueling at a station in rural Missouri near Fort Leonard Wood (FLW). Initiated by a request from the U.S. Army Maneuver Support Center (MANSCEN) at FLW, Missouri S&T is helping to establish a commuter service between FLW and the neighboring towns of Rolla and Lebanon, each of which are located about 25 miles from the military base on Interstate-44. With funds provided by the Defense Logistics Agency through the Air Force Research Laboratory, this hydrogen initiative is seeking a partnership with an energy supplier to build and operate a hydrogen fueling facility that includes on-site generation of hydrogen through electrolysis as well as selling a range of other traditional and alternative fuels.

R203—Graduate Research Training in Transportation Areas Year 2
[Myers, J., PI- Missouri S&T, new in this reporting period]

The objective of this project is to increase the number of students who will pursue teaching and research careers in transportation areas.

This project is aimed at graduate research training of students interested in pursuing careers in transportation areas. Financial support will be provided to recruit eight new graduate students interested in pursuing their doctoral degrees in transportation areas each year. These students can pursue doctoral studies in any department at Missouri S&T. In departments where a master's degree is the highest degree awarded, students pursuing their master's degree with a thesis option will be considered. Areas of research pertaining to the goals, interests and objectives of State Departments of Transportation and Missouri Department of Transportation in particular will be considered for support in this project.

R202—Geophysical Characterization of Tunnel Construction Site, Louisville, Kentucky
[Anderson, N., PI- Missouri S&T, new in this reporting period]

The objective of this project is to use electrical resistivity and refraction tomography tools to image the subsurface along the length of the proposed Louisville, Kentucky tunnel.

Missouri S&T proposes to acquire electrical resistivity and refraction tomography at the KDOT tunnel site, Louisville, Kentucky. These geophysical data will be processed, analyzed and interpreted with the objective of mapping and characterizing soil and bedrock at this construction site. The main project deliverables will be a suite of maps and geologic cross-sections depicting variations in soil thicknesses and lithology and rock quality. Maps showing the locations and orientations of solution-widened joints and other potential engineering hazards will also be presented.

R201—Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Construction: Year 1 Funds
[Wang, J., PI- Missouri S&T, new in this reporting period]

The overall objective of this project is to help the construction industry and the energy industry in selecting the appropriate types of fly ashes for road construction and other beneficial use applications. Specifically, this research will: (1) generalize the leaching behavior of major oxyanionic elements for various fly ashes (generated from different coal sources and/or different power generation process – NOx and mercury control); (2) understand the leaching mechanisms of oxyanionic elements for different ashes (as effects of pH, ash type, ash composition, ammonia, activated carbon, presence of other trace elements, etc.; and (3) quantify the leaching behavior of oxyanionic metals under various leaching conditions.

The use of coal fly ash in road base and sub-base applications can provide better properties and performance, and is superior to it being otherwise disposed and becoming a possible environmental liability. Understanding the metal leaching behavior for various fly ashes can help the construction industry and the energy industry in selecting the environmentally benign fly ash for road construction and for other beneficial use applications, and determining the long term environmental impact of fly ash during road construction. This research will focus on the leaching behavior of 6 major oxyanionic elements, antimony, arsenic, boron, chromium, molybdenum, and selenium, for various fly ashes under different management scenarios, using both batch and column experiments. Mathematical models will be developed to quantify the leaching behavior of these elements. Speciation of these oxyanionic elements will be determined using the most advanced Perkin-Elmer HPLC-ICP-MS system available at Missouri S&T.

R200—Development of Teaching Material to Integrate GT-POWER into Combustion Courses for IC Engine Simulations
[Koylu, U. PI- Missouri S&T, new in this reporting period]

The main objective of this project is to develop instructional engineering projects that will utilize the newly-offered PACE software GT-POWER for engine simulations in combustion-related courses at the Missouri University of Science & Technology (Missouri S&T). Students will team up to perform modeling of engine performance and emission characteristics so that they can learn state-of-the art engine technology and explore innovative design procedures routinely employed by the leading automotive companies. This will help bridge the gap between the theoretical and simple concepts learned by students in the classroom and the practical and advanced skills desired by industry.

The utilization of simulation software will be extended into alternative fuels, including hydrogen and ethanol. In particular, exploration and demonstration of hydrogen engine combustion and addressing safety issues as well as the necessary codes and standard for this new technology will be undertaken.

R198—Development of Hand-Held Thermographic Inspection Technologies
[Washer, G., PI-UMC, new in this reporting period]

The goal of this project is to provide maintenance and inspection personnel with an effective tool for detecting and monitoring concrete deterioration without disrupting traffic flow.

Subsurface deterioration in concrete structures presents a significant challenge for inspection and maintenance engineers. Cracking, delaminations and spalling that can occur as a result of corrosion of embedded reinforcing steel can lead to pot holes and even punch-through in concrete decks. For overpass bridges, concrete can separate from the structure and fall into traffic below the bridge, resulting in numerous deadly accidents. Although this deterioration can frequently be detected using hammer sounding and/or chain dragging, these inspection techniques require hands-on access to the surface of the concrete. For both overpass bridges and decks, lane closures are required to gain access to the structure. The resulting traffic disruptions make inspections expensive and logistically difficult. The proposed research would explore the use of hand-held infrared cameras for the remote detection of deterioration in concrete. This technology could reduce the need for lane closures and improve the ability of inspection and maintenance personnel to detect and monitor deterioration in its embryonic stages, such that maintenance procedures can be employed before deterioration becomes critical. The technology can also be used to monitor and improve concrete repairs by rapidly identifying the extent of deterioration and locating its boundaries.

R197—Design of FRP Systems for Strengthening Concrete Girders in Shear Phase II
[Belarbi, A., PI- Missouri S&T, new in this reporting period]

The objective of this project is to develop design methods, specifications, and examples for design of FRP systems for strengthening concrete girders in shear.

FRP systems have been used on a project-specific basis for the last two decades. They are now becoming a widely accepted method of strengthening concrete structures. The acceptance and utilization of these new strengthening techniques depend on the availability of clear design guidelines, installation procedures and construction specifications. Standard specifications exist for all commonly used traditional materials in civil engineering structures. At this time, design specifications for FRP use are still under development. The results of several experimental investigations have shown that FRP systems can be effective for increasing ductility and strength to structural members such as columns and girders. As most of the research focused on strengthening of axial members of flexural members, there are less experimental and analytical data on the use of FRP systems for shear strengthening of girders. Shear strengthening with FRP is still under investigation and the results obtained thus far are scarce and sometimes controversial. Even in traditional reinforced concrete members without FRP, the shear design is a complex challenge and uses more empirical methods as compared to axial and flexural design methods. Adding FRP to the equation, with its specific design issues, would bring another level of complication in the design. These FRP-related shear design issues and lack of comprehensive analytical and experimental models are the main motivation for this research project. Thus, a thorough understanding of the shear design problem along with the development of an AASHTO design method for FRP shear strengthening of concrete girders are needed.

R195—Long-Term Remote Sensing System for Bridge Piers
[Washer, G., PI-UMC, new in this reporting period]

The objective of the project is to develop a targeted health monitoring system intended to detect and measure tilt and vertical displacement/settlement conditions of bridge columns and piers through a high-density sensor network.

Scour and other natural hazards have the potential to undermine the stability of piers in highway bridges. This has led to bridge collapse in the past; significant efforts have been undertaken to address the potential danger of scour and other hazards. However, there remains a lack of reliable, cost-effective, long-term monitoring devices capable of determining the structural stability of bridge piers. Research and development proposed within this project is intended to develop a unique and robust monitoring system for highway bridge piers. This system will be designed to measure changes in tilt and vertical displacement of bridge piers using an array of low-cost sensors mounted on the bridge pier and superstructure. Signal processing correlation algorithms will be developed that use sensor density and location to better measure long-term bridge rotations and displacements. The use of a high-density sensor array will provide a redundant, autonomous and stable measurement system. Unique and innovative aspects of the proposed system include 1) the ability to measure vertical displacement of a pier that may occur without tilt, and 2) special signal processing algorithms that will reduce temperature and drift problems common to long-term monitoring systems, and 3) the implementation of a redundant sensor array to reduce costs and increase long-term system reliability. The prototype system will be tested in cooperation with the New York State Department of Transportation.

Research Equipment Projects: Year I

RE206—Leica ScanStation LiDAR Unit
[Maerz, N., PI- Missouri S&T, new and completed in this reporting period]

The objective of this project is to purchase a LiDAR (Light Detection and Ranging) unit to generate external funding in many diverse areas.

The investigators will initially seek funding from NSF, transportation agencies, and emergency management agencies for studies on rock cut raveling, movement of highway embankments, and architectural reconstruction. It will be used in measuring bridge deflection during load tests. The Natural Hazards Mitigation Center will use it for forensic investigations of transportation infrastructure damaged by natural hazards. Further applications will be funded from homeland defense initiatives on blast resistance of bridges and tunnels. The use of LiDAR will be revolutionary in the field of geology, geological, civil, and architectural engineering.

Education and Technology Transfer Projects: Year II

ETT229—2008 Summer Transportation Institute
[Pickerill, H., PI-Missouri S&T, new in this reporting period]

The objective of this project is to provide an educational experience which explores all aspects of the transportation industry and its role in our society for rising 10th, 11th and 12th grade high school students in a 4-week intensive summer session.

The Missouri University of Science & Technology has hosted a USDOT Summer Transportation Institute (STI) for several years. The program is primarily targeted toward minority students, but does not limit attendance, and includes a course available for college credit. The overarching

goals are to increase the number of youths entering the transportation profession with mathematics, science, and technological enrichment and to aid the university in its recruiting efforts through exposure and participation in a series of academic and practical experiences and a healthy dose of campus life.

ETT226—American Concrete Institute 2008 Fall Conference: Sponsorship and Student Training
[Myers, J., PI-Missouri S&T, new in this reporting period]

The objective of this project is two-fold: a) to provide concrete related education and training for Missouri S&T graduate students working in the concrete field and, 2) to expose our NUTC to the nation in the area of structural concrete and concrete materials.

The national American Concrete Institute Fall Conference will be held in St. Louis, Missouri on November 2nd– 6th, 2008. This educational and outreach activity will provide sponsorship to the conference and provide an opportunity for Missouri S&T graduate students with the ability to attend the conference. The ACI Convention will provide the graduate students the opportunity to learn and give input on concrete industry codes, specifications, and guides undertaken in some of the 300+ committee meetings. The ACI Convention also provides a forum for networking, learning the latest in concrete technology and practices. Additionally, there will be over 35 technical and educational sessions open for the students to attend and gain valuable information. The past conference of this series attracted over 1,200 participants, making the 2008 Convention a viable venue to continue exposing our NUTC to the nation in the area of structural concrete and concrete materials.

ETT224—Outreach for the Missouri University of Science & Technology University Transportation Center
[Rolufs, A., PI-MTI, new in this reporting period]

The goal of this comprehensive outreach program is to provide opportunities for students and faculty members to engage with leaders in the transportation industry from: private consulting and construction firms; the Missouri Department of Transportation (MoDOT); other state departments of transportation; Federal Highway Administration (FHWA); local government agencies; and other university-based transportation centers while also creating technology transfer opportunities in support of the projects undertaken through the Missouri S&T NUTC.

Outreach efforts will fall within the following areas:

1. Coordination of transportation research for MoDOT and MTI in the theme areas of: Structures, Geotechnical, and Environmental Sustainability & Energy Efficiency

2. Annual Transportation Conference Planning focused on CTIS theme areas

3. Monthly Seminars/Lecture Series

4. Partnerships with Industry, MoDOT, US DOT, other state DOTs, and local government agencies

ETT220—Missouri Local Technical Assistance Program (LTAP) at Missouri S&T Year 2
[Rolufs, A., PI-MTI, new in this reporting period]

The objective of this project is to manage the Missouri LTAP program for the Missouri Department of Transportation. The LTAP program was established by the Federal Highway Administration (FHWA) in 1982 and operates in each state to provide community leadership through advocacy and implementation of education and training.

The Missouri LTAP program will provide a resource center and technology transfer activities for local officials, counties, parishes, townships, cities and towns throughout the state of Missouri in the form of: workforce development services; resources to enhance safety and security; solutions to environmental concerns, congestion, capacity and other issues; technical publication; and training videos and materials.

ETT216—Women in Science & Engineering and Minority Engineering Scholarships: Year 3
[Elmore, C., PI- Missouri S&T, new in this reporting period]

The objective of this project is to make scholarships available to minority and women students interested in engineering and science and will increase significantly the number of minority and female students that Missouri S&T can recruit to its science and engineering programs. Recipients of scholarships will also be exposed to career opportunities in transportation.

Women in Science and Engineering (WISE) scholarships are awarded to support female Missouri S&T students studying science and engineering. Missouri S&T's WISE program provides a campus focal point for increasing the number of women in science, engineering, math, and technology fields through outreach, recruitment, and retention efforts from middle school age through undergraduate levels. WISE provides support programs such as mentoring, advising, professional/technical workshops, and social activities, with the goal of providing a rich academic and social experience for young women at Missouri S&T.

Minority Engineering and Science Program (MEP) scholarships provide critical financial support for under-represented students majoring in engineering and science programs at Missouri S&T. MEP scholarship students receive professional and academic support through the close-knit MEP network of friends, mentors and Missouri S&T staff. MEP has a rich 30 year tradition of sponsoring events, activities and organizations that ensure its students are prepared for personal and professional success.

Education and Technology Transfer Projects: Year I

ETT217—GeoMO 2008 – Geotechnical Earthquake Engineering – Site Response
[Luna, R., PI- Missouri S&T, new in this reporting period]

The objective of this project is to present a seminar led by top academics to promote our Transportation Geotechnics Research ties with the Missouri Department of Transportation and inform the Midwest civil engineering community about perceived risks and new code requirements around seismic threats.

This course will include a full day of lectures, extensive references, notes and pictorial examples of up-to-date methods in geotechnical earthquake engineering and site response. Participants from the geotechnical and structural engineering communities will have the opportunity to get answers to questions which frequently arise in new or retrofit engineering projects related to site response.

ETT215—Outreach Activities in Support of the Missouri S&T National UTC
[Rolufs, A., PI- Missouri S&T, new in this reporting period]

The goal of this comprehensive outreach program is to provide opportunities for students and faculty members to engage with leaders in the transportation industry from: private consulting and construction firms; the Missouri Department of Transportation (MoDOT); other state departments of transportation; Federal Highway Administration (FHWA); local government agencies; and other university-based transportation centers while also creating technology transfer opportunities in support of the projects undertaken through the Missouri S&T NUTC.

Outreach efforts will fall within the following areas:

1. Coordination of transportation research for MoDOT and MTI in the theme areas of: Structures, Geotechnical, and Environmental Sustainability & Energy Efficiency

2. Annual Transportation Conference Planning focused on CTIS theme areas

3. Monthly Seminars/Lecture Series

4. Partnerships with Industry, MoDOT, US DOT, other state DOTs, and local government agencies

ETT212—6th National Seismic Conference on Bridges and Highways, Charleston, South Carolina, July 27-30, 2008
[Chen, G., PI- Missouri S&T, new and completed in this reporting period]

The objective of this project is to expose the NUTC at Missouri S&T to the engineering and research communities in the area of extreme loads and effects.

The theme of the 6th National Seismic Conference on Bridges and Highways is “Seismic Technologies for Extreme Loads.” The past conference of this series attracted over 400 participants from various Departments of Transportation and academies. This conference will be a viable venue to continue exposing the NUTC at Missouri S&T to the nation in the area of extreme loads and effects through a Platinum Sponsorship and advertisements in conference publications.

ETT205—Preparing for a Significant Central U.S. Earthquake: Science Needs of the Emergency Response Community
[Anderson, N., PI- Missouri S&T, new in this reporting period]

The objective of this project is to facilitate relevant science in preparation for a significant Central U.S. earthquake; the Missouri University of Science & Technology (Missouri S&T), the U.S. Geological Survey (USGS), and the Missouri Department of Natural Resources are hosting a workshop to bring scientists together with the first response community. The workshop will specifically address: 1) existing research that describes what is known about the probability of a significant Central U.S. earthquake; and 2) current monitoring efforts and research.

The New Madrid and Wabash Valley seismic zones are capable of producing large magnitude earthquakes that could cause significant damage and interrupt the east to west flow of transportation, communication, electricity, natural gas and oil across the central United States. A large magnitude quake also could disrupt the movement of coal, fertilizer, or agricultural products to and from ports along the middle Mississippi and lower Ohio Rivers as well as disrupt the lives of countless residents of the Central U.S. The USGS and the Center for Earthquake Research and Information of the University of Memphis estimate that for a 50-year period, the probability of a repeat of the 1811-1812 earthquake (magnitude 7.5-8.0) is 7-10 percent, and the probability of a magnitude 6.0 or larger is 25-40 percent. Unlike earthquakes that occur in southern California, the causes and effects of earthquakes in the central and eastern United States are just beginning to be understood. In addition, earthquakes in the central and eastern United States tend to affect a much larger area. Consequently, regional collaborations between Federal, State, local and academic partners is essential to coordinate planning and responses.

ETT199—Missouri Local Technical Assistance Program (LTAP) at Missouri S&T Year 1
[Rolufs, A., PI-MTI, new in this reporting period]

The objective of this project is to manage the Missouri LTAP program for the Missouri Department of Transportation. The LTAP program was established by the Federal Highway Administration (FHWA) in 1982 and operates in each state to provide community leadership through advocacy and implementation of education and training.

