Dear Alumni and Friends,

IT IS A PLEASURE TO ANNOUNCE some special honors that have accumulated for our faculty.

Many of you are aware of the contributions that Charles Fairhurst has made to the department and the field of rock mechanics. Charles will soon receive the highest decoration in France, the National Order of the Legion of Honor, for his commitment to French-American relations and his work in rock mechanics. This is a huge honor, and we could not be more proud of our colleague.

Professor Paige Novak is receiving national attention for her research. She will serve on the National Academies Committee on Chemical Demilitarization and will participate in the first Korean-American-focused symposium in the Kavli Frontiers of Science.

The accomplishments of our alumni are among the best advertisements of our successes. We are pleased to share with you a story about John Houle (BCE 1983, MCE 1984), who built a multi-faceted career at 3M. We also celebrate with Marcelo Garcia (PhD 1989), who was recognized as a Distinguished Member of the American Society of Civil Engineers.

Our undergraduates are no less impressive. This issue features student Michelle Maciej and how she has made the most of her time in CE. You will also see that our graduate students Cale Anger (advised by Bill Arnold), Tucker Burch (Tim LaPara), Steve Hankey (Julian Marshall), and Bing Xue (Jia-Liang Le) have received recent research awards.

I am thrilled to report our building remediation is nearly complete. We are making the inside space even more conducive to study and collaboration. WSB & Associates, one of our supportive industry partners, is sponsoring the redesign of our student lounge. The Chi Epsilon room has also been remodeled thanks to James Weinel (BCE 1956).

And of course, we are strongly committed to research and teaching. New faculty members, Lauren Linderman, Merry Rendahl, and Dominik Schillinger are introduced in this issue. The research feature explains the mechanics of hydraulic fracturing and related work performed through CE. Also, faculty members Bill Arnold, Cathy French, Karl Smith, and Fotis Sotiropoulos have recently won awards for research and teaching.

Our work could not continue without your support, and we are always grateful. I encourage you to keep in touch!

Joseph Labuz
MSES/Kersten Professor & Department Head
OF SPECIAL NOTE

STEVEN L. CROUCH, Dean of the College of Science and Engineering, and professor in the Department of Civil Engineering, was inducted into the National Academy of Engineering. The induction ceremony of the class of 2013 took place October 6 in Washington, DC. Crouch was chosen for his contributions to simulation methodology for the behavior of fractured rock masses.

MARCELO H. GARCIA (PhD ’89) and MARK A. BRADFORD (visiting professor in 1990) were recognized as Distinguished Members of the American Society of Civil Engineers, the highest honor that the Society confers. The title is given only to those who demonstrate “knowledge eminence” in a branch of engineering. The twelve new members were acknowledged at the ASCE Celebration of Leaders Luncheon in Charlotte, North Carolina, on October 10.

USDOT’s Research and Innovative Technology Administration selected the Center for Transportation Studies at the University of Minnesota to lead a new $10.4 million regional University Transportation Center. Contributors from the Department of Civil Engineering include GARY DAVIS, JOHN HOURDOS, DAVID LEVINSON, and HENRY LIU. Such transportation centers at universities are important to addressing USDOT’s priorities and environmental and safety issues in transportation. Out of more than 142 applications UMN’s CTS was selected as one of eight regional centers (five national centers were also funded).

FACULTY HONORS

BILL ARNOLD is a co-author on the paper “Photochemical Formation of Brominated Dioxins and Other Products of Concern from Hydroxylated Polybrominated Diphenyl Ethers (OH-PBDEs),” which tied for First Runner-Up Environmental Science from Environmental Science & Technology for 2012 (see http://pubs.acs.org/doi/abs/10.1021/es401684v).

