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The Cornerstone Fall 2007

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New Fund-raising Campaign Crucial to Achieving Goals

The Department of Civil and Environmental Engineering (CEE) is planning to be a very active participant in the university's upcoming system-wide fund-raising initiative, The Campaign for Tennessee, which is expected to be officially announced in April 2008.

CEE's theme for this campaign will be "Building a better future through innovative education."

One of the primary areas of support that will be emphasized during the campaign will be the rebuilding of Estabrook Hall, which will be a destination to inspire prospective students to enroll in the CEE's program and a focal point to begin a productive career in civil and environmental engineering.

Estabrook Hall will be a showpiece facility for the department, featuring state of the art classrooms and laboratories. Current plans are also for the facility's structure to be as environmentally sensitive and energy efficient as possible.

Additional campaign goals for CEE include funding for program support, a new endowed department Chair position and two named professorships. The department also plans to continue to encourage contributions for both undergraduate and graduate scholarships.

"We are very excited about working with UT and COE development on these priorities during the campaign," said Interim CEE Department Head Dayakar Penumadu. "The next few years will offer us many opportunities to achieve our department's strategic and financial goals. We hope that our alumni, friends and supporters will continue to provide us with support during this crucial campaign."

THE CAMPAIGN **UT**
FOR TENNESSEE

Department Head's Message

Support and Guidance Essential for Success

In this column, many of you are accustomed to reading a message from Dr. Gregory Reed, who has served as a department head for two decades. He accepted the position of associate vice chancellor of research and started serving in this position since July, 2007. We thank him for his visionary leadership of this department for 21 years.

Change is never comfortable, but it is a great opportunity for us to grow and recognize the world of opportunities ahead of us. The most exciting change for the Civil and Environmental Engineering (CEE) Department at the University of Tennessee, Knoxville that is on the horizon is the groundbreaking ceremony expected for a brand new building during the fall semester of 2008. Estabrook Hall has served the needs of this department since 1898 and it is time to move on.

Details of the new Estabrook Hall are included in this newsletter. We would like to see all of you for the ground breaking ceremony and anticipate your involvement in helping us develop an educational facility that is a destination for learning and scholarship. The State of Tennessee has provided \$16.6 million dollars for this building. Based on the current and future needs of this department, a premier facility that will make us all proud at a cost of approximately \$20 million dollars is being planned. I have included an overview about the upcoming capital campaign and sincerely hope many of you will seriously consider giving back to this university and alma mater.

Since my family's arrival to Knoxville from Potsdam, NY in 2001, we have enjoyed observing the Tennessee VOLUNTEER spirit from so many of you, and we are delighted to be a part of this community. The department is counting on your support for the major initiatives being planned to provide the best educational opportunities for the CEE students of Tennessee and the world. Your financial contributions can make a significant difference, but equally important to us is for you to stay involved with the department and guide us into the future.

We have a lot to brag about: student enrollment, research funding and the department's ranking in *U.S. News & World Report* is steadily rising. Our undergraduates continue to excel on FE licensing examination with passing rate above 90% while the national average is in mid-70%. We continue to expand our distance education program to serve practicing professionals via the web. The department faculty and staff are working harder and smarter than ever before to ensure success in teaching, research and service, yet always finding time to mentor our young students with educational and personal issues.

We hope that you can significantly enhance your giving during the coming five years to make a long-term impact to the future generation of Tennesseans as we officially embark on our new capital campaign in April, 2008. To keep you informed of the current activities of my department, this edition contains articles detailing ongoing interdisciplinary research of significant relevance to the civil and environmental engineering community. I can assure you we will continue to strive for excellence in developing collaborative research teams within the department, college, consulting community and national laboratories.

Please drop me a note at cee@utk.edu, I would enjoy hearing from you.

—Dayakar Penumadu, Interim CEE Department Head



Dr. Dayakar Penumadu

New Faculty Members

The Department of Civil and Environmental Engineering (CEE) welcomed four new faculty members in August 2007.



Dr. Chris Cherry a concentration in transportation. His research interests include transportation needs of rapidly developing countries, specifically China; public transportation planning and operations; travel behavior and demand; transportation economics; and transit security.

Dr. Qiang He, assistant professor, comes to UT from Temple University where he taught as an assistant professor in civil and environmental engineering. He received his Ph.D. in environmental engineering from the University of Illinois at Urbana-Champaign in 2003.