The Missouri LTAP program will provide a resource center and technology transfer activities for local officials, counties, parishes, townships, cities and towns throughout the state of Missouri in the form of: workforce development services; resources to enhance safety and security; solutions to environmental concerns, congestion, capacity and other issues; technical publication; and training videos and materials.

ETT196—Women in Science & Engineering and Minority Engineering Scholarships Year 2
[Elmore, C., PI- Missouri S&T, new in this reporting period]

The objective of this project is to make scholarships available to minority and women students interested in engineering and science and will increase significantly the number of minority and female students that Missouri S&T can recruit to its science and engineering programs. Recipients of scholarships will also be exposed to career opportunities in transportation.

Women in Science and Engineering (WISE) scholarships are awarded to support female Missouri S&T students studying science and engineering. Missouri S&T's WISE program provides a campus focal point for increasing the number of women in science, engineering, math, and technology fields through outreach, recruitment, and retention efforts from middle

school age through undergraduate levels. WISE provides support programs such as mentoring, advising, professional/technical workshops, and social activities, with the goal of providing a rich academic and social experience for young women at Missouri S&T.

Minority Engineering and Science Program (MEP) scholarships provide critical financial support for under-represented students majoring in engineering and science programs at Missouri S&T. MEP scholarship students receive professional and academic support through the close-knit MEP network of friends, mentors and Missouri S&T staff. MEP has a rich 30 year tradition of sponsoring events, activities and organizations that ensure its students are prepared for personal and professional success.

SUCCESS STORIES

This section lists a sampling of "success stories" for Year I and Year II, including notable Center events; NUTC News articles of interest; faculty and student awards; and media articles about the Center, faculty or campus. Articles, awards and events with corresponding clips are available in the Appendix.

2008 RITA Site Visit

On April 15, 2008 RITA representatives Robin Kline and Amy Stearns spent a day at Missouri S&T with Center faculty and staff to get an inside look at programs and operations. The last site visit to the Center was in 2000, well before the Center became National. With a new National status and many exciting projects ongoing, the Center planned an informative and event-filled day for the RITA representatives, providing an effective demonstration of Center activities and successes.

The Center was also visited by RITA Administrator Paul Brubaker, Jan Brecht-Clark of RITA and Stephen Costa of the Volpe Center on February 22, 2008. Their visit included tours and meetings both on and off campus, including time in the Hydrogen-powered vehicle, which provided the chance to see how the USDOT funding has been invested and utilized.

Featured Articles in the NUTC News: Year II

- "'Show Me' Road Scholar Program." Volume 3, Issue 3.
- "GeoMO 2008" Volume 3, Issue 3.
- "Karst Activities along Missouri's Roadways." Volume 3, Issue 2.

Featured Articles in the NUTC News: Year I

- "It's a Girl Thing!" Volume 2, Issue 4.
- "Freight Optimization and Development in Missouri – Waterways and Ports Module." Volume 2, Issue 4.

Awards: Year II

- David J. Holdener was named 2007 UTC Outstanding Student of the Year.
- Mary Kathryn Masterson was selected as an Eno Transportation Foundation student.

- Dr. K. Chandrashekhara was named Curator's Professor of Mechanical & Aerospace Engineering at Missouri S&T.

- Dr. Ronaldo Luna was named a Fellow of the American Society of Civil Engineers (ASCE).

- Dr. John J. Myers was named a Fellow of the American Society of Civil Engineers (ASCE).

- Missouri S&T Hydrogen Design Team took the grand prize in the Hydrogen Education Foundation's (HEF) 2007-2008 Hydrogen Student Design Contest.

- Dr. Jerry Bayless is the first recipient of the National Arthur N.L. Chiu Outstanding Faculty Advisor Award from Chi Epsilon, the national civil engineering honor society.

Awards: Year I

- Jared Brewe was named 2006 UTC Outstanding Student of the Year.

- Dr. John J. Myers was named a Fellow of the American Concrete Institute (ACI).

- Dr. Shamsher Prakash was named an Honorary Fellow of the Indian Geotechnical Society and was admitted to the order of the Golden Shillelagh of MSM-MST Alumni Association.

- Construction Innovation Forum selected the Green County bridge project as one of eight finals for the Forum's NOVA Award for Outstanding Innovation in Construction.

Missouri S&T in the News: Year II

External Media Sources

- "New VUE of autos." Rolla Daily News. May 21, 2008.

- "E2 complex aims at green solutions." Rolla Daily News. May 14, 2008.

- "University Converts Crude Beer into Hydrogen." USDOT RITA UTC Spotlight. May 2008.

- "Contest Winner Could Improve Airports Worldwide." Environmental Protection. April 25, 2008.

- "People should prepare for Midwest quakes, experts say." Springfield News-Leader. April 18, 2008.

- “Clean-burning cars rolled out: Vehicles powered by sun, hydrogen, grease highlight possibilities.” Springfield News-Leader. February 24, 2008.

- “Osage River bridge was test site for innovative monitoring device.” Lake Sun Leader. August 31, 2007.

- “Fall Enrollment Increases at UMR.” Rolla Daily News. August 21, 2007.

Internal Media Sources

- “S&T research contributes to Nobel Peace Prize.” Missouri S&T Public Relations. June 10, 2008.

- “Missouri S&T students to compete in national finals of environmental design contest.” Missouri S&T Public Relations. May 12, 2008.

- “Engineers Without Borders students to leave Rolla for Guatemala.” Missouri S&T Public Relations. May 6, 2008.

- “S&T students to take their steel bridge to nationals.” Missouri S&T Public Relations. April 22, 2008.

- “re:building bridges.” Missouri S&T Magazine. Spring 2008.

- “Missouri S&T receives $376,000 grant from U.S. Steel for scholarships.” Missouri S&T Public Relations. February 18, 2008.

- “Researchers at Missouri S&T plan to help maximize the state’s waterways.” Missouri S&T Public Relations. January 29, 2008.

- “S&T ranked among top 20 for faculty research.” Missouri S&T Public Relations. January 17, 2008.

- “Bridges can be retrofitted to improve blast resistance, say UMR researchers.” UMR Public Relations. July 25, 2007.

- “UMR helping MoDOT meet biodiesel mandate.” UMR Public Relations. July 16, 2007.

Missouri S&T in the News: Year I

External Media Sources

- “Blanchette Bridge on I-70 needs upgrades, team finds.” St. Louis Post Dispatch. December 8, 2006.

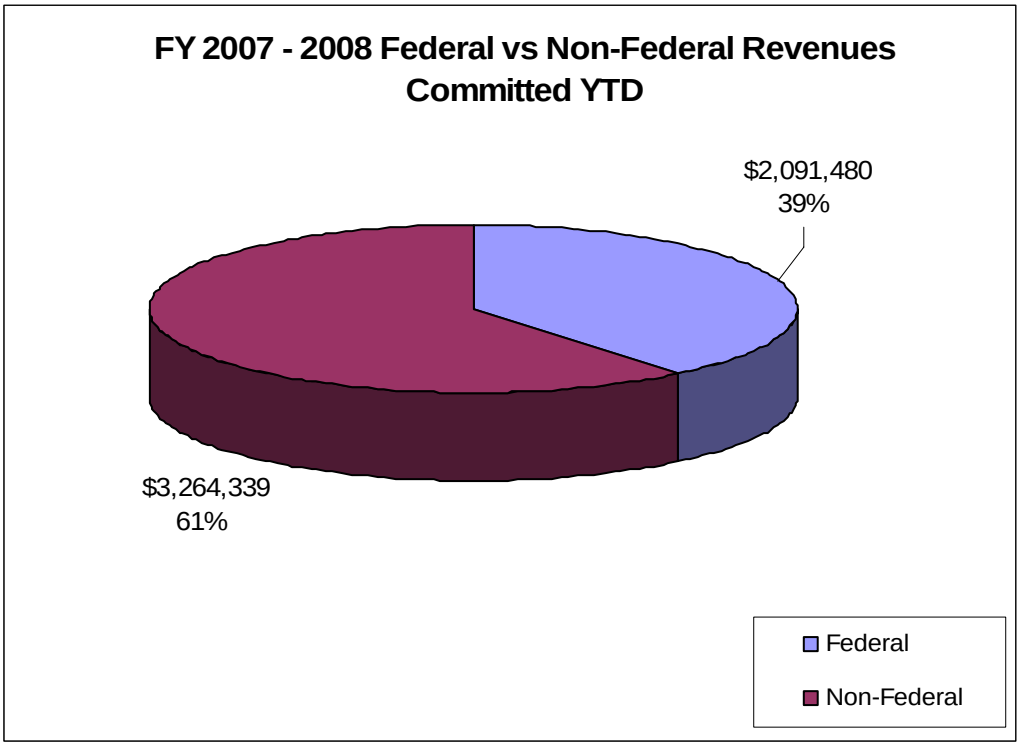
- “Bridge Building Competition.” KFVS12-Heartland News. November 10, 2006.
- “UMR Students put best foot forward at career fair.” Rolla Daily News. September 29, 2006.
- “UMR Degrees to be offered at Missouri State.” Rolla Daily News. August 22, 2006.
- “U.S. News Names UMR to top 50 engineering schools.” Rolla Daily News. August 18, 2006.
- “Forum Selects bridge project.” Springfield News Leader. August 9, 2006.
- Greene County Bridge on the cover of Composites Manufacturing. August 2006.

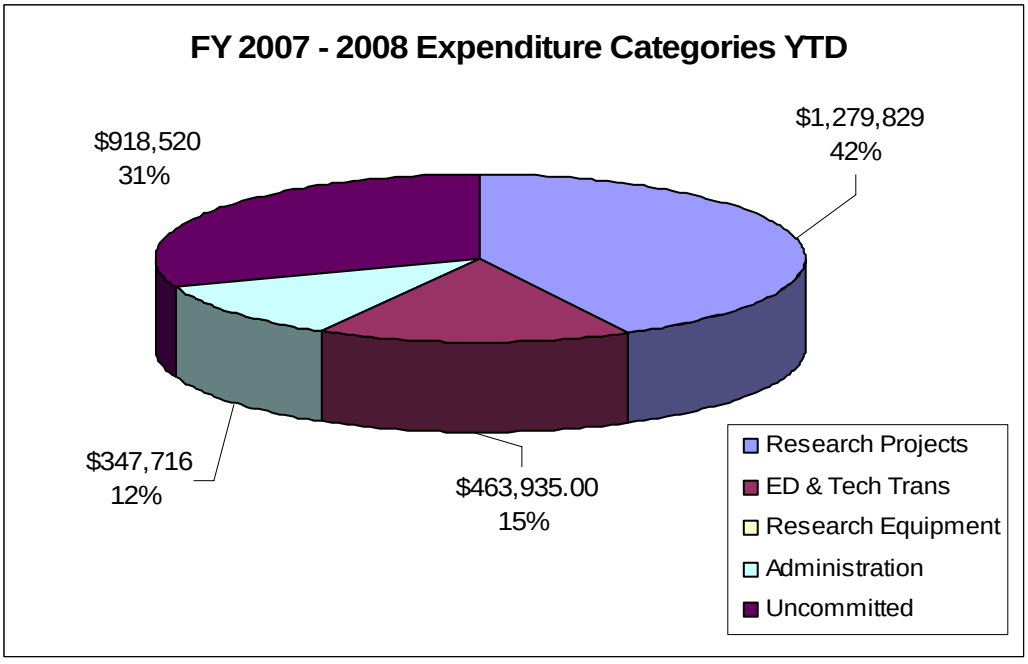
Internal Media Sources

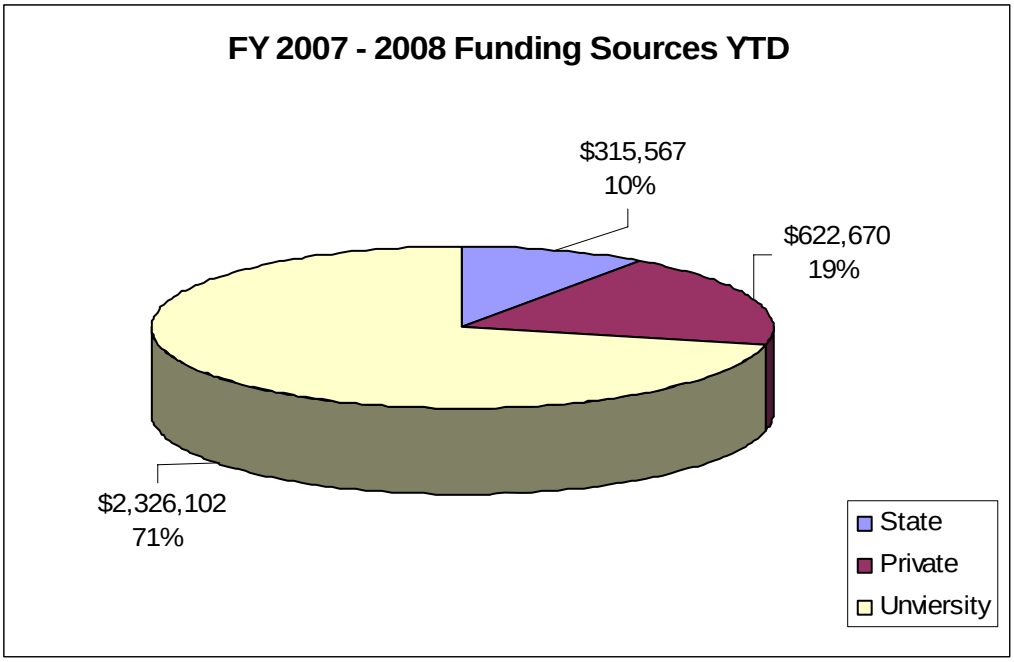
- “Future engineers and scientists visit Boeing.” UMR Magazine. Winter 2007.
- “Get on the bus: bringing hydrogen fuel to rural Missouri.” UMR Magazine. Winter 2007.
- “These bridges won’t come falling down.” UMR Magazine. Winter 2007.
- “UMR, MoDOT complete Blanchette Bridge study.” UMR Public Relations. December 7, 2006.
- “UMR team does well in national big beam contest.” UMR Public Relations. September 18, 2006.
- “Rolla’s steel-free bridge shows substantial benefits.” UMR Public Relations. July 24, 2006.
- “UMR students to help Bolivians increase water supply.” UMR Public Relations. July 21, 2006.
- “Donors increase endowments, establish faculty chairs.” UMR Public Relations. July 20, 2006.

FUNDING SOURCES AND EXPENDITURES

Year II: July 1, 2007 – June 30, 2008





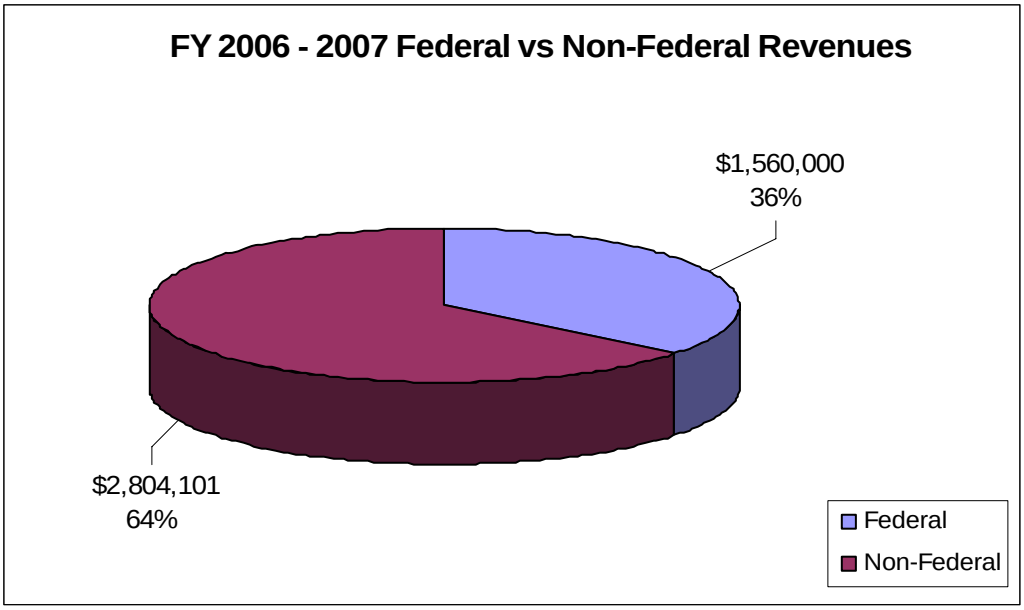


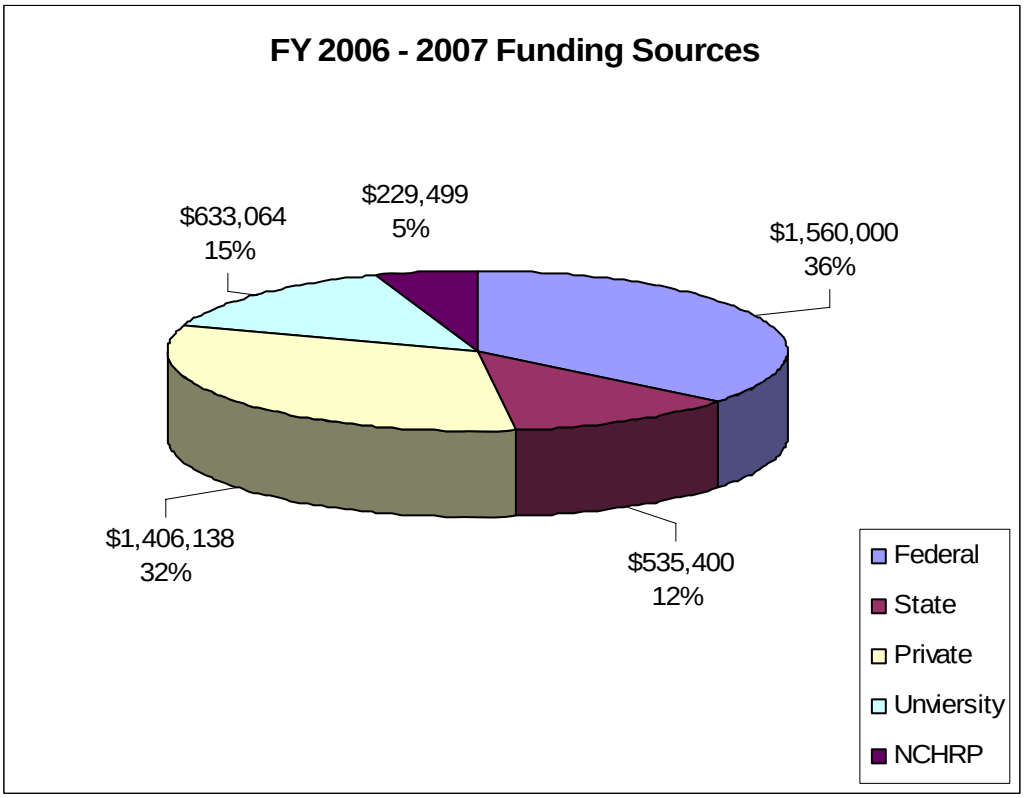
Amounts and Sources of Funding: July 1, 2007–June 30, 2008

