Earthquake Protection
Buckling Restrained Brace: A seismic system for structure and human protection.
Message from the Chair

Dear Alumni and Friends,

Welcome to our Fall 2014 Newsletter! Thank you for taking time to catch up on all the great things happening in Civil and Environmental Engineering (CvEEN) here at the University of Utah. Reflecting back on my first year as Chair of CvEEN, I am truly amazed at the wonderful advancements that we as a Department, College, University, and Community have been able to accomplish. Driven by enthusiastic faculty, dedicated staff, hard-working students, and caring alumni all working together to constantly advance our program, we have been able to turn the challenges faced by academia into opportunities to improve the educational and research experiences of our students. As you all know, civil and environmental engineers design and build the infrastructure essential for economic growth and societal well-being. We are working hard to provide opportunities for our students to learn about and problem-solve real solutions to the challenges we face now and into the future with the help of faculty such as BJ McPherson, Luis Ibarra, and Pedro Romero (see pages 3 and 4) and exciting research projects involving critically important topics such as earthquake protection and wastewater recycling (see pages 6 and 7).

Over the past year CvEEN has proudly graduated over 70 undergraduates, 32 master’s students and seven Ph.D.’s. In addition, our Nuclear Engineering program awarded 10 undergraduate minors and graduated four master’s students and one Ph.D. However, demand for civil and nuclear engineers capable of providing sustainable solutions of increasingly complex problems continues to grow. With a projected 20 percent growth in civil engineer employment for the foreseeable future, our mission of CvEEN is to increase the number of graduates with high-quality educational training and innovative research experiences to pursue the challenges of today and tomorrow.

To help meet our growth targets, we are excited to welcome two new faculty members to our growing ranks, Azaree Lintereur in Nuclear Engineering and Dan Fagnant in Transportation Engineering (see page 4). This brings our full time ranks up to 22 faculty members who are all working towards improving our state, national, and world status as an academic institution. Our increasing success is being reflected in various evaluation metrics associated with rankings and national recognition of faculty. For example, CvEEN is now ranked No. 56 according to the latest US News & World Report assessment of civil engineering programs, and the American Society of Civil Engineers recognized Dr. Richard Porter (RJ) as this year’s recipient of their Excellence in Civil Engineering Education (ExCEEd) New Faculty Excellence in Teaching Award.

Rest assured that we are not slowing down. The 2014-2015 academic year is shaping up as another exciting year for CvEEN as we continue to increase the quantity and quality of our student body, our faculty, and our research endeavors. We are actively recruiting top students by increasing scholarships and evaluating and modifying our curriculum to insure we stay at the forefront of highly rated engineering programs expanding our research efforts both nationally and internationally.

As always, I encourage you to get involved with the Department to help find creative ways to interact with the students and show them the many wonderful opportunities a degree in CvEEN from the University of Utah can provide. Go Utes!

Yours truly,

Michael E. Barber
Professor and Chair of Civil & Environmental Engineering
University of Utah
Dr. Lawrence (Larry) Reaveley has been part of the department for more than five decades.

He began his academic endeavor when he graduated from the U with a Bachelors of Science in Civil Engineering in 1963. He continued at the U and received his Masters in Civil Engineering in 1964 before going to the University of New Mexico to complete his Ph.D.

In 1992 Larry procured the position, Chair of the Department. At the time he took over, the Department was in serious need of rejuvenation. During the Department’s restructuring, Larry did a great job in attracting new faculty and rebuilt the department to become one of the top 60 civil and environmental engineering schools in the country.

During his time as a tenured faculty, Larry passionately guided students towards a prosperous career, who are now some of today’s leading industry professionals. Through the civil engineering halls he evoked countless hours of service to the department’s needs in advancing students, lab upgrades and alumni relations.

Larry has left a perpetual imprint on the program and legacy that the department will continue to fulfill. His love of the students, alumni and industry will remain an integral part on a path toward excellence. Through Larry’s provision the department will continue to be a valuable contributor to the state of Utah, the nation, and the world.