CATHERINE FRENCH was one of the authors awarded the 2013 ASCE Raymond C. Reese Research Prize this past spring. The Raymond C. Reese Research Prize honors a paper published by ASCE that describes a notable achievement in research related to structural engineering and recommends how the results of that research (experimental and/or analytical) can be applied to design. The winning paper, titled “Transverse Joint Details with Tight Bend Diameter U-Bars for Accelerated Bridge Construction,” was published October 2011 in the Journal of Structural Engineering. A joint detail was developed for rapid construction and good long-term performance based on the experimental results. Authors included Zhongguo John Ma, Samuel Lewis, Zhiqi He, Qi Cao, Edwin G. Burdette, and Catherine E.W. French.

KARL A. SMITH, Civil Engineering Professor Emeritus, STEM Education Center Executive Co-Director, and faculty member in the Technological Leadership Institute, was awarded an Honorary Doctorate at the Universiti Technologi Malaysia (UTM) at the 51st Commencement Ceremony on October 26. The recognition is based on his “outstanding and excellent contribution pioneering engineering education at the global stage.” Professor Smith has been a Visiting Professor at UTM since 2006 and helped start their engineering education PhD program.
FOTIS SOTIROPOULOS has been reappointed as the James L. Record Professor. This endowed professorship was awarded to Sotiropoulos in recognition of his contributions to the Department. The new term will continue for five years into 2017. Sotiropoulos researches in the area of computational fluid dynamics spanning a diverse range of topics in biofluids, hydraulics, environmental fluid mechanics, chaotic advection, and large-scale transport in geophysical flows.

FACULTY NEWS

BILL ARNOLD and PAIGE NOVAK, with their colleague, David Tat Ui Tan, published an article in the journal Environmental Science and Technology. “Impact of Organic Carbon on the Biodegradation of Estrone in Mixed Culture Systems” details their experiments on the effects of organic carbon concentrations and loading on the degradation of estrone (E1) under various conditions in batch reactors and membrane-coupled bioreactors (MBRs). Experiments examined effects on individual microorganisms (substrate competition and growth) and on the whole community (selection). The results of their experiments point to the importance of multiple substrate utilizers in E1 degradation and suggest that while initial growth of biomass depends on the presence of sufficient organic carbon, further enrichment under starvation conditions may improve E1 degradation capability. The full article is available online (http://dx.doi.org/10.1021/es4027908).

PAIGE NOVAK’S research was featured in the July issue of the Research e-newsletter published by the Office of the Vice President for Research (http://researchumn.com/2013/07/29/breathing-bacteria-clean-up-toxic-waste/). Novak specializes in research on the biological transformation of hazardous substances in sediment, groundwater, and wastewater. Toxic chlorine-containing chemicals have left a legacy of superfund sites and fouled groundwater and sediments. Engineers have made great strides using microbiological techniques to clean up trichloroethylene and perchloroethylene, two of the chemicals Novak studies.

MICHAEL SEMMENS, Professor Emeritus, taught a graduate course on water treatment at the University of Padova in Italy between March and June. Students from all over Europe attend the program, which is the only environmental graduate program taught entirely in English. Semmens will be spending six months at University College Dublin, Ireland, from March to August in 2014. He received a Fulbright Scholarship to work with environmental faculty and teach in the Civil and Chemical Engineering departments. He will be helping his colleagues and students conduct research on membrane applications in water/wastewater treatment.

TIM LAPARA was promoted to Professor. His research interests include biological wastewater treatment, environmental and wastewater microbiology, structure-function relationships in microbial communities, microbial ecology and evolution, and antibiotic resistance.

EMMANUEL DETOURNAY was a member of the National Research Council committee responsible for publishing “Induced Seismicity Potential in Energy Technologies.” The report was commissioned by the National Academies of Science to “examine the scale, scope, and consequences of seismicity induced during fluid injection and withdrawal activities related to geothermal energy development, oil and gas development including shale gas recovery, and carbon capture and storage…and to assess options for steps toward best practices with regard to energy development and induced seismicity potential.” The report is available online at the National Academies Press (http://www.nap.edu/catalog.php?record_id=13355).

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MIHAI MARASTEANU was promoted to Professor. Marasteanu pursues research in visco-elasticity and fracture mechanics concepts applied to asphalt materials characterization, and development of laboratory testing methods.