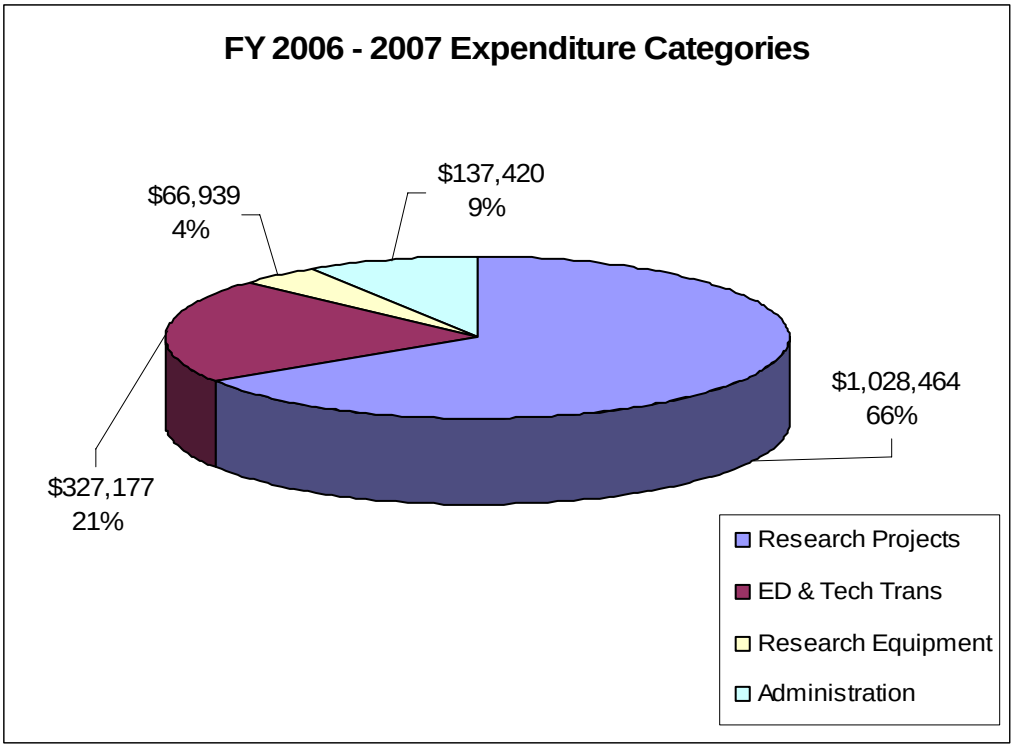
Seq. No.	Non-Federal * Source	Amount	UTC	Total
ETT216	Industry	406,065	187,500	$ 593,565
R219	MoDOT	68,324	34,161	$ 102,485
ETT220	MoDOT	211,885	211,885	$ 423,770
R221	SCI Engineering	23,431	11,715	$ 35,146
R222	HNTB Corp.	10,387	5,116	$ 15,503
R223	Lake Sherwood Estates	4,500	2,250	$ 6,750
ETT224	MS&T-VPR	26,102	26,102	$ 52,204
R225	MS&T Departments	1,800,000	900,000	$ 2,700,000
ETT226	Industry	77,125	20,769	$ 97,894
R227	Egyptian Concrete	26,162	14,087	$ 40,249
R228	Ameren	25,000	12,500	$ 37,500
ETT229	MODOT	35,358	17,679	$ 53,037
R230	NYSERDA	50,000	50,000	$ 100,000
R231	MS&T Departments	500,000	250,000	$ 750,000
	Facilities & Admin. Indirect Costs		347,716	$ 347,716
	TOTAL	**3,264,339**	**2,091,480**	**5,355,819**

Legend:
MODOT= Missouri Department of Transportation
MS&T-VPR= Missouri University of Science and Technology-Vice Provost of Research
NYSERDA= New York State Energy Research and Development Authority

Year I: July 1, 2006 – June 30, 2007






FY 2006 - 2007 Expenditure Categories
$137,420
9%
$66,939
4%
$1,028,464
66%
$327,177
21%
Research Projects
ED & Tech Trans
Research Equipment
Administration

Amounts and Sources of Funding: July 1, 2006–June 30, 2007

Seq. No.	Non-Federal * Source	Amount	UTC	Total
R195	NCHRP-NYSDOT-MS&T CE	$ 157,873	$ 78,936	$ 236,809
ETT196	Industry	$ 529,450	$ 187,500	$ 716,950
R197	NCHRP-MS&T CE	$ 120,000	$ 60,000	$ 180,000
R198	MoDOT-UMC CE	$ 269,378	$ 100,087	$ 369,465
ETT199	MoDOT	$ 212,054	$ 99,537	$ 311,591
R200	General Motors	$ 26,902	$ 13,776	$ 40,678
R201	EPRI	$ 68,980	$ 37,985	$ 106,965
R202	FMS&ME	$ 230,000	$ 115,000	$ 345,000
R203	MS&T Depts.	$ 500,000	$ 250,000	$ 750,000
R204	GTI	$ 250,000	$ 250,000	$ 500,000
ETT205	MS&T DCE	$ 20,000	$ 10,000	$ 30,000
RE206	LGA	$ 133,880	$ 66,939	$ 200,819
R207	CDOT	$ 25,000	$ 12,500	$ 37,500
R208	Roesch, Inc	$ 10,000	$ 5,000	$ 15,000
R209	Coreslab Structures	$ 7,746	$ 3,873	$ 11,619
R210	Transystems, Inc.	$ 21,200	$ 10,600	$ 31,800
R211	USB	$ 50,000	$ 25,000	$ 75,000
ETT212	Industry	$ 15,050	$ 7,525	$ 22,575
R213	Ameren	$ 25,000	$ 12,500	$ 37,500
R214	EPRI	$ 58,660	$ 29,330	$ 87,990
ETT215	MS&T VPR	$ 19,115	$ 19,115	$ 38,230
ETT217	MS&T DCE	$ 7,000	$ 3,500	$ 10,500
R218	MoDOT	$ 46,813	$ 23,877	$ 70,690
Facilities & Admin. Indirect Costs			$ 137,420	$ 137,420
TOTAL		**$ 2,804,101**	**$ 1,560,000**	**$ 4,364,101**

Legend:
CDOT=California Department of Transporation
EPRI=Electrical Power Research Institute
FMSME=Fuller, Mossberger, Scott & May Engineering
GTI=Gas Technology Institute
LGA=Leica Geosystems Advantage
MODOT = Missouri Department of Transporation
MS&T DCE = Missouri Uniersity of Science & Technology Distance & Cont. Education
MODOT-UMC-CE = MODOT-University of Missouri-Columbia Civil Engineering
MS&T-VPR =MS&T-Vice Provost of Research
NCHRP-MS&T CE=National Cooperative Highway Research Program-MS&T-Civil Engineering
NCHRP-NYSDOT-MS&T CE=NCHRP-New York State Depart. of Transporation-MS&T-CE
USB=United Soybean Board

APPENDIX: SUCCESS STORIES CLIPS

2008 RITA Site Visit

RITA VISITS CTIS: APRIL 2008

On April 15, 2008, University Transportation Center (UTC) program specialists Robin Kline and Amy Stearns from the Research and Innovative Technology Administration (RITA), United States Department of Transportation visited the Missouri University of Science & Technology campus for an update on the Center for Transportation Infrastructure and Safety's (CTIS) national center program.

Before taking a ride on the hydrogen bus. Left to right: John Myers, Robin Kline and Amy Stearns.

The morning began with a welcome and brief overview of the University from Provost, Kent Wray. Vice Provost for Research, K. Krishnamurthy, presented information about the University's strategic goals, current programs, the University's ranking as a top U.S. technical university and the significance of CTIS as a University asset.

Students explain how ethanol becomes hydrogen at the Ethanol Reforming Lab.

CTIS Interim Director, Dr. John J. Myers, shared information about the current activities and state of the Center. Areas covered included: the history of the University Transportation Center at Missouri University of Science & Technology; current mission, theme areas and management; funding overview; and sample success stories in research, education and technology transfer. Dr. John Sheffield, Associate Director of CTIS, provided an update on the Center's hydrogen activities.

Student Michael Murphy with his prestressed girder at the SERL High Bay Structures Lab.

These presentations and discussions laid the foundation to share details about the future of the Center and new projects on the horizon. Hydrogen activities on and around campus will continue with the fine-tuning and further development of technology as well as the construction of a permanent hydrogen fueling station. Additionally, the Center looks forward to the opportunity to collaborate with private sector

Continued on page 4...

Site visit continued from page 2...

firms to undertake a 20-year project of updating, replacing, repairing, monitoring and maintaining 802 bridges across the state of Missouri.

After lunch, CTIS staff members and RITA representatives rode the hydrogen-powered bus to Hypoint Industrial Park where they met with Professor of Chemical Engineering, Sunggyu "KB" Lee and toured his Ethanol Reforming Lab.

A steel free mock-up at the SERL High Bay Structures Lab.

Back on campus, a poster session was held in the atrium of Butler-Carlton Hall. Students and faculty members gave brief presentations on recent UTC funded projects in transportation research, education and technology transfer, explaining the particular relevance of a project to the current needs of the field.

The visit concluded with a tour, led by Dr. John J. Myers, of the SERL High Bay Structures Lab, the home to a variety of equipment for small-scale and full-scale structural testing under static, fatigue and earthquake simulations.

"Show-Me" Road Scholar Program

Missouri LTAP is excited to announce that they are in the final stages of developing a Road Scholar Program for Missouri. Many states have a Road Scholar Program, which is a certification program that recognizes the importance and benefit of continued education and training in areas related to workers' current and future positions within transportation and public works agencies. The primary purpose of the program is to promote a skilled workforce for Missouri local transportation and public works agencies. The program provides recognition through training, which provides increased knowledge of road maintenance procedures and improved technical, supervisory and managerial skills. A Road Scholar Program is set up to enhance the skills and knowledge of maintenance personnel as well as those who supervise others or aspire to manage in local transportation and public works operations.

Road Scholar Programs are set up with various levels of training in areas such as road maintenance procedures, equipment operating skills, technical skills, supervisory skills and executive development. Certificates are awarded at each program level and must be earned at the proceeding level in order to obtain a certificate at a more advanced level. The programs are usually open to all those involved with transportation and public works in the state. Certification is awarded upon completion of a specified number of required courses pertinent to the program level the participant is working to achieve. Participating partners in the program determine the required courses, along with course content.

Missouri LTAP has been partnering in the development of the "Show-Me" Road Scholar Program with the Missouri Department of Transportation (MoDOT), Federal Highway Administration (FHWA), Missouri Association of Counties (MAC), Missouri Municipal League (MML), Missouri Association of County Transportation Officials (MACTO), Missouri Chapter of American Public Works Association (APWA), Missouri Public Entity Risk Management Fund (MOPERM), Linn State Technical College and the University of Missouri Extension. Each organization has been assisting in outlining the needs of its members and assisting in the development of training to meet those needs, along with the needs of everyone involved in city and county transportation and public works in the state. In addition, everyone involved has been discussing the best method of rewarding participants who complete the program as well as the best format to provide recognition for becoming a Road Scholar. It is hoped that in time being a Road Scholar in Missouri will be the goal of all those involved in local public works. The success of the program will ensure that cities and counties have a well-trained and dedicated work force for the future.

For more information about the program, visit http://mltrc01.cc.umr.edu/index.html.

Article by Heath Pickerill, Director, Missouri LTAP and Dan Ratermann, Outreach Coordinator, Missouri LTAP.
Article first appeared in the Spring 2008 Quarterly Newsletter of the Missouri Local Technical Assistance Program.

MISSOURI S&T

GeoMO 2008

Geotechnical Earthquake Engineering - Site Response

After the recent earthquake in Illinois, the perceived risk of a significant earthquake occurring in the Midwest has become a reality. Coupled with the constant reminder of the New Madrid Seismic Zone, new code requirements and current USGS hazard mapping, the topics discussed at the GeoMO2008–Geotechnical Earthquake Engineering – Site Response Conference were both timely and of great interest to participants.

On May 2, 2008, 95 members of the Midwest civil engineering community gathered at the Missouri University of Science & Technology Havener Center for a one-day seminar given by two of the leading authorities on soil stabilization.

Dr. Steven L. Kramer, P.E., is a specialist in geotechnical earthquake engineering and site response. Dr. Pedro Arduino specializes in computational geomechanics with an emphasis in constitutive modeling of soils, coupled formulations, contact mechanics and general finite solutions for geotechnical problems. Both presenters are professors of civil and environmental engineering from the University of Washington, authors and have extensive experience with site response.

Lecture topics included: Introduction to Site Effects; Ground Motions and Hazard Analyses; Dynamic Soil Properties; 1-D Analyses; 2-D Analyses and Site Response in the Future. These topics were chosen to provide answers to questions that arise frequently in site response-related new or retrofit engineering projects. References, notes and examples of up-to-date methods in site response were also provided.

The conference was directed by Dr. Ronaldo Luna of Missouri S&T and sponsored by the National University Transportation Center and the Civil, Architectural and Environmental Engineering Department. Participants were awarded six Professional Development Hours (PDHs).

Karst Activities along Missouri's Roadways

Missouri is well known for its caves, springs and other geological wonders which make the region a "Karst Wonderland," according to the Missouri Department of Natural Resources website. "The most typical features of karst landscapes are caves, springs and sinkholes."

Aerial photograph of the Jefferson County site, prior to the "emptying" of the sinkhole. The approximate location of the sinkhole has been superposed on the photograph with an "x."

Caves, often found in limestone and dolomite bedrock, are formed when mildly acidic water dissolves rock as it moves through joints, crevices and fractures in the bedrock, creating an air-filled opening. By this system, a single cave can form or a vast network of connected caves can develop.

Close-up photograph of the walls of the emptied sinkhole, taken from a location immediately south of the feature.

When a cave collapses within a matter of minutes it can form a sinkhole, which can be large enough to easily swallow cars or structures. Because of the potential danger and disturbance caused by such an occurrence, the Missouri Department of Transportation (MoDOT) will often consider karst activity before constructing new roadways and intersections.

Dr. Neil Anderson of Missouri S&T, and his team of researchers, recently conducted such testing at two construction sites in the State. Both test sites, one in Greene County, near Springfield and the other in Jefferson County, near St. Louis, already had sink holes present in the area.

Using an electrical resistivity method, which measures the resistance of a substance to an electrical current, the researchers were able to produce images of the sub-surface at the construction sites and determine the level of risk posed by potential karst activity.

The imaging produced at the two test sites not only allowed researchers to determine if there were more air-filled cavities in the area or below existing sinkholes waiting to collapse, but to identify the topographic composition of the sub-surface. Certain materials filling inactive sinkholes, clay for instance, can densify over time, creating roadway settlement and damage.

Featured Articles in the NUTC News: Year I

It's A Girl Thing!

In the lab

For three days this summer, 7th and 8th grade girls got a chance to learn how math and science can be fun, cool, and not just for boys. From freezing marshmallows in the chemistry lab to observing controlled explosions in UMR's experimental mine, these middle-school girls experienced science and technology in a way they won't soon forget.

"It's A Girl Thing" is co-sponsored by UMR's Women in Science and Engineering Program (WISE) and the University Transportation Center (UTC). The camp is in its second year and was created after the popularity and success of UMR's 9th and 10th grade girls' summer camps. Science, Technology, Engineering, and Math (STEM) careers are traditionally underrepresented when it comes to minorities and women. The key to increasing their numbers in these fields is exposing young women early on to the excitement and benefits of STEM careers—a cause many female faculty and staff are quite passionate about. Therefore, the campus is particularly pleased about the great turnout from all over the country. In fact, considering the great turnout this year, the camp is expected to expand to a week-long program next year.