After receiving his Ph.D., He worked as a research associate in the Environmental Sciences Division at Oak Ridge National Laboratory (ORNL) in nearby Oak Ridge, Tenn. He's research interests include environmental biotechnology, water quality and environmental microbiology.



Dr. Qiang He



Dr. Jack Parker, research professor, received his Ph.D. in soil physics from Virginia Polytechnic Institute and State University in 1980. Parker came to UT from ORNL where he worked as a distinguished research scientist. Before ORNL, Parker served as president of Environmental Systems & Technologies, Inc., from 1988 to 2001. His technical expertise are in the areas of multiphase flow and transport modeling in porous and fractured media; groundwater and unsaturated zone hydrology; model calibration and uncertainty analysis; and design and cost optimization and decision analysis.

Dr. Xuedong Yan, research assistant professor, comes to UT from the University of Central Florida where he received his Ph.D. in civil engineering and also worked as a research associate for two years. Yan's research interests include advanced driving simulator application on traffic engineering; traffic safety and statistical analysis; traffic simulation; geometric design; intelligent transportation system; and GIS application on traffic engineering.



Dr. Xuedong Yan

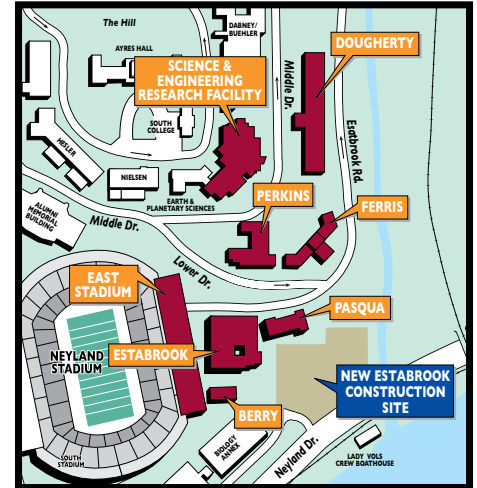
New Estabrook Design Moving Forward

Architects are making progress on the design of Estabrook Hall. The tentative layout of the ground level space is completed, with the building now located between Pasqua, the City of Knoxville Greenways creek and Neyland Drive. The area is now presently occupied by the engineering automotive annex.

Current plans are to complete the initial design that will lead to the confirmation of the Site Preparation Bid by August-September of 2008, with an anticipated ground preparation date in the late 2008 to early 2009 time period.

In addition to the space that is currently being designed for the CEE department, an expansion to the design is being developed that would provide an additional 25,000 square feet of assignable space that would house the Department of Industrial and Information Engineering as well as an expansion of space for the Department of Nuclear Engineering.

The UT Office of Development will be working with the college and departments to assist with efforts to raise funds for the expansion. It is anticipated that the building will be completed and available for occupancy in 2011.



UT Hosts Regional ASCE Student Conference

The Department of Civil and Environmental Engineering (CEE) at the University of Tennessee (UT) hosted the American Society of Civil Engineers (ASCE) 2007 Southeast Student Conference in Knoxville, Tenn. Over 700 students from 25 universities attended the three-day event.

Students who attended the conference competed in a range of events and presentations in order to earn points, which would determine their overall ranking. Competitions included a concrete canoe race, construction of steel bridges and display of spaghetti bridges. An awards banquet concluded the conference and the UT-ASCE chapter took fourth place overall.

"UT was very successful," said Rebecca Lind, CEE graduate student and conference coordinator. "Everyone had a great time and it gave us a great opportunity to showcase the campus, our facilities and Knoxville."

Dr. Eric Drumm, CEE professor, is the ASCE student chapter advisor. Platinum sponsors of the conference include Jordan, Jones and Goulding; S&ME; Ross Bryan Associates, Inc.; and UT's CEE.



Teams participating in the Concrete Canoe and Spaghetti Bridge competitions finalize their entries. Visit <http://conference2007.utkasce.org> for more information and photos.

Collaborations Improving Transportation in the New Millennium

Transportation research at UT, when viewed narrowly, is a core group of faculty whose expertise falls into the traditional areas of planning, design and operations. More broadly, it obviously includes pavements, structures and environmental issues, but even this broader view is insufficient to meet the needs of the 21st century. Now, more than ever, interdisciplinary collaboration is of paramount importance. One such effort involves Dr. Tom Urbanik, Goodrich Chair of Excellence and professor of civil and environmental engineering (CEE), in collaboration with Dr. Itamar Elhanany, assistant professor in the electrical engineering and computer science

department (EECS).