We wish Larry the best this Fall semester as he finishes with his final Ph.D. students.
Meet the Faculty

Dr. Brian McPherson is an Associate Professor of Civil and Environmental Engineering at the University of Utah. In 2006, Dr. McPherson formed the carbon science and engineering research group. The group consists of 10 high-caliber graduate students and two professional staff. The research focuses on injection of carbon dioxide into deep rock formations. This is called carbon sequestration, and is a popular approach to CO2 emissions reduction because the capacity of deep rock formations is tremendous: the state of Utah alone possesses subsurface storage capacity for at least 150 million tons of carbon dioxide, about 150 years worth of a typical coal-fired power plant’s emissions. Deep injection and storage is not without risk, and assessment and quantification of those risks is a primary topic of the research. Computer simulation modeling is a research tool, and surface CO2 monitoring is also a new emphasis.

Dr. Luis Ibarra teaches courses related to structural engineering, such as Structural Analysis and Structural Dynamics. He also mentors graduate students who work on projects related to seismic structural performance of nuclear components, Buckling Restrained Braces (BRBs) systems, and reinforced concrete frames with high strength materials. Dr. Ibarra and his students are currently working on a project to assess the seismic performance of nuclear containers during long-term periods. The team includes students at the U developing finite element simulations and experimental tests on anchor systems. Collaborators at the University of Nevada at Reno will test scaled casks on a shake table and nuclear engineers at Oregon State University are assessing the consequences of potential mechanical failure of the containers.

Some of his research projects focus on methods to increase the seismic resilience of buildings and bridges, which is the system’s ability to withstand earthquakes with minor damage. Dr. Ibarra and his students are investigating the performance of materials that have higher strength or are able to better dissipate energy, as well as new structural configurations that can withstand external hazards. Research on these topics will contribute to increase the safety of our community, if these external events occur.
Dr. Pedro Romero, associate professor, is focusing his research on developing better practices and products in design, construction, and maintenance of infrastructures. His research includes use of new materials such as locally available oil sands from the Uintah Basin to build roads, incorporation of recycled materials such as recycled asphalt pavements to maximize resources, development of warm-mix asphalt technology specifications to save energy and cost, and better characterization of construction materials at different temperatures to achieve superior performance. This work is the result of a trend towards a more sustainable infrastructure design which results in longer lasting roads with lower carbon footprint.

These concepts of materials and sustainability are also incorporated into his lectures where he teaches about construction materials, pavement design, and material characterization. Dr. Romero led a group of 24 students in a study abroad program to Costa Rica to learn about sustainability and the infrastructure. This was the first engineering, faculty-lead, study abroad class taught at the University of Utah.

Besides research and teaching, Dr. Romero is active in outreach activities. Thanks to a grant from the National Science Foundation, he cooperates with local high schools to develop lesson plans that incorporate engineering concepts in math and physics classes.

New Faculty

Dr. Daniel Fagnant is joining the University of Utah as an assistant professor in civil engineering. He holds civil engineering doctoral and master’s degrees from the University of Texas and a computer engineering bachelor’s degree from Gonzaga University. Dr. Fagnant is a member of the Transportation Research Board’s Vehicle-Highway Automation Committee, TRB’s Motorcycle and Moped Committee and TRB’s Safety and Systems Users Group Young Member Council. Among other honors, his autonomous vehicle work was presented to the U.S. House Subcommittee on Highways and Transit. Other research interests include project planning and evaluation, transportation safety, motorcycles, bicycles and pedestrians.

Dr. Fagnant also worked for five years at the Alaska DOT, where he was the youngest team member to develop Alaska’s Strategic Highway Safety Plan. He designed the state’s first-ever pedestrian hybrid beacon, has worked on numerous traffic- and safety-related projects, and was recognized with a commendation for outstanding service to the Alaska DOT.