In UMR's Experimental Mine

For more information, contact WISE at wise@umr.edu.

Outside the mine, sporting brightly colored hardhats

Freight Optimization and Development in Missouri – Waterways and Ports Module

Scott E. Grasman and Ganesh Kumar Venayagamoorthy

The Missouri Department of Transportation (MoDOT) seeks to achieve a greater role in national freight movement by capitalizing on its central location within the freight transportation system and the extensive infrastructure within Missouri. Current trends in domestic and international freight movement will impact Missouri as a freight handling center. Other emerging trends (*e.g.*, production of alternative fuels) will impact Missouri's port infrastructure since many of the raw materials and by-products of biofuels are ideally suited for barges and river ports. How those trends and impacts can be incorporated into a freight and logistics development model that supports efficient allocation of public investment resources is the focus of a current UTC sponsored study. In conjunction with TranSystems, UMR researchers are working to developing a freight and logistics prioritization model for Missouri that initially focuses on ports and waterways but is compatible with other modes. The model is expected to provide decision support for prioritized investment and development decisions related to the increased freight and logistics development in Missouri.

Investigators are analyzing the Missouri Planning Framework for Transportation Decision-Making to understand current needs identification and prioritization processes, as well as reviewing Missouri's freight and logistics status, focusing on criteria required to prioritize projects for port and waterways, including business and structural relationships, policy issues, commodity movements and potential commodity/product movement, along with overall efficiencies. The relevance of successful freight and logistics development models/frameworks is being used to develop a prioritization model consistent with Missouri's planning and decision-making processes. Collaborative partners are ensuring that the models are consistent with relevant data related to industry and economic trends and assisting with application of the multicriteria decision making models.

TranSystems MoDOT MTI Tomorrow's Solutions Today Missouri Transportation Institute

Awards: Year II

2007 University Transportation Center Outstanding Student of the Year: David J. Holdener

David J. Holdener has been named Outstanding UMR-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 the University and surrounding communities.

Holdener earned a B.S. degree in Civil Engineering with Magna Cum Laude honors from the University of Missouri-Rolla (UMR) in May 2004. During his undergraduate career, Holdener was a member of the UMR chapters of American Society of Civil Engineers (ASCE) and Tau Beta Pi National Engineering Honor Society. He served as social chair of Chi Epsilon, the National Civil Engineering Honor Society, and as treasurer for the UMR Concrete Canoe Team.

After working in industry for two years, Holdener decided to return to Rolla to pursue an advanced degree in Civil Engineering at the Missouri University of Science & Technology. "I felt I needed to advance my career and gain more technical expertise in the structural engineering arena," says Holdener, "Additionally, conducting a research project appealed to me."

As a graduate student, Holdener has studied and made technical contributions to several aspects of Fiber Reinforced Polymer (FRP) bridge applications, including: field validation of both existing bridges strengthened with FRP and

David Holdener was recognized at the TRB Awards Ceremony on January 12, 2008. Left to right: President CUTC/Director of the Mineta Institute at San Jose State University Rod Diridon, Ph.D., DOT Administrator Paul Brubaker, David J. Holdener and Former Transportation Secretary Norman Mineta.

new bridges employing FRP technologies. "This material will help bridges last longer and gives engineers another material to consider when designing or strengthening structures," says Holdener.

During his graduate work, Holdener's advisor, Dr. John J. Myers, encouraged him to get involved with the UMR-MST PCI Big Beam Competition Team. "The contest involved designing, fabricating and testing a prestressed beam that needed to carry a load between 16 and 19 tons," explains Holdener. "We designed a beam that helped us secure a second place regional finish."

Holdener anticipates graduating from Missouri S&T with a M.S. degree in Civil Engineering in May 2008 and plans to work in industry as a structural engineer designing bridges.

Mary Kathryn Masterson: Eno Transportation Foundation Student

Mary Kathryn Masterson has been selected by the Board of Regents of the Eno Transportation Foundation to participate in the 16th Annual Eno Leadership Development Conference in Washington, DC, May 19-22, 2008. Each year, the Eno Foundation selects 20 of the nation's top graduate students in transportation to attend the conference, which provides a first-hand look at how transportation policy is developed and implemented. Masterson will meet with top government officials, leaders of associations and members of Congress and their staff to explore how the nation's transportation policies are debated, shaped, formed and ultimately adopted and applied.

Masterson earned a B.S. degree in Civil Engineering with Summa Cum Laude honors from the University of Missouri – Columbia in May 2007. During her undergraduate career, Masterson was a member of the MU chapters of the American Society of Civil Engineers (ASCE), Tau Beta Pi National Engineering Honor Society and Chi Epsilon, the National Civil Engineering Honor Society. She was also a member of the Steel Bridge team in 2006 and a starting catcher for the University of Missouri Softball Team during the entirety of her undergraduate career. During the 2006-2007 season, she was a co-captain of the team.

Additionally, during her academic career, Masterson received several awards for excellence and participated in a number of service activities. A few of her activities included: working with Habitat for Humanity in her home city of St. Louis; tutoring elementary school children in mathematics and coaching softball clinics for young girls.

As a graduate student under the advisement of Dr. Glenn Washer, Masterson is conducting research on the long-term monitoring of highway bridges under the project entitled "Long-Term Remote Sensing System for Bridge Piers." This project is funded by the National Cooperative Highway Research Program (NCHRP) and the Center for Transportation Infrastructure and Safety (CTIS-NUTC) at Missouri S&T.

Masterson anticipates graduating from the University of Missouri – Columbia with a M.S. in Civil Engineering in December 2008 and plans to work as a bridge design engineer.

To learn more about the Eno Transporation Foundation, visit www.enotrans.com.

Dr. K. Chandrashekhara
Curators' Professor of Mechanical and Aerospace Engineering

Dr. K. Chandrashekhara, professor of mechanical and aerospace engineering at the Missouri University of Science and Technology and director of composite manufacturing laboratory, has been named Curators' professor of mechanical and aerospace engineering. The professorship is awarded by the University of Missouri Board of Curators to outstanding scholars with established reputation in their field of study.

Dr. Chandrashekhara came to Missouri S & T in 1985 after earning a Ph. D. in engineering science and mechanics at Virginia Polytechnic Institute and State University in Blacksburg, VA. He was promoted to associate professor of mechanical and aerospace engineering at Missouri S & T in 1991 and earned the rank of professor in 1997.

Dr. Chandrashekhara specializes in composite manufacturing, smart structures, biocomposites, nanocomposites, and finite element analysis. His research projects have been funded by the National Science Foundation, Army Research Office, the Office of Naval Research, the Air Force Research Laboratory, the Department of Agriculture, the Department of Housing and Urban Development, the Department of Transportation, the United Soybean Board, the National University Transportation Center, and several industries.

A winner of several Faculty Excellence Awards at Missouri S & T, Dr. Chandrashekhara has published his research in more than 75 scholarly journals. He is the co-author of a leading textbook on composite materials and is on the editorial board of the Journal of Biobased Materials and Bioenergy. He is a Fellow of the American Society of Mechanical engineers and an Associate Fellow of the American Institute of Aeronautics and Astronautics.

Dr. Chandrashekhara holds a master's degree in aerospace engineering from the Indian Institute of Technology, a bachelor's degree in aerospace reengineering from the Madras institute of Technology and a bachelor's degree in applied mathematics from the University of Mysore, India.

Dr. Ronaldo Luna, P.E., F.ASCE

Dr. Ronaldo Luna, associate professor of civil and geotechnical engineering at Missouri University of Science & Technology, has been named a Fellow by the American Society of Civil Engineers. Fellows are nominated and selected by their peers and must be a distinguished educator, leader or practitioner within their area of engineering expertise.

Dr. Luna specializes in geotechnical engineering, earthquake engineering, hazard modeling and information systems. He has received more than $2 million in funding for his research and the development of systems and methodologies which can help to lessen the impact of an earthquake. Some of the agencies which Dr. Luna has received funding from include the National Science Foundation, U.S. Geological Survey, Missouri Department of Transportation, U.S. Bureau of Reclamation and the Association of State Dam Safety Officials.

In 1999, after teaching and conducting research at Tulane University, Dr. Luna came to Missouri S&T where he helped to establish a soil dynamics laboratory in 2003. He has held previous positions as a professional engineer at Hart Crowser, Inc. in Seattle and Bechtel Corporation in San Francisco.

In 2005, Dr. Luna traveled to his home country of Guatemala for eight months as a Fulbright Scholar delivering lectures on landslides resulting from earthquakes and heavy rain. He also delivered the keynote lecture to the graduating class at the Universidad del Valle de Guatemala. Surviving the 1976 Guatemala earthquake, resulting in 23,000 fatalities, was largely what led Dr. Luna to become an expert in geotechnical and earthquake engineering.

Dr. Luna was awarded a Ph.D. in civil/geotechnical engineering from the Georgia Institute of Technology in 1995. He holds a master's degree in civil/geotechnical engineering from Purdue University and a bachelor's degree in civil engineering from the University of Maryland.

S&T professor named civil engineering fellow

05/12/2008 11:48 - Missouri S&T Public Relations

Dr. John J. Myers, associate professor of civil, architectural and environmental engineering at Missouri University of Science and Technology, has been elected a fellow of the American Society of Civil Engineers (ASCE).

ASCE awards fellow status to professional civil engineers "who have made significant technical or professional contributions to the profession and who have demonstrated notable achievement" in engineering.

An expert in high-performance materials, Myers recently developed an environmentally friendly construction material that is lighter and more durable than traditional clay bricks and concrete masonry blocks. The composite material is made primarily from ASTM class C fly ash, a byproduct of coal-burning power plants, and wood fibers – two materials that otherwise would be put in the nation's landfills. The development of this material has shown promise for impact and blast resistant applications.

Myers received his bachelor's degree in architectural engineering from Pennsylvania State University in 1987. He earned a master of science degree in structural engineering and a Ph.D. in construction materials and structural engineering from the University of Texas at Austin in 1994 and 1998, respectively. He joined the Missouri S&T faculty in 1999.

In addition to his teaching responsibilities, Myers serves as interim director of the Center for Transportation Infrastructure and Safety (CTIS) which is the National University Transportation Center at Missouri S&T.

OUT OF THE BLUE AND INTO THE GREEN

The Hydrogen Design Team receive awards from NHA Chairman and President of Shell Hydrogen Phil Baxley, SCHFCA Director Shannon Baxter Clemmons, DOT Administrator Paul Brubaker and DOE Deputy Assistant Secretary Steve Chalk.

Can you envision a safe, energy efficient airport with less noise, clean air and clean water? The Missouri University of Science & Technology 2007-2008 Hydrogen Design Team can, and their vision is hydrogen.

As grand prize winners of the Hydrogen Education Foundation's (HEF) 2007-2008 Hydrogen Student Design Contest, the Missouri S&T team traveled to Sacramento, CA for an awards ceremony and to present their design to over 1,000 industry professionals at the NHA's 19th Annual Hydrogen Conference.

Using the Columbia Metropolitan Airport in Columbia, SC as a basis for design and with an imagined budget of $3 million, the student design teams were asked to propose hydrogen technology solutions for the three most common challenges to airports: noise, air pollution and groundwater contamination. Additionally, each design was required to include necessary safety, economic and environmental analyses as well as a feasible marketing and education campaigns.

The Missouri S&T team's proposal was unique because of a strong focus on public education and outreach as well as the use of a wide range of hydrogen technologies which are already available in the consumer market, making it "completely realistic and technically accurate," according to the Columbia Airport Director Mike Flack. "If implemented, this design would greatly decrease our energy footprint and bolster airport operations as a whole." The airport would not only see a reduction in emissions, but also a potential savings of $28,000 in annual energy costs.

Some of the design elements proposed by the Missouri S&T team include: a primary fuel cell system to provide 200 kW of power to the airport; back-up power supply to protect the airport's computer systems; portable fuel cell power for tools and communications; a hydrogen forklift and baggage tug for use on the tarmac; and two hydrogen vehicles: an ICE shuttle bus to transport passengers from the airport to downtown and a hydrogen fuel cell scooter for use at the airport.

Continued on page 4...

Hydrogen continued from page 3...

The competition was sponsored by the South Carolina Hydrogen and Fuel Cell Alliance (SCHFCA), the U.S. Department of Energy, Chevron, Sacramento Municipal Utility District, Natural Resources Canada and American Wind Power and Hydrogen.

The interdisciplinary Hydrogen Design Team at Missouri S&T competed against twenty-two other teams from around the world in the 2007-2008 competition, including teams from Canada, China, Guinea, India, Libya, Nigeria, the United Kingdom and the United States.

Members of the student Hydrogen Design Team, advised by Dr. John Sheffield, include:

- Michael Steven Borrini of St. Louis, a December 2007 mechanical engineering graduate
- Gustavo D'Agnese of St. Charles, Mo., a senior in mechanical engineering
- Javier E. Garcia Joo of Lima, Peru, a graduate student in mechanical engineering
- Matthew David Richardson of St. Louis, a December 2007 mechanical engineering graduate
- Jadranko Sarar of Kansas City, Mo., a senior in mechanical engineering
- Mathew Thomas of Kottayam, Kerala, India, a graduate student in mechanical engineering
- Fanny E. Valencia Juscamaita of Lima, Peru, a former visiting scholar and chemical engineering student

Watch a 13-minute video of the proposal at http://h2miner.mst.edu/Presentations/Hydrogen-WMV.wmv. For more information about hydrogen activities at Missouri S&T, visit http://h2miner.mst.edu.

Professor first recipient of national award

06/13/2008 16:22 - Missouri S&T Public Relations

Jerry Bayless, associate professor of civil engineering at Missouri University of Science and Technology, is the first recipient of the National Arthur N. L. Chiu Outstanding Faculty Advisor Award from Chi Epsilon, the national civil engineering honor society.

The award was established in memory of Arthur Chiu, longtime Chi Epsilon faculty advisor at the University of Hawaii. The award is presented to faculty who have shown a dedication to advising and supporting chapter activities and encouraging chapter members. Bayless has served as faculty advisor to the Missouri S&T chapter for 40 years and was nominated for the award by chapter officers and members.

Bayless, who holds bachelor's and master's degrees in civil engineering from Missouri S&T, has been a member of the Missouri S&T faculty since 1959. He served as interim chair of civil engineering for one year before becoming assistant dean of the School of Engineering in 1986. He was appointed associate dean of the School of Engineering in 1990 and served as interim chair of civil, architectural and environmental engineering from 2006-2007.

Missouri S&T in the News: Year II

External Media Sources

New VUE of autos

Rolla, Mo. –

A Missouri University of Science & Technology team is one of 17 university groups from the United States and Canada selected to compete in a three-year competition, to design a more eco-friendly vehicle, announced Wednesday by the U.S. Department of Energy, General Motors and Natural Resources Canada.

EcoCAR: The Next Challenge will test students' abilities to re-engineer a Saturn VUE to achieve improved fuel economy and reduced greenhouse gas emissions, while retaining the vehicle's performance and consumer appeal.

Students will design and build advanced propulsion solutions that are based on the vehicle categories from the California Air Resources Board (CARB) zero emissions vehicle (ZEV) regulations.

They will be encouraged to explore a variety of cutting-edge clean vehicle solutions, including full-function electric, range-extended electric, hybrid, plug-in hybrid and fuel cell technologies.

In addition, they will incorporate lightweight materials into the vehicles, improve aerodynamics and utilize alternative fuels such as ethanol, biodiesel and hydrogen.

"With our emphasis on alternative energy research, the ecoCAR challenge is a natural fit for Missouri S&T," said Chancellor John F. Carney III. "The knowledge and experience gained from this project and other design competitions better prepare our students to address our world's environmental and energy issues."

During the three-year program, General Motors will provide production vehicles, vehicle components, seed money, technical mentoring and operational support.

The U.S. Department of Energy and its research and development facility, Argonne National Laboratory, will provide competition management, team evaluation and technical and logistical support. Through sponsoring such advanced vehicle engineering competitions, GM and the U.S. Department of Energy are developing the next generation of scientists and engineers.

"We're excited to see what these student engineers will develop over the next three years," said Beth Lowery, General Motors vice president of environment, energy and safety policy. "The objectives of ecoCAR are right in line with GM's strategy."

“EcoCAR is the latest in a series of Department-sponsored student competitions that will foster the training of the next generation of engineers who will develop the clean vehicle technology solutions to enhance our energy security and reduce greenhouse gas emissions,” said Ed Wall, DOE’s manager of the vehicle technologies program. “It will be exciting to watch as the students work over the next three years to design, build, test and showcase their vehicles.”

In the first year, teams will develop their vehicle designs through the use of GM’s Global Vehicle Development Process – the modeling and simulation process currently used to develop all of GM’s vehicles. Sophisticated hardware in the loop (HIL) and software in the loop (SIL) systems will be utilized, and teams will be challenged to model and simulate the integration of their subsystems into the overall vehicle design.

The emphasis is on optimizing a practical solution that will meet the goals of the competition.

During the second and third years of the competition, students will build the vehicle and continue to refine, test, and improve vehicle operation. At the end of years two and three, the re-engineered student vehicle prototypes will compete in a week-long competition of engineering tests.