Dr. Urbanik and Dr. Elhanany are conducting research at the National Transportation Center on a NTRCI-funded project for controlling vehicular traffic flows in complex transportation settings. The work utilizes a novel approach for scheduling vehicles across a network of intersections. By employing graph theory and systems control techniques, as commonly used in the area of high-speed communication networks, this work aims to deliver a robust and scalable framework for next-generation transportation infrastructure that can adapt the control decisions to reflect the characteristics of vehicles with a focus on trucks.



Students collect license plate data for a research project involving automated speed enforcement.

Unlike existing schemes for traffic signal control, which focus on vehicle throughput across intersections and the minimization of queuing delay, this work

addresses a broader spectrum of performance criteria. In particular, a unique aspect of this project is the emphasis on truck safety. The latter renders safety an inherent component in the traffic signal control process which dictates traffic light configurations. This results in a reduced probability of truck-related accidents, as well as improves the condition of the road. As a result, it is expected that overall flow of traffic, as well as safety, will be improved.

Another example of interdisciplinary collaboration involves Dr. Lee D. Han CEE associate professor, in collaboration with Dr. M. K. Jeong, assistant professor of industrial and information engineering (IIE), who are conducting a NTRCI-funded study on tracking and profiling heavy trucks for safety, security and air quality purposes. The study employs a locally-developed video-imaging-based license plate recognition technology to identify and track trucks at multiple locations along the interstate highways. Travel speeds, vehicular registration data and other information are derived and utilized to enforce speed regulations in a fashion far more extensive and efficient than the traditional practice.

Cooperative Education (Co-op) Making Positive Impacts

Since 1926, the Office of Professional Practice (formerly Co-op Engineering) has offered civil engineering students varied real world opportunities in Corporate America. The goal is simple, expose as many students as possible to the current expectations of the working world by connecting each student with an assignment relevant to his/her major and area of interest. With the start of a database in 1994, records show over 490 civil engineering students to pass through this program. Currently, there are 112 students seeking assignments, in assignments, or have just finished assignments and are awaiting graduation.

The recent surge in construction in the United States has caused an increase in the demand for civil engineering students, such that at our recent Engineering Fair, 51% of the participating employers were seeking civil engineers. Our 198 corporate partners that seek civil engineers are from 20 states around the country. Since 1994, we have had 459 civil engineering placements for Co-op or Internships. Our challenge is that the demand is greater than the supply by a factor of three. Today, there are over 60 Co-op/Intern companies looking to fill assignments with multiple openings, e.g. one Virginia business has a need for 35 students in their nationwide operations.

Our program has seen many civil engineering students succeed with the realization and confirmation that a particular career path is "right" for him/her. Three such individuals are James Gourley (2002 graduate), Blanca Mercedes (2004 graduate), and Joey Barbeauld (2006 graduate). James went to work with Skanska in North Carolina after finishing his MS at MIT. Blanca was a honor student and Diversity Engineering Scholarship recipient with the El Paso Corporation, but choose to work for Turner Construction after graduation and has had numerous assignments across the country. Joey Barbeauld, also an honor student, graduated last May and went to work for his Co-op employer, EMJ Corporation in Chattanooga, TN. Each individual garnered varied experiences to enhance their vision of the future. We are proud of all our students for their personal and professional successes and would offer that they have all recognized one variable, "when you get into Co-op, Co-op gets into you."



Recent CEE graduate **Joey Barbeauld** (center) is currently working full-time for his Co-op employer EMJ Corporation.

—Walter Odom

Director, Office of Professional Practice

Continued on page 8

UT Bridge Research Vital to Infrastructure Safety

The recent failure of the steel deck truss bridge in Minneapolis calls attention to the important role bridges play in our society and to the ever-increasing concern about the nation's infrastructure. The Department of Civil and Environmental Engineering (CEE) at the University of Tennessee (UT) has a rich history of bridge related research, started in the late 1960s by Drs. David Goodpasture and Edwin Burdette, professors of civil and environmental engineering, which has continued to the present.

The gates of the Tennessee Valley Authority's Tims Ford Dam were closed September 1, 1970, inundating four serviceable, contemporary highway bridges. In research supported by The Tennessee Department of Transportation (TDOT) and the Federal Highway Administration (FHWA), Burdette and Goodpasture and a team of research assistants tested the four bridges to failure. At the time this research was performed, it was unique; copies of the final report were distributed to all fifty state departments of transportation and to a number of foreign counties.