Dr. Azaree Lintereur joined the CvEEN faculty this fall as an assistant professor in civil engineering with an emphasis in nuclear engineering. Azaree was a postdoctoral research associate at Pacific Northwest National Laboratory prior to moving to the University of Utah. She received her bachelor’s degree in physics from the University of Wisconsin Stevens Point and her PhD in Nuclear and Radiological Engineering from the University of Florida. Azaree’s research interests are in radiation detector development. Her research experience includes work with wide-band gap semiconductors for room temperature gamma ray spectroscopy, He replacement technologies, and pulse shape discrimination methods for neutron-gamma ray sensitive materials.
Earthquake Protection
Buckling Restrained Brace: A seismic system for structure and human protection - Dr. Chris Pantelides
The University of Utah is home to a plethora of buildings designed with one of the greatest advancements in structural engineering at this time. Buildings such as the Warnock Engineering, Spencer Fox Eccles Business, Beverley Taylor Sorenson Arts and Education Complex, and the Marriott Library are built with large diagonal elements. These are no ordinary braces, they are highly specialized seismic braces called Buckling Restrained Braces (BRBs). Unlike conventional bracing systems, they dissipate energy in compression as well as in tension; they are increasingly being used in seismic design and retrofit as seismic fuses. The rapid expansion in the use of BRBs has occurred due to cost savings in the overall structure, the simplicity of design and erection, and the repeatability of excellent performance in laboratory tests. BRBs dissipate energy through yielding and are a preferred option for earthquake-resistant structures since they absorb most of the input energy from the earthquake, thus protecting the main structure from damage; simply put, instead of damaging the structure, the earthquake-induced damage is diverted to the BRBs. This means that the building is relatively undamaged during the earthquake, and after the earthquake it may be necessary to replace the BRBs. BRBs were introduced in the United States in the late 1990’s and since then have been used in hundreds of buildings. Well-known structures using BRBs in Utah include the Rio Tinto Stadium and the Wallace F. Bennett Federal Building.

The BRB brace consists of two main parts: the central-yielding steel core and the surrounding outer casing assembly (Fig. 1). The main load-carrying element, the core, is encased in an outer steel shell filled with concrete that confines the steel core and provides stability to the system. A very thin gap between the steel core and concrete is built in the brace. The core does not buckle in a large half-sine wave but in many smaller sine waves after significant displacements and cycles of loading. The core yields under compression and this creates a brace with a strength that is nearly the same in both tension and compression. The performance of the BRB in terms of force versus displacement is desirable; stable hysteretic performance is observed for a large number of cycles under strains exceeding 2%, which implies that structures with BRBs can withstand large earthquakes.

Research at the University of Utah on BRBs started in 2002 when the Tall Structural Frame was completed under the supervision of Professor Larry Reaveley. The Tall Structure Frame is a unique piece of equipment and is only available for testing in a small number of locations nationwide. The Tall Structural Frame is equipped with a hydraulic actuator, which has a capacity of 2 million pounds in compression and 1.4 million pounds in tension, from research and instrumentation grants through the efforts of Professor Chris Pantelides and Reaveley. Research is continuing on the development of BRBs with new designs, new materials, and new connections. Analytical studies regarding buckling of the yielding core, buckling of the surrounding steel casing, and out-of-plane buckling of the gusset plates are currently being carried out by Pantelides and his students; analytical studies on the use of BRBs as nonlinear rooftop tuned mass damper frames for the seismic retrofit of existing buildings and for seismic retrofit of bridges are also ongoing. BRBs are passive energy dissipation devices with a history at the University of Utah and will continue to be elements of innovative structural systems in the future.

Two of the three domestic manufacturers of BRBs are local companies, namely Star Seismic and CoreBrace. Both companies have conducted experimental investigations in the Tall Structural Frame and both employ several University of Utah CVEEN alumni. Several experimental investigations have been completed on BRBs at the University of Utah.
Wastewater Recycling

Dr. Otakyue Conroy-Ben is researching the water resources in the Arid West, where strains on freshwater sources may necessitate wastewater recycling. In fact, some areas are re-using wastewater to water turf and to blend groundwater. In Dr. Conroy-Ben’s lab, they focus on the impacts of wastewater on the water cycle, and related health effects.

**Wastewater epidemiology and drug abuse:** When humans ingest drugs – over the counter, prescription, or illicit – not all are metabolized and they get excreted in urine. By correcting for sewer flow rate and population, community drug abuse trends can be determined. We collected sewer samples from the eight main trunks entering the Central Valley Water Reclamation Facility, and analyzed the drug trends of cocaine, methamphetamine, oxycodone, marijuana, and codeine. Results showed that certain sections the Salt Lake Valley have more drug activity than others.

**Endocrine disruption:** Human and household waste contain many organic chemicals that eventually make their way to the wastewater treatment plant. Not all contaminants are removed during treatment, including human hormones, which when released in wastewater effluent, wreak havoc on aquatic animals. Fish living downstream of wastewater treatment plants display both male and female characteristics. We quantify the amounts of endocrine disrupting chemicals in wastewater impacted water.