These tests will be similar to the tests GM conducts to determine a prototype’s readiness for production. The Greenhouse gas, Regulated Emissions, and Energy in Transportation (GREET) model, developed at Argonne National Laboratory, will be used to assess a well-to-wheel analysis of the greenhouse gas impacts of each technology approach the teams select.

Additional information about EcoCAR is available online at www.ecoCARchallenge.org.

E2 complex aims at green solutions

By Alan Lewis Gerstenecker

Dr. John W. Sheffield, S&T professor and subject editor for the International Journal of Hydrogen Energy, and Angela B. Rolufs, director of the Missouri Transportation Institute, review a map indicating the university's unique positioning in the Midwest as a hydrogen fueling center.

By Alan Lewis Gerstenecker
The Rolla Daily News
Wed May 14, 2008, 12:06 AM CDT

Rolla, Mo. -

A new Missouri University of Science & Technology development is planned west of the main campus, across Interstate 44, and it will complement its propsed Tech Park.

Called E2 (E-Squared) for energy and environment, Missouri University of Science & Technology Chancellor John F. Carney, III, recently unveiled plans to create a showcase for the university's commitment to sustainable energy development.

E2 would promote Missouri S&T's commitment to addressing some of the nation's most pressing energy and environmental issues, Carney said.

Plans for the area include a wind turbine at the adjacent Missouri State Highway Patrol Troop I Headquarters and the Hydrogen Fueling Station.

These two projects are serving as anchors for what the university is saying will be the hands-on technical area to complement offices planned at the University Tech Park on 10th Street where the S&T golf course now sits.

Dr. John W. Sheffield, a professor of mechanical and aerospace engineering and subject editor for the International Journal of Hydrogen Energy, called the hydrogen refueling project "the next step" for the university as it continues to be "on the forefront of alternative fuel sources."

Sheffield presented a map of other hydrogen fueling stations, mostly on the nation's coastal areas.

"Our campus is getting recognized as a team leader," Sheffield said, recalling the university's grand-prize winning status in a demonstration of hydrogen technology.

Currently, a hydrogen fueling station is located at Hy Point Industrial Park on Rolla's eastern edge, but that station will be moved to the E2 site.

The hydrogen fueling station is part of collaborative research by Missouri S&T and several federal and state agencies to demonstrate the feasibility of hydrogen-powered transportation in rural Missouri.

In addition to the hydrogen fueling station, Sheffield hinted of another hydrogen project coming to the university soon.

"We'll have more on to release on that May 21," Sheffield said.

Sheffield, with the aid of Angela B. Rolufs, director of the Missouri Transportation Institute, presented a chronology of planning and implementation for the hydrogen project:
• By July, a permanent hydrogen fueling station, with support from the Gas Technology Institute;
• By August, full operation of rural hydrogen transit test bed — with commuter service to Fort Leonard Wood;
• By August, installation of 5kW hydrogen fuel cell;
• And by November, the installation of a solar-powered electrolysis 5kg per day hydrogen production unit.

Currently, the university is leasing two Ford Hydrogen E-450 shuttle buses. The V-10 vehicles run on both hydrogen and internal combustion technology with 235 horsepower and a range of 150 to 200 miles.

“The test bed we have here in Missouri is significant because unlike other test markets, the buses here travel town, and they get out on the interstate,” Sheffield said. “That is significant.”

The university also has led firefighter and first-responders training about the hydrogen vehicles so they can adequately respond to vehicular emergencies.

More than anything, Sheffield said, E2 will allow the university to further its cutting-edge partnerships with students and corporations to solve energy problems while partnering with corporations.

“E2 will be right there next to the interstate. It will be a high-visibility area while complementing the research (tech) park while allow our students to have hands-on technology,” Sheffield said.

The university’s E2 teams have been a leader — and past champion — in the solar-car competition and just last summer won an international competition in the human-powered vehicle competition, just narrowly missing a setting a new speed record.

And, the 10-acre E2 site will be the future home for S&T’s Solar Village, the site for construction of the university’s solar home competition efforts.

“It’s time we take our excellent energy and environmental research work out of the laboratories and put them on display,” Carney said.

“Located near Interstate 44, the E-Squared initiative will be a highly visible showcase of our sustainability research, as well as a test bed for future projects, including partnerships with private industry, governmental agencies and other forward-thinking universities,” Carney said.

The E-Squared development also will include a waste-to-energy and water-recycling demonstration project, an education center in collaboration with the St. Louis Science Center, and a “green” hotel and conference center.

Continuing a theme he introduced in his Fall 2007 State of the University Address, Carney noted that Missouri S&T is uniquely positioned to address many environmental and energy issues.

Missouri S&T is the only university in the country that offers 16 different engineering bachelor’s degree programs and the only one with a combination of energy-friendly programs that includes geology and geophysics and environmental, geological, mining, nuclear and petroleum engineering fields.

UTC Spotlight
University Transportation Centers Program
May 2008
U.S. Department of Transportation, Research and Innovative Technology Administration

This monthly report from the University Transportation Centers Program highlights some of the recent accomplishments and products from one of the University Transportation Centers (UTCs) managed by the U.S. Department of Transportation's Research and Innovative Technology Administration.

University Converts Crude Beer into Hydrogen

Missouri University of Science and Technology (Missouri S&T)[1] recently announced a novel and robust process for converting ethanol into hydrogen—*E-H*$_2$ technology. This new process, developed by Missouri S&T's National University Transportation Center, uses bio-based feedstock, specifically crude beer derived from agricultural ethanol, to produce hydrogen for fuel cells and power generation applications as well as transportation fuel. This research supports the transition of our nation's economy from one dependent on fossil fuels to one based on renewable hydrogen.

[1] Formerly the University of Missouri—Rolla.

Technological Advantages

The *E-H*$_2$ process has several distinct advantages over existing technologies:

- It is a compact, energy-efficient process that eliminates the costly and energy intensive steps needed to produce ethanol; instead, it uses crude ethanol beer—without further need of filtration, distillation, or refining.
- It has the potential to improve safety by substantially reducing the need to distribute and transport dangerous flammable chemicals.

Photo courtesy of Missouri S&T

Administrator Brubaker and UTC representatives traveled aboard a hydrogen-powered bus between meetings on the Missouri S&T campus. *Left to right:* Stephen Costa (Volpe Transportation), Brent Franzel (Cardinal), Angie Rolufs (Missouri S&T), Jan Brecht-Clark (RITA), Paul Brubaker (RITA), John Sheffield (Missouri S&T), Steve Tupper (Missouri S&T), Rex Tennyson (USA Tours).

- The *E-H_2* process' ability to utilize unrefined crude ethanol beer complements and augments the emergent technology that produces ethanol from lignocellulosic sources such as corn stover, switch grass, and wood chips.

Other Benefits

Ethanol boosts the economic development of agricultural communities, adds value to agricultural products, helps clean America's air, and strengthens national security by moving America toward energy independence. Hydrogen is an excellent energy carrier with a high energy content by mass, burns cleanly, is abundantly available in compound forms, and is also renewable.

By using a bio-based feedstock, more specifically agricultural ethanol and its crude beer, to produce hydrogen, the *E-H_2* process provides a direct link between the ethanol economy and the hydrogen economy. Ethanol to hydrogen, via supercritical water reformation, optimally uses ethanol in water at the same concentrations found in crude ethanol beer and can readily handle all the impurities in crude ethanol beer without the need of extensive filtration.

In Summary

First, this approach allows elimination of the expensive and energy intensive separation of water from ethanol. Second, ethanol does not need to be transported in its highly refined and hence flammable and corrosive state. Third, the water content in crude beer is enough to carry out the subsequent reformation reaction and the associated water can be sterilized *in-situ*, thus reducing the environmental burden via minimization of wastes. Fourth, crude ethanol beer can be used not only for conventional production of oxygenated blends of gasoline and E-85, but also for direct conversion into hydrogen.

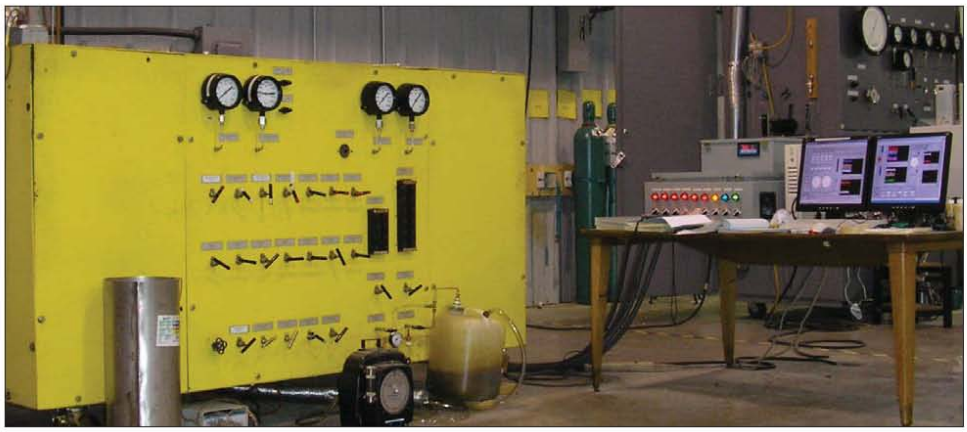


Photo courtesy of Missouri S&T

MST H2 Process System Panoramic View.

About This Project

DOT invests in the future of transportation through its University Transportation Centers Program, which awards grants to universities across the United States to advance the state-of-the-art in transportation research and to develop the next generation of transportation professionals. The DOT grant supporting this research was awarded to the National University Transportation Center at the Missouri Uinversity of Science and Technology (Missouri S&T), where John Myers, Ph.D. (jmyers@mst.edu), is the interim director.

The principal investigator for this project is Sunggyu Lee, Ph.D. (Leesu@mst.edu), of the Department of Chemical and Biological Engineering at Missouri S&T in Rolla, Missouri.

Additional information on this project can be found at:
http://web.mst.edu/~leesu/hydrogen.html

For additional information on the DOT UTC Program, see utc.dot.gov

Photos on banner by: Elvis Santana and Carl Silver

Environmental PROTECTION

Contest Winner Could Improve Airports Worldwide

April 25, 2008

The team from Missouri University of Science & Technology won this year's Hydrogen Student Design contest, sponsored by the Hydrogen Education Foundation of the National Hydrogen Association. The award was presented in March at the 19th annual Hydrogen Conference.

The winning team's design included an on-site hydrogen fueling station, a primary fuel cell system to provide 200 kW of power to the airport, back-up power supply to protect the airport's computer systems, portable fuel cell power for tools and communications, a hydrogen forklift and baggage tug for use on the tarmac, as well as two hydrogen vehicles designed to increase public attention: a hydrogen ICE shuttle bus to transport passengers from the airport to downtown, as well as a hydrogen fuel cell scooter for use at the airport. Not only does the system drastically reduce the emissions created by power and personal vehicle use at the airport, it saves over $28,000 in heating and electric costs annually.

"The design presented by the team from Missouri was completely realistic and technically accurate," said Columbia Airport Director Mike Flack. "If implemented, this design would greatly decrease our energy footprint and bolster airport operations as a whole."

The contest challenged student teams to use a $3 million budget to design the most effective airport hydrogen system to address the three main challenges for airports: noise, air pollution, and groundwater contamination. Designs were based on the Columbia International Airport in Columbia, S.C., but are applicable to other airports worldwide. Twenty-three teams, including those from Canada, China, Guinea, India, Libya, Nigeria, registered for the competition.

Four teams received honorable mention awards: McMaster University (Ontario, Canada), University of Waterloo (Ontario, Canada), and two teams from Wayne State University (Detroit, Michigan).

To see the designs submitted by all contest finalists, visit http://www.HydrogenContest.org.

People should prepare for Midwest quakes, experts say

Rolla — The earthquake that hit eastern Illinois and the St. Louis area this morning is the type of event communities throughout the Midwest should prepare for, say organizers of an earthquake preparedness conference to be held this summer at Missouri University of Science and Technology.

"Preparing for a Significant Central U.S. Earthquake" is the theme of the "New Madrid Seismic Zone Conference," to be held Aug. 12-14 at Missouri S&T in collaboration with the U.S. Geological Survey, the USGS Mid-Continent Geographic Science Center, the Missouri Department of Natural Resources' Division of Geology and Land Survey, the State Emergency Management Agency and the American Society of Military Engineers. More conference information is online at conference.mst.edu/newmadridconf/ <http://conference.mst.edu/newmadridconf/>.

Although the conference title focuses on the possibility of a major earthquake along the New Madrid Seismic Zone in southeastern Missouri, the subject matter should also prove relevant to other seismic zones in the Midwest.

As part of the conference, the first day will be devoted to emergency management training for first responders.

Clean-burning cars rolled out

Vehicles powered by sun, hydrogen, grease highlight possibilities.

Wes Johnson
News-Leader

A plume of white exhaust wafted into the chill breeze as clear liquid dripped from the van's tailpipe onto the ground.

If he had a cup, Jim Gardner said he'd be glad to catch the exhaust and drink it.

"When you burn hydrogen and oxygen, you get water," said Gardner. "It would take about 10 minutes to fill up a glass of water from the tailpipe."

Missouri University of Science and Technology brought one of its two hydrogen-powered shuttle buses to the two-day Ozarks New Energy Conference.

It was joined by two "veggie" vehicles powered by cooking oil and a brand new $25,000 Honda Civic hybrid car that gets up to 45 miles per gallon on the highway.

Elaine Johnson of Springfield said she liked the looks of the shiny silver Honda, but found the price daunting.

"I have a 2000 Honda Civic that I just finished paying off," she said. "I don't want a new car payment right now."

But she's still interested in gas-electric hybrid cars that offer better gas mileage and don't pollute the environment as much.

Gardner, an alternative fuels consultant, said he believes cars of the future will run on hydrogen gas.

He fired up the 10-cylinder Missouri S&T van, which uses six cylinders filled with hydrogen at 6,000 pounds per square inch.

The engine produces no carbon dioxide — a greenhouse gas — or lethal carbon monoxide, and the bus can travel about 150 miles on one fill-up.

Although hydrogen is a remarkably clean fuel, it's not yet readily available. The van's fuel supply is extracted from natural gas, and a mobile fueling truck is needed to fill it since there's no network of hydrogen filling stations in Missouri.

Dr. K. Krishnamurthy, vice provost for research at Missouri S&T, said the university has been testing the two hydrogen-powered buses since November 2006.

"Part of the project is to find out the cost of using hydrogen as a fuel," he said. "It is going to be expensive for a while, but our goal is to reach a cost of between $1.75 and $4.75 per gallon of gasoline equivalent."

Ordinary water can be broken down into hydrogen and oxygen, but researchers are still looking for an economical way to do that.

"Ultimately, hydrogen is the most efficient energy source there is," Gardner said.

Osage River bridge was test site for innovative monitoring device

By Charis Patires/Lake Sun
Published: Friday, August 31, 2007 11:44 PM CDT
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LAKE OF THE OZARKS - The name may sound strange, but the small, battery-operated monitor is the most innovative way researchers have engineered to increase safety for those traveling across the state's bridges.

The Flood Frog, an autonomous monitoring device, could ultimately eliminate the need for regular inspections on the more than 10,000 Missouri bridges.

A prototype was taken down last week after completing the first field study on the Highway 54 Osage River Bridge.

Installed on one of the bridge's piers in November 2006, the device is equipped with sensors that measure temperature, water level, vibration and other parameters. It can transmit findings and alerts wirelessly to the appropriate authorities.

The Flood Frog, a monitoring devise developed by researchers at the University of Missouri Rolla was placed on the Osage River Bridge during a field study. The device measures a number of elements including water level, temperature and acceleration. It transmits the information via a wireless network. The goal is to aid in improving the safety and reducing the maintenance cost of infrastructure including bridges. Photos courtesy of Valerio Plessi

The Flood Frog was developed by University of Missouri-Rolla researchers Filippo Bastianini and Sahra Sedigh, assistant professor of electrical and computer engineering.

'This was the first field test of the prototype, so the main emphasis was ensuring the robustness of the system, the accuracy of the data collected and the communication capability,' Sedigh said. 'The simplest use of such information is automatic generation of alerts whenever the data shows an alarming pattern.'

One example would be utilizing the water level measurement to automatically warn law enforcement or other authorities of a flash flood.

Currently the most common way information is gathered is by regular inspection visits, which yield subjective information and are more costly, she said.

The Osage River Bridge was chosen for the study because independent water level measurements were available and its close proximity to the university. The location was the perfect spot to test how well the device would hold up, Sedigh said.

The project was sponsored by the U.S. Department of Transportation and carried out in collaboration with the Center for Infrastructure Engineering Studies at UMR.

It works on any bridge and currently costs less than $500 to manufacture. Batch production would reduce the cost to about $200 a piece. The monitor has a battery life of five years.

Plans are to use a solar backup in the next prototype which will reduce its size.

The study will continue when a bridge in Washington County is outfitted with three devices in the immediate future.

Fall enrollment increases at UMR

The University of Missouri-Rolla is again breaking with the national trends that show a decrease in the number of students interested in studying mathematics, engineering, and science. Enrollment on the first day of classes at UMR is expected to be 5,663, an increase of 234 students over last year's figure of 5,429, says Laura Stoll, UMR registrar. The total enrollment is now more than 30 percent larger than that of fall 2000 when the university opened with 4,256 students.