The full-scale bridge testing project was the beginning, and the results contributed significantly to an enhanced understanding of how bridges respond to load. Research since then has broadened to include not only structural behavior, but other important aspects of bridge safety and economy. Other UT research related to structural behavior addressed questions of appropriate modeling for seismic loading and lateral distribution of loads to supporting members.

An early project dealt with learning the stress history of highway bridges. This was part of a nationwide effort to evaluate the level of stresses in steel bridges, an effort whose importance has been underscored by fatigue failures in several of the nation's bridges. One such failure was local; a large crack appeared in a plate girder. Because of redundancy, the bridge remained stable, but extensive repairs were necessary. Again, Goodpasture and Burdette, with the valuable addition of Dr. Hal Deatherage, professor of civil and environmental engineering, made field measurements to evaluate the adequacy of the fix.

TDOT is the acknowledged national leader in the design and construction of jointless bridges, a design concept directed toward minimizing expensive and troublesome joints. Extensive research sponsored by



Joint test in progress, under the direction of Dr. John Ma, at the National Transportation Research Center Laboratory.

TDOT and FHWA has been carried out by the civil engineering research team of Burdette, Goodpasture and Deatherage to evaluate the appropriateness of TDOT criteria and to determine limits on bridge length for which this design approach is appropriate.

Two bridges have been designed and built in Tennessee that utilized an innovative method of construction, which led to improved economy. These bridges were instrumented and tested under special vehicular rolling loads. Analysis of the data, still ongoing, confirmed the adequacy of this design approach.

Development of new materials or improved existing materials is an important facet of ongoing bridge research. Burdette and Deatherage are completing a study of high performance concrete in which a dense graded concrete mix has been developed to enhance durability of the bridge deck concrete. A recent addition to the civil engineering faculty, Dr. John Ma, associate professor, is doing composites research in which concrete in the slabs of "decked bulb tees" will be replaced with fiber reinforced plastic. This research, supported by the National Science Foundation (NSF), will potentially have an important effect on the design of more durable and economical bridges.

An area of research described as "structural health monitoring" has emerged as a particularly relevant and valuable area of bridge research. While the concept is hardly new, formal recognition of this branch of research and an enhanced awareness of the importance of this subject are relatively new. Currently, work under the direction of Dr. Dayakar Penumadu, professor and interim head of CEE, uses geophones and sophisticated data collection equipment to assess the soundness of bridge members in order to

Burdette Delivers Address

Dr. Edwin G. Burdette, Fred N. Peebles Professor in the Department of Civil and Environmental Engineering, was the honorary guest speaker for the College of Engineering's Spring Commencement Ceremonies. The event was held on May 10, 2007.

The keynote speaker, CEE graduate Darwin Walker, Vice President and Chief Development Officer of Pennoni Associates Inc. and a standout National Football League player, was one of Burdette's former students. Walker was also a member of the UT Vols 1998 National Championship team.

Burdette has been a member of the COE faculty since 1969, and he remains active in research, teaching and consulting in the area of structural engineering.



Dr. Ed Burdette

Burdette received an Outstanding Teacher Award at the 2007 Chancellor's Honors Banquet, and he was also presented with the COE's Teaching Fellow Award in 2006. He also was awarded the Alexander Prize for Teaching and Scholarship in 2001 and received the University Macebearer Award in 1990.

At the September COE Faculty Meeting, Dean Way Kuo presented Burdette with a framed photo, autographed by Walker, of the two speakers taken during the ceremony.

detect any deterioration in their condition, and then to assess the "structural health" of the bridge as a whole. A doctoral student, William Ragland, is currently working to refine the methodology for practical use in evaluating the structural integrity of bridges, particularly older bridges.

From the early work on full-scale bridge testing to current efforts on structural health monitoring, research on bridges has been and continues to be a vital part of the research program in civil engineering. This research, affecting both economy and safety, is needed as a part of a nationwide effort to address crucial issues relating to an aging infrastructure.

Team Studying Effects of Pollution in Great Smoky Mountains National Park

The U.S. Environmental Protection Agency (EPA) awarded the UT Department of Civil and Environmental Engineering (CEE) a \$750,000 grant to study the impacts of atmospheric deposition of acid pollutants on water quality and fish.

The three-year grant was awarded in 2006 through the University of Tennessee Natural Resource Policy Center. Dr. John S. Schwartz, CEE assistant professor will take the lead as the principal investigator, with help from Dr. Bruce Robinson, CEE professor emeritus; Dr. Ted Henry, research scientist in the Center for Environmental Technology; and Dr. Randy Gentry, CEE associate professor and director of UT's Institute for a Secure and Sustainable Environment (ISSE). To date, the project has funded one post-doctorate researcher, Dr. James Calcagno, and six graduate students: Keil Neff, Meijun Cai, Edwin Deyton, Amanda McKenna, Candice Owen and Tom Zimmerman.