JULIAN MARSHALL was promoted to Associate Professor. His research interests include air pollution exposure assessment, urban sustainability, environmental and health impacts of transportation, and air pollution in developing countries.

STUDENT NEWS

CALE ANGER, a PhD student advised by BILL ARNOLD, received the 2nd Place Montgomery-Watson-Harza Consulting Engineers Master’s Thesis Award from the Association...
of Environmental Engineering and Science Professors.

Anger and Arnold also co-authored a related paper, “Quantification of Triclosan, Chlorinated Triclosan Photoproductions, and their Dioxin, which was published in Environmental Science & Technology. To read the full research paper, visit (http://pubs.acs.org/doi/abs/10.1021/es3045289).

TUCKER BURCH, a PhD student advised by TIM LAPARA, won a Best Poster Award at the Fifth International Conference on Water Engineering and Microbial Ecology, held at Rackham Graduate School in Ann Arbor, Michigan, last March. His winning poster was titled “Persistence of Antibiotic Resistance Genes and Class 1 Integrons in Soil Amended With Treated Residual Wastewater Solids.”

STEVE HANKEY, a PhD student advised by JULIAN MARSHALL, researches healthy bike routes and is earning recognition—both academic and popular—for his work.

Hankey won this year’s Swiss Tropical and Public Health Institute’s annual L.-J. Sally Liu Award for Outstanding Doctoral Student in Air Pollution Exposure Science. His winning abstract is titled “Measuring and Modeling Particulate Air Pollution Using a Mobile, Bicycle-Based Platform.” The honor was presented in Switzerland at the conference, which attracts hundreds of high-quality students and researchers from across the globe.

Hankey also earned 2nd place at the Young Researchers Seminar in Lyon, France. The seminar was jointly supported by the European Conference of Transport Research Institutes and the Forum of European Road Safety Institutes. Thirty-seven students from Europe and the US submitted papers and the top three were recognized.

Hankey’s research was also featured in the local Minneapolis Star Tribune. The article described his efforts to catalog the concentrations of particulates in the air along local bike and commuter routes. He hopes to integrate his data with route-finding search engines to give bicyclists a chance to choose the healthiest routes. He hopes his research will eventually influence the planning of city bike routes. (See http://www.startribune.com/local/blogs/216949181.html)

BING XUE, a PhD student advised by JIA-LIANG LE, recently won the ASCE Engineering Mechanics Institute’s student paper competition in probabilistic methods. Xue’s paper is titled “Probabilistic Analysis of Reinforced Concrete Buildings against Progressive Collapse.” The award was given at the 2013 Engineering Mechanics Institute Conference (Aug. 4-7) in Evanston, Illinois.

The ASCE STUDENT CHAPTER partnered with APWA to host the annual ASCE job fair on campus in October. Students plan and arrange the entire fair, inviting companies and promoting the event. This year 43 civil engineering companies gathered in the beautiful DQ Room at TCF Bank Stadium to recruit our graduates. About 160 students attended the event. Pictures are posted on the Civil Engineering facebook page (facebook.com/umn.cive).

ALUMNI NEWS AND UPDATES

LAURA M. AMUNDSON (BCE ’78) is the Vice President, Senior Engineering Manager and Senior Project Manager at Parsons Brinckerhoff’s Minneapolis, Minnesota, office. Amundson serves in a variety of senior roles on bridge and highway related projects and is the Bridge Technical Excellence Center lead for the Northwest region. Amundson recently served as project manager for Minnesota Bridge Inspections, which started after the collapse of the Minnesota I-35W Bridge. She managed placing inspection teams in the field and coordinated team response within 48 hours of notification.

SHONTAO DAI (PhD ’95) works at the Minnesota Department of Transportation, where he is responsible for research in pavement design and evaluation. He is currently conducting research on 3D ground penetrating radar in cooperation with the University of Minnesota. Dai returned to campus this fall to teach a course in the Department on highway pavement design.