"We are very happy to attract one of the largest, most diverse and highly talented new student classes in the university's history," says UMR Chancellor John F. Carney III. "I thank the UMR faculty and community for all of their efforts to add additional classes and accommodations to properly serve all of the students."

Demand for UMR's first-year engineering program is at an all-time high with more than 805 students already registered. To prepare for the increases, last May the university started adding instructors and class sections and allowed transfer students to live outside of university housing.

The freshman class is expected to be one of the three largest in UMR's history. Currently there are 980 freshmen enrolled. There were 899 freshmen enrolled on the first day of class last year. New students from 29 different states and more than 15 foreign countries will start classes on Monday. About 60 percent of the new students represent the upper 20 percent of their high school graduating classes. This year's average ACT score, a measure of the quality of the freshman class, was again in the upper 10 percent in the nation.

"This class is academically strong and more diverse," says Lynn Stichnote, director of admissions at UMR. "The early enrollment reflects major increases in the number of women and minority students, as well as a significant increase in the number of new students in the business, arts and sciences programs."

About 60 percent of the increased enrollment is due a higher number of students returning to university.

"Student success is a top priority at UMR," says Carney. "Our high student retention rates are a result of the efforts our excellent faculty and the many new student support programs initiated over the past few years."

Increasing the student retention and graduation rates have been a key part of UMR's strategic plan for the past six years.

"UMR attracts a very special type of student body, one that is now of national importance due to rapidly declining interests in the engineering and science fields," says Harvest Collier, vice provost of undergraduate and graduate studies. "I believe students recognize that the Rolla community is one of the few places in the nation that provides the caring attitude and early academic intervention systems that help today's Generation Y students succeed at high levels."

The total enrollment is expected to be more than 5,720 once students finish enrolling in fall classes. "We will continue to enroll students through the first few weeks of the fall

semester," says Jay Goff, UMR dean of enrollment management. "We usually gain well over 70 enrolled students by the end of registration."

The official fall semester enrollment numbers will be released after the fourth week of classes. Classes begin at 8 a.m. Monday, Aug. 21.

Internal Media Sources

S&T research contributes to Nobel Peace Prize

06/10/2008 16:32 - Missouri S&T Public Relations

Although former Vice President Al Gore got most of the credit in the media for the 2007 Nobel Peace Prize, the award was shared by the **Intergovernmental Panel on Climate Change** (IPCC). A team of researchers from Missouri University of Science and Technology were integral to the IPCC's work and this spring the group received official recognition from the Nobel Committee.

The award was presented for "efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change." The IPCC was recognized for its research connecting human activities and global warming. Missouri S&T researchers from the Center of Excellence for Aerospace Particulate Research contributed their work with studies and analysis related to aircraft emissions in the atmosphere.

The Missouri S&T team is led by Dr. Donald Hagen, professor of physics, and Dr. Phil Whitefield, professor and chair of chemistry. Their research into the role of aircraft emissions on climate change was featured in chapter seven of the IPCC report "**Aviation and the Global Atmosphere**," one of the scientific reports from the IPCC that contributed to the Nobel Prize. Hagen and Whitefield were two of the chapter's lead authors. The report summarized the knowledge of the roll of aircraft emissions on climate change and made predictions based on that information.

In the mid-1990s, Hagen and Whitefield were invited to join the IPCC and contribute their research to the panel. For more than a decade, the pair has been studying particulate emissions produced by aerospace activities, such as aircraft operations and rocket launches. Their work has led to the development of an internationally accepted approach to characterize the nature of particulate matter, or soot, in jet engine and rocket exhaust.

Soot is the most complex of the emittants of a jet engine and the least understood, Hagen says, despite all the research that has been done in recent years. "Much is still unknown about its environmental and health impacts," Whitefield adds.

The Missouri S&T researchers are examining soot, as well as other aircraft emittants, to attempt to answer some of these questions.

In relation to climate change, they're examining what airplanes are doing that affects the natural balance the earth uses to deal with the sun's radiation, Whitefield explains. "That is the energy driving the whole global climate change issue. We're dumping all these greenhouse gases into the atmosphere and they're upsetting that natural balance."

"And that's becoming increasingly interesting to the population as a whole," Hagen adds.

Hagen and Whitefield credit their colleagues at Missouri S&T for much of their recognition.

"One reason we were able to do so much work in this area is because we are at a university that is a mix of science and engineering," Hagen says.

"We were able to represent the university on the IPCC, but we drew on phenomenal support from our colleagues who work with us in this interdisciplinary center. Missouri S&T is a unique entity to foster that kind of work."

In addition to Hagen and Whitefield, Dr. Darryl Alofs, professor of mechanical and aerospace engineering, Dr. Nuran Ercal, professor of biochemistry, and Dr. Gary Gadbury, assistant professor of mathematics and statistics, also work on the project, as well as graduate and undergraduate student researchers.

Missouri S&T students to compete in national finals of environmental design contest

05/12/2008 16:23 - Missouri S&T Public Relations

Five students from Missouri University of Science and Technology will compete in the national finals of the **Metcalf and Eddy Academic Design Contest**. The Missouri S&T team will fly to New York on Wednesday, May 13, to square off against the defending champion University of Wisconsin. This is the first time Missouri S&T has participated in the competition.

For the competition, the Missouri S&T team developed plans to upgrade an existing wastewater treatment facility in order to extend the life of the plant and meet newly implemented effluent standards.

The biggest challenges the team faced were the limitation on the land area available for the plant upgrade and the stringent effluent standards. However, the team had an advantage in its design using novel technology developed by Dr. Jianmin Wang, assistant professor of civil, architectural and environmental engineering and advisor to the design team. His technology allowed the team to maximize use of the existing tank space by enhancing the biomass retention with very minimal tank modifications.

"The chance to experience a competitive, comprehensive design and bid process has been very educational," says team leader Gavin Risley, a senior in environmental engineering from Baylis, Ill. "We have enjoyed being able to work as a hard-working and knowledgeable team."

"Our students in both teams have performed extremely well, and I am very pleased with the outcome," adds Wang.

Members of the Missouri S&T team include Elizabeth Babb, a senior in environmental engineering from Benton, Ky.; Hannah Bruce, a senior in environmental engineering from Saltillo, Miss.; Richard Childers, a graduate student in environmental engineering from St. Robert, Mo.; and Eleanor Gillis, a graduate student in environmental engineering from St. Robert, Mo.

A total of 16 teams from 10 different universities participated in the competition, including two from Missouri S&T. The second team was also selected as one of the top five teams.

Engineers Without Borders students to leave Rolla for Guatemala

05/06/2008 20:08 - Missouri S&T Public Relations

Sixteen Missouri University of Science and Technology students representing seven different majors are spending their last few days of classes preparing for their upcoming **Engineers Without Borders** journey to Solola, Guatemala.

The chapter's return trip to this tiny village will focus on finishing the building of a second earthquake-resistant classroom -- adding a roof, stairway and electricity -- and repairing the school's bathrooms.

Andrew Blair of Perryville, Mo., a senior in civil engineering, will return to Guatemala May 18-28 as the team's leader after traveling with the EWB chapter **last year**. Also making the trip are two of Blair's high school classmates: Philip Graf of Perryville, Mo., a senior in mechanical engineering, and Justin Ruessler of Perryville, Mo., a junior in architectural engineering. The three are 2005 graduates of St. Vincent High School from a class of 40 students.

Blair says he and Graf traveled to Guatemala last year, and Ruessler "jumped on board immediately" after transferring last fall from Southeast Missouri State University.

"Along with helping the students in Guatemala, I will get more familiar with what it takes to make a trip like this happen," Ruessler explains. "I hope I will learn new skills from building the stairs, helping

make the bathrooms better and masonry work, and putting a roof together."

Paul Hamilton of Kansas City, Mo., has spent the last several months focusing on the project's designs and is looking forward to making a return trip to Guatemala.

"There's a need in Guatemala, and I have a skill set that's pivotal toward increasing their standard of living," Hamilton says. "It would be selfish to withhold what I have to offer."

Dr. Eric Showalter, an advisor who will accompany the group to Guatemala, says the students' designs center on simplicity and durability.

"In the United States, we can pump water and wastewater to get it where we want it; if the pump breaks, we'll get a new one tomorrow," he explains. "In many places, you try hard to use gravity flow because gravity works every day."

Showalter, a lecturer in civil, architectural and environmental engineering at Missouri S&T, says EWB has some of the best students on campus. "I always tell employers that these are students they should be trying to recruit," he adds.

Three professionals from Chicago will also join the EWB team, including relatives of the **late Gavin Donohue**, a Missouri S&T civil engineering student who was killed last summer by a drunk driver just weeks after he returned from Guatemala with EWB. Patrick Donohue, a professional engineer, and his wife, Kathy, a registered nurse, are traveling with the Missouri S&T chapter to honor their nephew. Juan Fraggoso, a professional engineer who works with Patrick Donohue, will also make the trip.

Students traveling to Guatemala include:

- Andrew B. Blair of Perryville, Mo., a senior in civil engineering
- Zach J. Brown of Festus, Mo., a senior in civil engineering
- Philip Brubaker of St. Robert, Mo., a freshman in computer engineering
- John P. Conroy of St. Louis, a junior in environmental engineering
- Philip Graf of Perryville, Mo., a senior in mechanical engineering
- Alyson Habermehl of Rolla, Mo., a senior in business management
- Paul B. Hamilton of Kansas City, Mo., a junior in civil engineering
- Brandon Kerr of Arbela, Mo., a senior in engineering management
- Daniel Kienitz of Belleville, Ill., a senior in civil engineering
- Andy Kornuta of Waynesville, Mo., a freshman in aerospace engineering
- David Malaway of Overland, Mo., a freshman in mechanical engineering
- Phillip McGee of Park Hills, Mo., a sophomore in environmental engineering
- Gabriel Olivo of St. Robert, Mo., a freshman in computer engineering
- Justin Ruessler of Perryville, Mo., a junior in architectural engineering
- William Strupp of Catawissa, Mo., a senior in engineering management

An additional 20 Missouri S&T students, members of the same EWB chapter, **will leave May 18 for the rainforests of Bolivia**, where they plan to build self-composting latrines, install LED study lights, and replace two pedestrian bridges.

S&T students to take their steel bridge to nationals

04/22/2008 10:21 - Missouri S&T Public Relations

The Steel Bridge Team from Missouri University of Science and Technology has qualified for the national intercollegiate steel bridge competition, which will be held Memorial Day weekend in Gainesville, Fla.

Missouri S&T finished third overall in the regional competition April 17 in Fayetteville, Ark. The top three regional teams advance to nationals.

Team members design and fabricate scale models of bridges that are reassembled at competition sites. Judges look at construction speed, design, lightness, stiffness and structural efficiency. The bridges are "loaded" to test structural performance.

In Arkansas, Missouri S&T relied on consistency in the individual judging events to make a strong overall showing. S&T finished fourth in construction speed, third in lightness, third in display, fourth in stiffness, third in economy and fourth in efficiency.

The University of Missouri-Kansas City finished first at the regional event and Kansas State finished second. The host team, the University of Arkansas, finished behind S&T in fourth.

Levi Smith, one of Missouri S&T's team leaders, says S&T almost missed out on a chance to go to Florida. The regional rules state that two teams from a 10-team field are allowed to advance to the national competition, while three teams advance from an 11-team field.

"Oklahoma State was going to drop out because they couldn't construct within the rules, but we let them borrow our temporary pier for construction, which allowed them to compete, bringing the team total to 11, which allowed the third place team go to the national competition...which luckily turned out to be us," explains Smith, a senior in architectural engineering from St. Joseph, Mo.

Features in Spring 2008

re:building bridges

Fiber-reinforced polymer decks offer durability and easy installation and may become key to the development of very long bridges, where being lightweight is a critical feature. *Illustration by Jeff Harper.*

Last summer's collapse of the Interstate 35W bridge in Minneapolis served as a stark reminder that the nation's infrastructure is aging, and was a dramatic example of the type of disaster researchers at Missouri S&T are working to prevent.

Long before the collapse occurred, Missouri S&T researchers were busy developing new materials and testing methods to preserve and protect the nation's roads, bridges and buildings.

As one of only 10 national university transportation centers in the United States, Missouri S&T's Center for Transportation and Infrastructure Safety is bringing together researchers from a variety of disciplines to address some of the nation's most pressing transportation issues.

As a result of their research, we may one day find ourselves driving across bridges made from soybeans and reinforced with glass, carbon or steel fibers. While we travel across these cutting-edge structures, sensors will monitor the impact of our vehicles and warn technicians at the first signs of trouble.

Nearly 30 percent of the country's bridges are structurally deficient or functionally obsolete, according to a 2006 report from the U.S. Department of Transportation. Developments at Missouri S&T in alternative building materials and methods of monitoring the structural "health" of roads and bridges could be the keys to safer and stronger transportation systems. In addition, faculty members are training today's students for a world in which these new approaches to bridge- and road-building will become commonplace.

"We want to educate the next generation of transportation engineers," says **John Myers**, associate professor of civil, architectural and environmental engineering and director of Missouri S&T's transportation center.

Myers and his colleagues are creating and testing alternatives to traditional

building materials like steel and concrete. Polymers reinforced with carbon, glass and steel fibers already have been tested on 26 bridges in Missouri and surrounding states. A polymer made from soybeans is even being developed, and **K. Chandrashekhara**, Curators' Professor of mechanical and aerospace engineering and director of Missouri S&T's Composite Manufacturing Laboratory, said the material could be used to build bridge decks that are strong, corrosive-resistant and environmentally friendly.

Many of the bridges where new materials are tested are also being monitored by devices invented by Missouri S&T faculty. One such device is a sensor developed by **Genda Chen**, professor of civil, architectural and environmental engineering. The sensor can provide a three-dimensional model of cracks in a structure, as well as information about where and when the crack occurred.

Another device developed at Missouri S&T, called a Flood Frog, is being used to test bridges for health indicators such as strain, humidity, water level and vibration. The "frog" is an inexpensive, battery-powered device inside a waterproof case. It can easily be fixed to the outside of a structure.

"The Flood Frog can measure pretty much any quantity," says its developer **Sahra Sedigh**, assistant professor of electrical and computer engineering. By exposing a bridge's weaknesses in their early stages, "it opens a lot more doors to securing bridges than any other technology around."

Although it might seem like something straight out of science fiction, Missouri S&T researchers have even invented an inspection method that uses microwaves to see through sheets of reinforced polymer.

When researchers aren't working in the field, they can still conduct large-scale tests at Missouri S&T's high-bay lab, where it's possible to simulate the stress an earthquake puts on a bridge. Much of the testing is part of a larger project for the Network of Earthquake and Engineering Simulation.
"We are unique because we are one of only about 10 schools in the nation that can take the entire body of a bridge and test it," says **Abdeldjelil Belarbi**, Curators' Teaching Professor of civil, architectural and environmental engineering. "We are trying to duplicate exactly what happens to a bridge in the real world."

Belarbi and his colleagues hope their work will lead to the development of a new design code for transportation infrastructure that will aid engineers in building bridges with life spans of up to 100 years.

Missouri S&T receives $376,000 grant from U.S. Steel for scholarships

02/18/2008 10:56 - Missouri S&T Public Relations

The United States Steel Foundation recently announced that it has awarded a total of $376,000 in grant money to Missouri University of Science and Technology. The funds are designated for scholarships in the following areas: $200,000 for computer and engineering disciplines, $96,000 for minorities in computer and engineering disciplines and $80,000 for women in computer and engineering disciplines.

"Missouri S&T has a well-earned reputation for developing top-flight talent in a variety of disciplines and is particularly well-known for its technology, engineering and metallurgical science programs, all of which have produced graduates that have made a significant impact at U.S. Steel," says Susan Suver, vice president of human resources at U. S. Steel. "This scholarship grant reaffirms our company's commitment to helping colleges and universities like Missouri S&T develop the diverse talents and skills of students who will one day be key contributors in the workforce of the future."

In order to be eligible for one of these scholarships, students currently enrolled at Missouri S&T must maintain a grade-point average of at least 2.75. The scholarships will be awarded to selected students who are entering the junior year of a four-year program or the fourth year of a five-year program. Eligible disciplines vary by scholarship.

"We are grateful for the generosity of the United States Steel Foundation," says Missouri S&T Chancellor John F. Carney III. "These scholarships will help our students make important contributions to society as future scientists and engineers."

Based in Pittsburgh, Pa., United States Steel Corporation is the largest integrated steel company headquartered in the United States and the fifth largest steelmaker in the world. The company produces high-quality, value-added steel sheet and tubular products at facilities in the United States, Canada and Central Europe. The United States Steel Foundation was formed in 1953 to provide support for educational, scientific, charitable, civic, cultural and health needs on behalf of United States Steel Corporation. Since its formation, the foundation has made grants totaling more than $244 million.

Researchers at Missouri S&T plan to help maximize the state's waterways

01/29/2008 09:36 - Missouri S&T Public Relations

Dr. Scott Grasman, associate professor of engineering management and systems engineering at Missouri University of Science and Technology, is helping the Missouri Department of Transportation (MoDOT) develop software to assess future projects involving the state's waterways.

Grasman's work with MoDOT is part of the transportation department's study of freight optimization and development in Missouri. MoDOT hopes to develop a freight and logistics development process that focuses on waterways, but is transferable to other modes of transportation, such as trucking and railways.

The tool developed by Grasman scores each proposed improvement project based on a variety of factors, including economic impact, impact on existing operations, urgency of need and available funding.