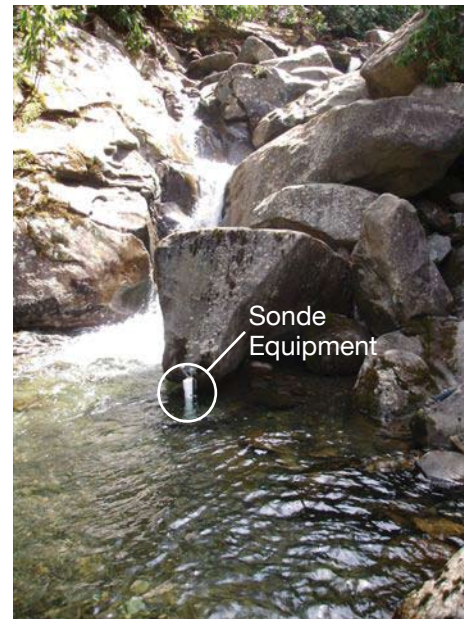
The research was initiated because native brook trout have been extirpated from six headwater streams in the Great Smoky Mountains National Park. Based on long term declines in stream pH, park resource managers fear brook trout will continue to be eliminated from streams and may disappear entirely from the park within about 25-50 years. Although acid deposition and acidic storm events are suspected of being the primary cause, baseline and storm event water quality monitoring coupled with fish sampling, in situ survival tests and physiological examinations are required to determine whether acid deposition is indeed the cause. The research project consists of monitoring streams that have experienced native brook trout elimination and those that have not. This research compares water quality, especially pH and toxic metal concentrations, and survival and stress of trout under baseline and storm event conditions. Results will also be compared between healthy stream reaches in the park and those that have seen extirpation. In addition, the project consists of developing a water quality model to predict stream pH based on different deposition loads of acid pollutants, and explore whether researchers can develop a model that predicts brook trout declines.

Three stream sites were selected for the

monitoring part of the study: Little Pigeon River, Ramsey Prong and Eagle Rocks Prong in the Greenbrier area of the park. The Little Pigeon River serves as a control in that it has not seen trout extirpation. Ramsey Prong and Eagle Rocks Prong have shown historical brook trout extirpation for unknown reasons. Stream monitoring consists of continuous water measurements with a multi-parameter monitor (data sonde for pH, conductivity, temperature, flow stage); collection of storm events stream samples with an ISCO automated sampler; measurement of fish population metrics with standard electrofishing gear; in situ brook trout survival tests; and collection of individual fish for physiological testing including whole-body sodium analysis.

Storm water samples collected by the ISCO samples have been analyzed for anions, cations, and metals. ISCO samplers collect 24 bottles per storm event approximately one hour apart. Because of the remote locations of the three study sites, researchers have had to address equipment issues, but have been successful in collecting approximately five storm events for each site. At each study site, stage-discharge relationships are being developed using standard USGS protocols. These relationships will allow researchers to convert the 15-minute recorded flow stage data into discharge. In addition, flow data and the 24 WQ samples will allow researchers to compute pollutant mass loadings per time (or flux) from the watersheds. Researchers plan to continue this WQ monitoring operation for the duration of the project. To date, storm water monitoring has recorded stream pH levels dropping to a low as 4.0, which is very acidic and at a level that can cause trout death. Preliminary analysis of the data has determined atmospheric deposition of sulfate acid is one of the main contributors to the observed stream acidification, however it appears there are other factors to contribute to stream acidification as well. Researchers are preparing for a new set of experiments to investigate the other factors starting fall 2007.

An in-situ brook trout survival test was successfully conducted for a two-week period in June 2006 and again in March 2007, where in each experiment, 120 brook trout were



Continuous water quality monitoring station on Eagle Rocks Prong in the Great Smoky Mountains National Park. Measurements taken include pH, temperature, conductivity and turbidity.

captured through standard field electrofishing techniques. The captured trout were placed in cages, 40 per stream, in three streams constituting the study sites. Fish were exposed in situ to storm flow events in which two streams dropped in pH to 5.5, and the third high elevation stream site dropped in pH to 5.0. Fish were collected from the cages before and immediately after the storm, and then twice after the storm for the next week. Brook trout collected, 48 total were brought back to the UT lab for whole-body sodium analysis. The remaining 72 fish were released back into their native stream unharmed. Other researchers have shown that whole-body sodium can be used as an indicator of fish stress from acid pollutants. Results from the whole-body sodium analyses indicate that physiological stress occurs in the brook trout from episodic stream acidification.