**Bacterial efflux pumps for water treatment:** We are engineering antibiotic pumps, membrane-bound proteins that export antibiotics and endocrine disrupting chemicals from the bacteria cell, to remove contaminants from water. Bacteria were made to over-produce these pumps, and the proteins were purified and inserted into a spherical liposome. The proteoliposome is capable of transporting contaminants from water into the structure. Contaminants targeted include nonylphenol (detergent by-product), 17-ethynylestradiol (birth control estrogen), bisphenol-A, and radioactive waste.

“My research addresses possible health effects arising from the reuse of wastewater. Particularly in the Western U.S., where climate change is expected to put a strain on groundwater and surface water quantities, reclaimed wastewater will become a critical resource that necessitates further testing.”
Graduate student Youcan Feng’s research focuses on applying green infrastructure in cities. Specifically, Youcan is advancing the understanding of green infrastructure impacts to the water budget. To conduct his research activities, Youcan is building on his multi-disciplinary training in civil engineering and watershed sciences, and combining that with guidance from Professor Burian and collaboration with Professor Pomeroy and other members of the Urban Water Group in the Department of Civil and Environmental Engineering.

Youcan’s green roof weighing lysimeter experiment is the first of its kind in this part of the United States. Youcan worked with researchers in Philadelphia to design and construct his experimental system and has been collecting data for nearly a year. The experiment is observing the water budget of green roof installations on the Marriott Library and Natural History Museum of Utah on our campus. This includes measuring precipitation, evaporation, transpiration, soil moisture, and outflows from the green roof replicas. Due to a common interest with professors in the Department of Mechanical Engineering, a higher-performance micrometeorology observation system has also been borrowed and added to the study. The system was positioned on one of the green roof sites, which allowed Youcan to further observe the energy budget of the green roof. The new observation capacity includes radiation, soil heat flux, sensible heat flux, and latent heat flux.

The results of Youcan’s research are being combined with other research results from the Urban Water Group leading to new models of green infrastructure tuned to work properly in our sub-humid climate. In the second phase of Youcan’s research he is integrating his new model advances into the U.S. EPA Storm Water Management Model (SWMM) to provide a new modeling framework for analysis and design of watershed green infrastructure programs. Ultimately, Youcan’s work will help contribute to improved planning and design of integrated urban water management systems.

Youcan’s project has been funded by the Sustainable Campus Initiative Fund, the Global Change and Sustainability Center, and by the NSF-sponsored Innovative Urban Transitions and Aridregion Hydro-sustainability (iUTAH) project.
Alumni Society Board

The University of Utah is on the verge of becoming one of the top 50 engineering schools in the nation. Fred Fife, (B.S. 1996) the new chair of the Civil Engineering Alumni Society Board, believes alumni can help make that happen.

“I have had the opportunity to watch the department grow and become more highly regarded over the years. The Civil and Environmental Engineering Department continues to grow today with more students and high-quality professors than ever before. As we look to increase research opportunities, our impact will be greater than ever. As alumni, we need to look for opportunities to share our individual and collective successes, showing the nation how our students are creating innovative solutions for both the opportunities of today and the challenges of tomorrow.”

The alumni society invites you to become an active member today. Visit our website, or contact ashley.arpero@utah.edu, for more information on how you can become a sponsor of the Alumni banquet or participate in some other meaningful way.

Get Involved: Industrial Advisory Advisory Board

The role of the Industrial Advisory Board is to advise the department chair on the professional needs and outlook of our industry and to help craft direction to meet the needs of the public, government, industry as well as the state, private enterprises and governmental agencies. With the recent selection of Department Chair Dr. Michael Barber, this is an opportune time for the IAB to work closely with him to continue developing a path for the department to meet the future needs of our industry and our diverse community.
33% of the department's faculty are women. The women faculty ratio has increased by 26% since 2006.

117 students are seeking their Master's or Doctorate degree.

110 degrees were awarded for the 2013-2014 academic year.

345 students are enrolled in the Civil Engineering Bachelor of Sciences program.

Imagine. Innovate. Design.

“Our students are dedicated to the future and research of civil engineering.”

Student Groups

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www.civil.utah.edu
Scholarships

The Department of Civil and Environmental Engineering awarded over 30 scholarships for the 2014-2015 academic year.

Alumni can directly impact the engineers of tomorrow by becoming a scholarship donor today.

www.coe.utah.edu/dollar_for_dollar