"MoDOT has a limited amount of resources, so they have to determine which projects will have the greatest impact," Grasman says. "We've looked at the status of the industry, and what Missouri has to offer in terms of waterways and freight."

Grasman says there currently are 12 inland ports in Missouri, and there is potential for increased capacity and use, especially with the growing production of ethanol and other biofuels in the region.

"Missouri is uniquely positioned in that it has the Missouri and Mississippi Rivers, and it's centrally located in the Midwest," MoDOT has awarded $125,000 in funding since February, 2007. The funding originated from MoDOT but was given to Grasman through **TranSystems**, a Kansas City based transportation consulting company hired by MoDOT. Grasman also has been given some matching funds from Missouri S&T's National University Transportation Center.

Grasman is being assisted on the project by Dr. Ganesh K. Venayagamoorthy, associate professor of electrical and computer engineering at Missouri S&T, and graduate student Pranav Akolkar.

Grasman says the project now is in its final stages. The tool has been presented to MoDOT, which will provide feedback that may lead to modifications.

S&T ranked among top 20 for faculty research

01/17/2008 09:26 - Missouri S&T Public Relations

Missouri University of Science and Technology has one of the most productive research levels among universities that specialize in science, technology, engineering and mathematics, according to a recent study by Academic Analytics of Stony Brook, N.Y.

Missouri S&T is ranked 14th among the nation's specialized "STEM" (science, technology, engineering and mathematics) universities in Academic Analytics' 2006-07 Faculty Scholarly Productivity Index. The index evaluates doctoral programs at research universities by evaluating the number of research publications (books and journal articles) by an institution's faculty, citations of journal publications, federal research funding, and research-related awards and honors.

Academic Analytics is a for-profit company owned by the State University of New York at Stony Brook and Educational Directories Unlimited Inc.

Because the index is for the 2006-2007 year, Missouri S&T is listed in the rankings under its former name, the University of Missouri-Rolla. The university's name changed on Jan. 1, 2008.

Academic Analytics also ranked large, comprehensive universities, small universities, and specialized universities in biomedical health sciences, business, education and social sciences, and theology.

news@umr

Bridges can be retrofitted to improve blast resistance, say UMR researchers

07/25/2007 13:18 - **UMR Public Relations**

After completing a series of explosions at nearby Fort Leonard Wood, Mo., researchers at the University of Missouri-Rolla say they are still confident their retrofitting techniques could improve a bridge's ability to withstand everything from blasts to earthquakes to old age.

UMR researchers prepare to detonate high explosives by their bridge column replicas.

Dr. Genda Chen, professor of civil, architectural and environmental engineering and interim director of the Center for Infrastructure Engineering Studies, and Brian Wood of Rolla, a graduate student in civil engineering, designed and constructed three identical, one-quarter-scale replicas of typical bridge columns -- with one exception. Inside each of the columns was a sensor that could find cracks and other damage not seen during visual inspection, Chen says.

"The problem with visual inspections is that much of this damage in columns can't be seen after the earthquake or disaster is over," Chen explains. "Cracks on the columns are typically closed immediately after an earthquake due to gravity loads. You won't be able to see them with your eyes -- but this sensor can pick them up."

Of the three 10-foot columns, one remained bare to serve as the benchmark; a second was strengthened with a sheet of carbon fiber-reinforced polymer; and a third was reinforced with carbon FRP and then coated with a rubber-like layer before being covered with an additional FRP sheet.

"The FRP sheet is used to confine concrete," Chen explains. "We used the rubber-like material to dampen or modulate the shockwave effect."

Chen and Wood worked with UMR explosives expert Dr. Jason Baird to initiate four explosions using increasing levels of high explosives.

"FRP composites have very high strength-to-weight ratios in addition to being resistant to corrosion and fairly easy to apply," Wood says. "They are already used in bridge strengthening, but the additional rubber-like layer increases the amount of energy that is dissipated during an extreme loading situation such as an earthquake or an explosion, which can significantly decrease the risk of a catastrophic failure."

The FRP performed better than expected during the explosions, considering the close proximity of the blast to the columns, Wood says.

"We would like to do some additional blast testing on replica bridge columns strengthened using this methodology," Wood says.

Chen credits the strong support from Fort Leonard Wood as being the key to the smooth operation and success of this series of tests.

UMR helping MoDOT meet biodiesel mandate

07/16/2007 09:51 - UMR Public Relations

If the Missouri Department of Transportation improved its sources of **biodiesel**, the department would be able to meet **a state mandate** that calls for fueling at least 75 percent of its diesel fleet and heavy equipment with biodiesel. That suggestion is part of a list of best practices being developed for MoDOT by a University of Missouri-Rolla researcher.

Dr. Scott Grasman, associate professor of engineering management and systems engineering at UMR, is working with MoDOT to create a set of steps the department can take to improve its consumption of B-20, a blend of 20 percent by volume biodiesel with 80 percent by volume diesel.

A legislative mandate, revised last August, required MoDOT to fuel at least 75 percent of its diesel vehicle fleet and heavy equipment with B-20. Last year, biodiesel accounted for 51 percent of the 6 million gallons the department consumed.

"B-20 is more environmentally neutral and has lower greenhouse emissions," Grasman explains. "Although biodiesel is probably not the best long-run alternative fuel source, it's a more renewable fuel that can come from vegetable oils, animal fats, or really any biomass. That's one reason it's a good regional alternative."

While biodiesel may be better for the environment, the alternative fuel does have its **disadvantages**. First, vehicles and equipment powered by biodiesel have lower fuel economy and power. That loss of power, although small, may be problematic for heavy equipment like snowplows and bulldozers. Biodiesel can also be more expensive than regular diesel, a fact the Missouri legislature took into consideration when mandating its use.

As part of the research, Grasman, and Sundaresan Sadashivam of India, a graduate student in engineering management, contacted other states that have a state biodiesel program to determine any issues they faced with year-round use. According to the responses to the survey, quality was the issue that respondents felt was most important. Nearly all of the states that responded said that all the biodiesel they use should meet the American Society for Testing and Materials' biodiesel standards.

Cold weather can also affect the use of the alternative fuel because biodiesel can turn into a sludge-like consistency.

"Biodiesel is heavier than regular diesel, so it tends to settle out at lower temperatures," Grasman says. "But once it's properly mixed, it tends to not settle out. So again, it's a quality issue."

Grasman is still developing his list of recommendations and plans to provide them to MoDOT by the end of September. Although securing quality biodiesel will be a primary recommendation, Grasman says other suggestions may relate to the state's 300 biodiesel fueling points. Possible recommendations may include cleaning fuel storage tanks and placing some tanks underground.

"Improved vehicle maintenance is also important," Grasman says. "But it's clear that if you start with good fuel, you're likely to have fewer problems overall."

Missouri S&T in the News: Year I

External Media Sources

Blanchette Bridge on I-70 needs upgrades, team finds

By ***Elisa Crouch***
ST. LOUIS POST-DISPATCH
Friday, Dec. 08 2006

A team of researchers has recommended that the Missouri Department of Transportation structurally upgrade parts of the Blanchette Bridge after a crack in a support beam was discovered in July 2005.

Their report released Thursday by the University of Missouri at Rolla blamed the crack on several factors, including welding and design problems. It was found on the westbound side, and similar to one found in 1999.

The Blanchette Bridge carries Interstate 70 and about 190,000 vehicles daily between St. Louis and St. Charles counties. Bridge inspectors examine the Blanchette Bridge annually for structural problems, department spokesman Tom Miller said.

In 2003, they found dozens of cracks in supports on the eastbound side and closed lanes until crews made structural repairs. The crack found last year was unrelated and not as serious. Traffic was not affected. Nevertheless, the transportation department asked UM-Rolla researchers to pinpoint its cause.

According to the report, the bridge's problems are largely of design. They date to the late 1970s, when crews replaced the original concrete roadway deck on the westbound side with a more rigid and stronger steel grid deck system. The original structure was built in 1958. The nature of the new deck created an unequal weight distribution on the supporting beams — one factor in the cracking.

The significance of this wasn't recognized during construction, said W.N. "Nick" Marianos, a research professor at UM-Rolla who led the yearlong investigation. During the 1970s, bad welding also occurred. The culmination of these factors, plus today's heavy traffic and temperature differences on the upper and lower parts of the deck, increase the stress, the report said.

The report recommends retrofitting. Kenneth Foster, the department's supervising bridge inspection engineer, said retrofits — or structural upgrades — will occur only when other rehabilitation work is needed. Inspections will continue on an annual basis.

Marianos said he agrees with this approach. If a crack like last year's appears again, the existing deck is strong enough that it's safe for traffic.

"This single problem isn't enough to justify tearing the bridge apart to fix it," he said. The bridge deck, though it's part of the problem, also makes the structure very strong, he said. "If you do have a crack you can make it to the next inspection."

Bridge Building Competition

Updated: Nov 10, 2006 04:32 AM CST

Bridge Building Competition

By: Jason Lindsey

Cape Girardeau, MO - More than 100 future scientists from 24 southeast Missouri schools build and break bridges in MoDOT's 3rd Annual Bridge Building Competition. On Thursday, November 9th each bridge was put to the test and at the end of the day, Jeff Rose from Dexter High School stood victorious. Science reporter and meteorologist Jason Lindsey joined in on the science fun and broke his bridge LIVE on the Breakfast Show. Before breaking to pieces Jason's bridge held 26 pounds of sand.

MoDOT's bridge building competition is open to high school juniors and seniors each year. The students are provided with wood, glue, along with thread and asked to design and build the lightest bridge to carry the greatest load.

Southeast Missouri State University, the University of Missouri-Rolla, the University of Missouri-Columbia, Arkansas State University, and Southern Illinois University partnered with MoDOT to offer nearly $9,000 in civil engineering scholarships.

Prizes were awarded for first, second, and third place as well as the most creative design and most aesthetic design. Here's a peek at the winners.

- 1st Jeff Rose - Dexter High School
- 2nd Aaron Stewart - Scott City High School
- 3rd Eric Schrader - Ste. Genevieve High School
- Most Aesthetic - Lindsey Gettinger, Ste. Genevieve
- Most Creative - Adam Flannigan, Dexter High School
- Electronic Competition - Adam Flannigan, Dexter High School

UMR students put best foot forward at career fair

by Jaime Baranyai Staff Writer

Dressed to impress, UMR students stepped up and put their best foot forward as they traded resumes for business cards with potential employers at the university's biggest career fair ever Thursday afternoon.

UMR student Dan Dilliard learns about job opportunities at Ameren from company representative Scott Sandbothe at the university's career fair Thursday afternoon. jaime Baranyai/Rolla Daily News Photo

UMR's fall career fair attracted a record number of employers to campus yesterday with representatives from more than 200 companies. Today, many of those representatives will hold formal interviews with selected students.

The career fair, held at the Gale Bullman Multipurpose Building, was packed with students eager to talk to potential employers about job opportunities.

"This is the biggest career fair we've ever had and it's great," Dan Dilliard, a mechanical engineering student scheduled to graduate in December, said. "The career fairs help give us a good overview of a lot of different companies and give us the chance to get our name out there. Since I graduate in December, I'm doing a lot of 'resume dropping' today."

Brian Madson, a senior in civil engineering, hopes the career fair will give him the option to explore a number of job possibilities.

"I've actually already been offered a job, but I wanted to come to the career fair to see what else is out there," he said. "Who knows, I might end up getting an even better job offer. It's also a good place to make contacts with companies you might end up working for in the future."

Employers gave students feedback on their resumes and dispensed advice about when to apply for internships at their companies and how to get hired.

"I'll make sure to get your resume to the right person," Eric Lidholm of Terracon told Madson. "Just get me your resume A.S.A.P. and I'll make sure it goes where it needs to."

The career fair benefits the recruiters just as much as the students.

"It gives us an opportunity to meet a lot of people in one place in a short amount of time," Fred Kummer, an employer representing Dynetics, said. "We want to tell them about our internship opportunities and full-time jobs that are available, and just like the students are getting their name out to us, we're getting our name out to them. The career fair is a good recruitment tool for us, plus we just like coming here because a few of us who work at Dynetics are UMR alumni."

UMR has a strong history of students being hired in the work force upon graduation. Last year, 576 different employers recruited UMR students.

Among the employers that hire the most UMR students are Boeing Co., Anheuser-Busch Companies Inc., Caterpillar Inc., Spring Corp., Exxon Mobil Corp., Garmin International and burns & McDonnell.

The majority of those jobs are good paying ones. The average starting salary for those who earned a bachelor's degree from UMR in the past year was $51,059.

UMR degrees to be offered at Missouri State

by Jaime Baranyai - Staff Writer

A partnership between the University of Missouri-Rolla and Missouri State University that will offer two UMR engineering degrees on the MSU campus advanced today with the signing of an agreement at the Havener Center yesterday morning.

Jaime Baranyai/Rolla Daily News Photo
University of Missouri President Elson S. Floyd (far left) shakes hands with University of Missouri-Rolla Chancellor John F. Carney III (far right) after Floyd, Carney and Missouri State University President Michael T. Nietzel (middle) sign the partnership agreement between UMR and MSU that will offer two UMR engineering programs on the MSU campus. Dr. Charles McClain, interim commissioner of the Missouri Department of Higher Education, and Gov. Matt Blunt witness the signing.

Missouri Gov. Matt Blunt joined leaders from UMR, MSU and the University of Missouri for the signing ceremony of the agreement that outlines how the universities will work together to deliver the programs. Community leaders from Rolla and Springfield, along with area legislators, also attended the event.

"This is a momentous occasion in the life of the University of Missouri," University of Missouri President Elson S. Floyd said at the signing ceremony. "This collaboration between UMR and Missouri State University provides a wonderful opportunity to expand the offering of one of the nation's premier technological universities to better meet the needs of Missourians. Working together, UMR and Missouri State University are ensuring broader student access to two engineering disciplines that are among the most critical to the social and economic future of our state and nation."

The agreement between the universities allows UMR to offer bachelor's degrees in civil and electrical engineering on the MSU campus. The degree programs will be the same as UMR offers on its Rolla campus. The degrees will be from UMR, but the diplomas will read, "in cooperation with Missouri State University." Under the terms of the agreement signed

Monday, a significant portion of the course work will be offered on the MSU campus. Courses will be taught by MSU and UMR faculty, depending on the subject matter. Some classes will be delivered online from UMR and some of the upper-level courses will require MSU students to travel to Rolla.

UMR Chancellor Dr. John F. Carney III called the agreement a win-win proposition for both universities.

"This agreement paves the way for more higher education in Missouri and it will lead to a technological boost for the state," Carney said. "This country is in grave danger of losing its technological edge. We are becoming more dependent on other countries for our technology and innovation, and we also rank very low on the number of students who are graduating with math and science degrees. I am happy to say that UMR is doing its part to turn that trend around."

Which is exactly what Missouri needs, according the governor.

"The United States is becoming increasingly dependent on foreign ability for its math and science skills; we are in a technology deficit," Blunt said. "We have to get students interested in math, science and engineering, and this partnership is a great way to do that."

Blunt called the agreement a "wonderful partnership" between UMR and MSU that will help move Missouri forward in terms of technological innovation.

"The jobs of the future will require a high level of critical thinking, and math and science degrees," he said. "This will help move Missouri forward in the areas of higher education, research, technology and innovation."

Blunt said the partnership will also provide easier access to engineering degrees in Missouri.

"This partnership is a significant milestone for creating engineers in Missouri. I am grateful for your leadership and work on this exciting new program for our state," he told Floyd, Carney and University of Missouri State President Michael T. Nietzel.

Nietzel said the signing ceremony Monday marked more than a year's worth of work on the program.

"This sustains and expands the partnership that we've had with UMR for a while now," Nietzel said. "It is a real partnership with real consequence. Together we will make a very powerful team."

He said he is thrilled to offer MSU students this opportunity and said the results of it will positively affect economic development in the Springfield area.

"We believe this is a significant event, both for students and economic development in the Ozarks," Nietzel said. "The engineering degrees will meet a significant unmet need in Springfield and the surrounding area."

A starting date for the program has not yet been determined, as it will depend on additional funding from the state. The plan calls for UMR and MSU to collaborate on developing programs but notes that state money will be needed to fund a market study, develop a system to deliver laboratory-based courses online and renovate existing labs at MSU. Blunt said science and technology are a priority in his administration and he will continue to work for increased funding for higher education through the Lewis and Clark Discovery Initiative.

Although the program has not officially started, Monday's signing ceremony was a big step in moving it forward.

"This is a great day not only for the University of Missouri-Rolla, but also for Rolla and

Print this story

U.S. News names UMR to

Top 50 engineering schools

U.S. News and World Report has ranked the University of Missouri-Rolla undergraduate engineering program as one of the top 50 in the nation in the magazine's annual guidebook, "America's Best Colleges 2007," which hits newsstands next week.

UMR is tied for 48th on the list and tied for 26th place among engineering programs at doctoral-granting public universities.

The guidebook also includes UMR in its listing of the nation's top doctoral-granting public universities. UMR ranks No. 54 on that list.

UMR is also ranked 112th among all doctoral-granting universities.

Forum selects bridge project

News-Leader Staff

The Construction Innovation Forum has selected the University of Missouri-Rolla's Greene County bridge project as one of eight finalists for the forum's NOVA Award for Outstanding Innovation in Construction.