The research team is conducting additional field experiments to learn more about the impacts of atmospheric deposition of acid pollutants in the Great Smoky Mountains National Park. The team works on this project in collaboration with Steve Moore and Matt Kulp, resource fishery biologists in the park, and regularly meet with park staff to discuss their management needs and focus research efforts to support their needs.

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CEE Students and Professor Instrumental in Engineers Without Borders Project

Last year, several students in the Department of Civil and Environmental Engineering (CEE) completed a water development project for the village of Los Cerros in the Dominican Republic through their involvement with the UT Chapter of Engineers Without Borders (EWB). Tom Zimmerman, former chapter president and CEE student, organized a team to work on this project. In March 2006, students Jordan Mynatt, Andy Dodson, Dan Carter and Peter Arant from UT, and CEE Assistant Professor John Schwartz traveled to the village of Los Cerros to assess the water problems and complete survey work. While the group was there, a meeting with local government officials resulted in an agreement that the "county" public works department would drill two boreholes about 100 feet deep.

Once back at UT, students designed a water system that included a borehole pump, 3,000 feet of water distribution pipeline and two water storage tanks. Zimmerman directed the fundraising and secured a \$10,000 grant from the Anna Campana Judge Foundation and the National Ground Water Educational and Research Foundation. In December 2006, the same students and professor that when on the March assessment trip, along with students David Ritter and Lee Mauney, went back to the village to construct the project. The project was successfully completed during that December implementation trip.



CEE Awards and Recognitions

The College of Engineering hosted its annual Honors Banquet April 10, 2007, in the University Center Ballroom where faculty, staff and students from Department of Civil and Environmental Engineering were recognized for the following:

- Outstanding Support Staff—**Kenneth Thomas**, Electrical & Instrumentation Shop Supervisor
- COE 2007 Research Fellow Award—**Dr. Baoshan Huang**, Assistant Professor
- Joint Institute for Advanced Materials Chair of Excellence in Transportation Award—**Dr. Dayakar Penumadu**, Professor and CEE Department Head
- Chancellor's Award for Extraordinary Undergraduate Academic Achievement—**Joseph Barbeauld**
- Chancellor's Award for Extraordinary Professional Promise, Undergraduate—**Stephen Harris**

2006 Engineers Day Exhibit Awards:

- Class I Exhibits, 1st Place—**American Society of Civil Engineers** for West Point Bridge Design
- Class II Exhibits, 1st Place—**Engineers Without Borders** for Agua Limpia

As transportation management and operations become larger components of transportation engineering practice, computer and information technology will become more important engineering tools. Through collaboration

beyond traditional areas of expertise, transportation faculty and their students are involved in leading edge technology and its application to the 21st century.

Department of Civil and Environmental Engineering

Faculty

Dr. Richard Bennett..... Associate Head and Professor
 Dr. Sandeep Agnihotri..... Assistant Professor
 Dr. Edwin BurdetteFred N. Peebles Professor
 Dr. Arun Chatterjee..... Professor
 Dr. Chris Cherry Assistant Professor
 Dr. Chris Cox..... Professor
 Dr. Hal Deatherage Emeritus Professor
 Dr. Eric Drumm..... Professor
 Dr. Joshua Fu Research Assistant Professor
 Dr. Randy Gentry..... Associate Professor
 Dr. David Goodpasture Emeritus Professor
 Dr. Lee Han..... Associate Professor
 Dr. Qiang He..... Assistant Professor
 Dr. Baoshan Huang..... Assistant Professor

Dr. John Ma Associate Professor
 Dr. Terry Miller Associate Professor
 Dr. Jack Parker Research Professor
 Dr. Dayakar Penumadu Interim Department Head and Professor
 Dr. Stephen Richards... Associate Professor and Center for Transportation Research Director
 Dr. Kevin Robinson Associate Professor
 Dr. R. Bruce Robinson Emeritus Professor
 Dr. John Schwartz Assistant Professor
 Dr. Tom Urbanik..... Professor and Goodrich Chair of Excellence
 Dr. Elis Vllasi Research Associate
 Dr. Xuedong Yan.. Research Assistant Professor
 Dr. Qiuhong Zhao Assistant Professor

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