The innovation forum is an international, non-profit organization formed in 1987 to encourage and recognize construction innovations and to increase awareness of those innovations where proven to be effective.

The NOVA is the forum's most distinguished honor, awarded by a jury of internationally recognized experts following an intense and thorough investigative process.

Winners will be announced Nov. 14 at the 2006 National Conference of Construction Owners in Tucson, Ariz.

The county bridge, a 73-year-old structure on Farm Road 148 in Springfield, was in need of upgrade because of severe structural and functional inadequacy.

The Construction Innovation Forum has given a nod to the University of Missouri-Rolla's Greene County bridge project.

Its replacement, having the state's first bridge deck constructed using prefabricated glass fiber-reinforced polymer reinforcement, opened to travelers in January 2006.

The replacement bridge, funded with a $400,000 grant from the U.S. Department of Transportation, combines the corrosion resistance of fiber-reinforced polymer internal reinforcement with the speed of installation of lightweight, stay-in-place, modular fiber-reinforced polymer panels.


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Internal Media Sources

Around Campus in Winter 2007

Future engineers and scientists visit Boeing

Last summer, Boeing opened its doors to students in UMR's Minority Engineering and Science Program, a scholarship program supported in part by Boeing since 2003.

Nearly 100 students toured the Center for Integrated Defense Simulation and the Building 67 production facility in St. Louis. Afterward they met Boeing engineers, some of whom are MEP veterans, and asked questions about careers, benefits and internships at Boeing.

"This is a great opportunity for all involved," says **John Eash**, AE'79, MS EMgt'90, director of IDS Supplier Quality and executive focal for UMR. "Students have the opportunity to see what a career in engineering involves, ask questions concerning challenges faced by recent graduates, and hear from seasoned veterans. Boeing enhances relationships with the university and students, which strengthens our recruiting, research and development, and continuing education partnerships. It's an investment in their future and ours."

UMR values the site visits as well, according to **Jacques P. Fransaw**, EMgt'04 and MS SysE'07, former UMR program coordinator. "Telling students about Boeing's engineering programs is one thing; showing them is another," Fransaw says.

The Boeing visit marked the conclusion of "Hit the Ground Running," a summer program that prepares incoming freshmen for their first year in college. The program's coursework in math, chemistry and English provides a strong foundation for college life.

"I really enjoyed the hands-on approach. I now have a better understanding of how co-ops and internships play a role in getting ahead in corporate America," said **Danielle Bowles-Martin**, a freshman in chemical engineering.

Get on the bus: bringing hydrogen fuel to rural Missouri

Cleaner transportation is coming to rural Missouri, thanks to a joint effort by UMR and several federal agencies.

The state's first two hydrogen-powered shuttle buses, built by Ford Motor Co., took their first passengers on July 31 from UMR's Havener Center to the Hy-Point Industrial Park in Rolla. The hydrogen-powered buses are an integral part of the first rural test site for the federal government's hydrogen-technology program.

Currently, the hydrogen is supplied from a mobile hydrogen fueler built by Air Products and Chemicals Inc. and installed at the Hy-Point Industrial Park. Plans call for the state's first permanent hydrogen-fueling station to be built in St. Robert by 2008. The station will provide both the fuel for a commuter service for nearby Fort Leonard Wood employees along the Interstate 44 corridor and a test bed for demonstrating the safe generation, storage and dispensing of hydrogen.

Federal partners in this project include the U.S. Department of Transportation's Research and Innovative Technology Administration, National University Transportation Center, U.S. Air Force Research Laboratory and the Defense Logistics Agency.

Research in Winter 2007

These bridges won't come falling down

A group of UMR researchers led by **Genda Chen** has developed a way to retrofit bridges to help them withstand everything from blasts to earthquakes to old age.

Last summer, the researchers completed a series of explosives tests on their retrofitted bridge components at Fort Leonard Wood, Mo. The initial results make the researchers confident that their technique will improve bridges' ability to hold up under pressure.

Chen, a professor of civil, architectural and environmental engineering and interim director of the Center for Infrastructure Engineering Studies, and civil engineering graduate student **Brian Wood** designed and constructed three identical, one-quarter-scale replicas of typical bridge columns - with one exception. Inside each of the columns was a sensor that could find cracks and other damage not seen during visual inspection, Chen says.

"The problem with visual inspections is that much of this damage in columns can't be seen after the earthquake or disaster is over," Chen explains. "Cracks on the columns are typically closed immediately after an earthquake due to gravity loads. You won't be able to see them with your eyes - but this sensor can pick them up."

Of the three 10-foot columns, one remained bare to serve as the benchmark, a second was strengthened with a sheet of carbon-fiber-reinforced polymer (FRP), and a third was reinforced with carbon FRP and coated with a rubber-like layer before being covered with an additional FRP sheet.

"The FRP sheet is used to confine concrete," Chen explains. "We used the rubber-like material to dampen or modulate the shockwave effect."

Chen and Wood worked with UMR explosives expert **Jason Baird**, PhD MinE'01, to initiate four explosions using increasing levels of high explosives.

"FRP composites have very high strength-to-weight ratios in addition to being resistant to corrosion and fairly easy to apply," Wood says. "They are already used in bridge strengthening, but the additional rubber-like layer increases the amount of energy that is dissipated during an extreme loading situation such as an earthquake or an explosion, which can significantly decrease the risk of a catastrophic failure."

news@umr

UMR, MoDOT complete Blanchette Bridge study

12/07/2006 04:20 - **UMR Public Relations**

A smorgasbord of factors, including welding problems and construction misfits, contributed to the cracking of "stringers" on the Blanchette Bridge in St. Louis in July 2005, according to a recent report issued by University of Missouri-Rolla researchers.

Blanchette Bridge carries Interstate 70 across the Missouri River, connecting St. Louis and St. Charles counties in eastern Missouri. Constructed in 1958, the bridge approaches are supported with three large plate girders alternated by smaller stringers. Bridge inspectors with the Missouri Department of Transportation discovered a vertically cracked stringer – a continuous beam that supports the bridge deck – during a routine inspection in July 2005 and asked UMR researchers to help pinpoint its cause.

Dr. W.N. "Nick" Marianos, a research professor in UMR's Center for Infrastructure Engineering Studies, led the team's year-long investigation, which included site visits and field tests. The team concluded that a combination of factors converged to lead to the cracking. Although the elements had several sources, most occurred in the design phase.

The bridge's troubles began in 1979, when the westbound bridge's original reinforced concrete roadway deck was replaced with a steel grid deck system. This rigid system was placed on top of the original larger plate girders and smaller stringers, creating a unequal weight distribution.

"If a structure is given the choice between giving loads to stiff supports or less rigid supports, the load will tend to go to the larger supports," Marianos says. "Loads were shifted as the big plate girders essentially sucked the weight away from the stringers, causing an unequal weight distribution. This variance was one factor in the beam's cracking."

Marianos's team found that while the lighter steel decking helped improve the bridge's overall capacity by reducing the amount of strength the bridge had to use to carry itself, the 20-year-old stringers and plate girders rebounded inconsistently when the heavy concrete deck was removed.

To compensate for the differences, construction workers first added shim plates to the top of some of the stringers in an effort to get many of them up to the right elevation. Yet even with the addition of shim plates, workers occasionally couldn't get the grid to sit on all four supports.

"Discussions with one of the contractors' project engineers revealed that a number of these misfits occurred during the construction, and that the typical solution to the problem was parking a piece of construction equipment on the panel, forcing it to seat itself on all of the shim plates for welding," Marianos says. "Apparently, this 'fix' was not a common occurrence, but was not rare, either."

The UMR team also found that welding problems contributed to the crack. Shim plates were added in a piecemeal fashion to run the length of the bridge. Although designers were careful not to place open joints in the shim plates in places that would undergo negative bending, they didn't instruct the contractor and welders how to handle welds at the shim plate open butt joints.

"The workers just welded across the joints, something that by modern practices isn't done," Marianos says. "In several of these locations, the grid was being forced to touch the stringers by parking a truck on the grid. The stringers tried to bounce upward once the weight was removed, which stressed the weld."

Temperature cycles during the day also loaded the weld.

"The top of the bridge deck is more exposed to the sun and heats up faster in the mornings than the bottom does, which drags the stringers upward," Marianos explains. "All of these factors lead to the fact that for a significant amount of time, some of these stringers are bending backwards from what the designers thought they would be.

UMR team does well in national big beam contest

09/18/2006 12:45 - **UMR Public Relations**

The University of Missouri-Rolla recently received notification from the Pre-cast/Pre-stressed Concrete Institute (PCI) that a team of four UMR graduate students has placed second nationally in the report category of the PCI Big Beam contest.

More than 50 university teams competed in the national competition. Each team designed a reinforced concrete beam according to contest specifications and then fabricated the beam with help from a pre-cast manufacturer.

After making design calculations that included predicted failure loads and deflections, the teams conducted load tests and recorded measurements. All of the information was reviewed by PCI judges.

"The students design and perform analysis of their beam up front," says the UMR team's advisor, Dr. John Myers, an associate professor of civil engineering. "This year, the results proved that our predictions were very accurate."

Last spring, the UMR graduate students designed their beam on campus and then traveled to Coreslab Structures Inc., in Marshall, Mo., where they fabricated the finished product. The 16-foot beam was later tested back at UMR's high-bay structural engineering laboratory.

"The students actually have to work directly with a pre-cast fabricator to produce the test beam, so they learn how pre-cast, pre-stressed concrete works," says Myers. "All of the beams have to be constructed within certain boundary conditions, including length and cross-section size, for the competition."

Basic concrete is a mixture of cement, water and aggregates. The trick is to utilize higher performing materials and additional chemical and mineral admixtures to produce a highly performing product, according to Myers. The UMR team added fly ash and silica fume, among other things, to enhance its mixture.

Pre-cast, pre-stressed concrete is used in the construction of structures like parking lots and stadiums.

The ideal beam for the competition is one with low weight, low cost and high strength. The beam should also be ductile enough to deform significantly prior to failure. Structural components need to have high ductility to withstand extreme events like earthquakes.

In addition to finishing second nationally in the report category of the PCI contest, the UMR team also finished third regionally in the testing category. The 2006 UMR Big Beam Team will receive at total of $1,000 and other prizes from PCI. A team from the University of Illinois finished first overall and won $2,000.

Specifications for next year's PCI Big Beam contest will be released as early as this October. Members of this year's UMR team include:

– Jared Brewe, a graduate student in civil engineering from Marthasville, Mo.

– Trevor Hrynyk, a graduate student in civil engineering from Waterloo, Quebec.

– Amol Sawant, a graduate student in civil engineering from Mumbai, India

– Mathew Tinsley, a graduate student in civil engineering from Jonesboro, Ark.

Rolla's steel-free bridge shows substantial benefits

07/24/2006 01:55 - **UMR Public Relations**

The bridge that crosses Carter Creek on Southview Drive in Rolla has a split personality, with one lane using conventional technologies (left) and the other lane employing the latest in fiber-reinforced polymer composites.

The bridge that crosses Carter Creek on Southview Drive in Rolla is an unassuming structure, but researchers at the University of Missouri-Rolla have been paying close attention to what's hidden beneath the concrete. And so far, the researchers like what they see.

In 2004, Rolla city officials allowed UMR researchers to construct the bridge to demonstrate the use of the latest in fiber-reinforced polymer (FRP) composites, materials that were first developed for use in the aerospace and automotive industries.

"Ultimately, this research will produce safety improvements, reduce public costs and achieve technology advancement, all primary goals of UMR, the Missouri Department of Transportation and of the City of Rolla," says Dr. Antonio Nanni, an expert in the development of new construction materials, who joined UMR in 1997 but recently accepted a new position at a Florida university.

The bridge has a split personality. One lane was built using convention technologies. The other lane employs a FRP-reinforced concrete deck. The FRP deck, attached to the walls using glass fiber-reinforced polymer (GFRP) anchoring bars, uses both GFRP bars for tension reinforcement and carbon fiber-reinforced polymer (CFRP) prestressed tendons to enhance the deck's performance under both ultimate and service loads.

Two systems were designed by UMR and Rolla Technical Institute to prestress the CFRP tendons. RTI students constructed the systems to "make students familiar and eager to learn innovative technologies," says Max Vath, who supervised the students.

The use of FRP bars as internal reinforcement for concrete has been increasing steadily over the last several years, say Dr. Nestore Galati, a research engineer in the Center for Infrastructure Engineering Studies (CIES) at UMR. The CIES is closely aligned with another research initiative on campus: the national University Transportation Center, which is one of 10 in the nation that focuses on non-destructive testing technologies and advanced materials for strengthening bridges, roads and buildings.

"FRP has many advantages over conventional steel reinforcement, such as high tensile strength, light weight, and corrosive resistance," Galati explains. "These advantages make it an ideal alternative reinforcement."

The final report on the bridge will be available Tuesday, Aug. 1, online at **www.utc.umr.edu**.

UMR students to help Bolivians increase water supply

07/21/2006 03:27 - **UMR Public Relations**

A team from the Engineers Without Borders (EWB) chapter at the University of Missouri-Rolla will journey into Bolivia's rainforests next month on a fact-finding mission.

The Rio Colorado Technical Agricultural High School, situated on 400 acres of rainforest in the Beni area, is a bright spot in Bolivia's educational system, with almost 70 percent of its graduates going on to study at universities. But despite its picturesque setting, the school struggles to provide an adequate water supply to its 250 students who stay in dormitories on campus and go home only on weekends.

The UMR team's goal is to gather enough information about the water supply and geology surrounding the campus so they can return next spring and develop a safe and sustainable water supply for the school.

"We will look into providing ways to provide the school with more water," says David Longrie of Grover, Mo., a senior in civil engineering. "We will assess their well, the pump and the existing storage unit."

The team will leave Friday, Aug. 4, and return on Friday, Aug. 11. Once back on campus, EWB team members plan to design an appropriate water system for the school and prepare for a return trip to build the system.

Dr. Rick Stephenson, EWB's faculty advisor and professor of civil engineering, and Dave Schepers, a professional partner from Ameren UE, will travel with the students and provide guidance. Tom Shipley, manager of video productions at UMR, will also accompany the team. The three UMR students traveling to Bolivia are:

- Lindsey N. Campbell of Parma, Mo., a senior in ceramic engineering;
- David Longrie of Grover, Mo., a senior in civil engineering; and
- Jared Wehde of Foley, Mo., a junior in environmental engineering.

This is the fourth project for the UMR EWB chapter, which was formed on campus in 2004. Similar to the more established Doctors Without Borders, EWB works to improve the lives of people around the world by partnering with communities in building infrastructure such as water and sanitation systems and other engineering endeavors.

Donors increase endowments, establish faculty chairs

07/20/2006 04:18 - **UMR Public Relations**

The University of Missouri-Rolla has received two new gifts from major donors to endow chairs in the civil, architectural and environmental engineering department.

John and Susan Mathes of St. Louis have added $550,000 to their previous donation of $550,000, which created an endowed professorship in 1995. Vernon and Maralee Jones of Tulsa, Okla., have added $525,000 to a previous donation of $580,000, which created an endowed professorship in 1997.

"These generous increases to faculty endowments will allow us to endow chairs for two nationally known experts who will continue to help distinguish UMR as a leading technological research institution," says UMR Chancellor John F. Carney III. "We are grateful to the Matheses and Joneses for their continued support."

Dr. Craig Adams, an expert in environmental engineering, left Clemson University to accept the Mathes professorship at UMR in 1995. He will now be the John A. and Susan Mathes Chair of Civil Engineering at UMR.

Dr. Antonio Nanni, an expert in the development of new construction materials, left Pennsylvania State University in 1997 to accept the Jones professorship at UMR. Nanni recently accepted a new position at the University of Miami in Coral Gables, Fla. A search committee will be convened soon to fill the Vernon and Maralee Jones Chair of Civil Engineering at UMR.

"We got what we wanted with Tony through the creation of the professorship," says Vernon Jones, who earned a bachelor's degree in civil engineering from UMR (then the Missouri School of Mines and Metallurgy) in 1953. "We wanted to make an investment in an individual who could bring something fresh and new to the university, and we got more than we expected. Now we expect that his successor will be an eminent researcher in the field. I intend to be a full member of the search committee to fill the new chair."

Jones is the former president of The Williams Company, an energy and communications company in Tulsa.

With help from Adams and Nanni, UMR's civil engineering department has been ranked among the top 25 civil engineering departments in the nation by U.S. News and World Report. According to Carney, both researchers have attracted and retained junior faculty, raised millions of research dollars, and played important roles in the recruitment of students.

Nanni led UMR's research efforts involving the use of composite materials for the construction of new bridges and the rehabilitation of existing structures. He also provided leadership geared toward solving problems that impact the nation's infrastructure systems.

Adams directs UMR's Environmental Research Center. As the John A. and Susan Mathes Chair of Civil Engineering, he will continue to develop traditional and innovative ways to treat water and wastewater containing a wide variety of contaminants. Adams' work involves understanding and optimizing the use of activated carbon and other absorbents in water treatment methods.

"I feel we made a great investment, and that feeling caused us to invest again – to move the professorship held by Craig to a full chair and to expand on our success," says John Mathes, who earned a bachelor's degree in civil engineering from UMR in 1967 and a master's degree in civil engineering from UMR in 1968.

Mathes founded John Mathes and Associates Inc., an environmental engineering firm based in Columbia, Ill., in 1975. He sold the company to Burlington Environmental Inc. of Seattle in 1988.