GREG LEFEVRE (PhD ’12) received the 2013 Paul V. Roberts/AEESP Outstanding Doctoral Dissertation Award from the Association of Environmental Engineering and Science Professors (AEESP). This prestigious award recognizes outstanding dissertations in the field of environmental science and engineering. As part of this award, LeFevre received $1500 and a commemorative plaque. LeFevre is currently a post doctoral researcher at the Department of Civil & Environmental Engineering at Stanford University working with Professor Richard Luthy. LeFevre completed his dissertation, Fate and Degradation of Petroleum Hydrocarbons in Stormwater Bioretention Cells, under the advisement of PAIGE NOVAK and RAYMOND HOZALSKI.

CHRIS RILEY (MCE ’93) is in his 18th year as an Applications Engineering Manager for Siemens Industry, Inc., in Roseville, Minnesota. He specializes in industrial wastewater treatment. He is often on campus cheering on the Gophers.
Paige Novak is a member of the environmental research group within the Department of Civil Engineering. She primarily specializes in research on the biological transformation of hazardous substances, how external environmental factors influence the biodegradation of these substances, and implementing biologically based remediation systems. Her expertise in these areas has been recognized internationally, and she has recently been asked to join two high-level endeavors at the National Academies of Science.

Novak was selected to serve on the National Academies Committee on Chemical Demilitarization. The Board on Army Science and Technology (BAST) serves as a convening authority for the discussion of science and technology issues of importance to the Army and oversees independent Army-related studies conducted by the National Academies. BAST convenes this committee to oversee studies in support of the US Army Chemical Materials Agency and the Assembled Chemical Weapons Alternatives as they execute the United States’ Chemical Demilitarization Program. Novak will serve on the Committee through September 2016.

Professor Novak was also invited to participate in the National Academies of Science Kavli Frontiers of Science Symposium. Kavli Frontiers of Science symposia bring together outstanding young scientists to discuss exciting advances and opportunities in a broad range of disciplines. The discussions and exchanges encourage communication and collaboration, breaking down barriers between fields. The Symposium in August will be the first with a Korean-American focus. A list of previous symposia and presentations can be found at the NAS website (http://www.nasonline.org/programs/kavli-frontiers-of-science/).

Novak’s work is also recognized by her colleagues on the UMN campus. In September 2013, she was selected for the Sara Evans Faculty Woman Scholar/Leader Award, sponsored by the University of Minnesota Office for Faculty and Academic Affairs and the Women’s Center. Novak was chosen from a field of high-caliber nominees who demonstrated significant national and international accomplishments and honors, as well as contributions and promise as campus leaders. Novak received the award at the Celebrating University Women Awards program September 27 at McNamara Alumni Center. The honor comes with a grant of $5000 to support her scholarly work.
JOHN HOULE (BCE ’83, MCE ’84) LOVES WHAT HE DOES. HE HAS A PASSION FOR ENGINEERING AND FOR MAKING THE WORLD A BETTER PLACE. “I HAVE DONE A LOT OF DIFFERENT THINGS, VERY DETAILED DESIGN, PROJECT MANAGEMENT, BUSINESS LEADERSHIP. AS LONG AS I WAS HAVING FUN AND HAD A PASSION FOR WHAT I WAS DOING, IT WAS ALL EXCITING. YOU HAVE TO DO THINGS YOU LOVE; THEN THE WORK IS EXCITING, THE DAYS GO FAST, AND THE PROJECTS TURN OUT WELL.”

Growing up as one of 10 children in a loving family gave Houle confidence that life would turn out well. However, the family was not wealthy, and it could not be assumed that John Houle would be able to go to college. Houle’s father had given up his own education to take on another job when child number seven—John himself—was born. It was Houle’s athletic ability that opened the door for a college education. Houle received a football scholarship to the University of Minnesota and played on the travelling team as a freshman. He was the first in his family to go to college.

When Houle graduated in the early ’80s, the US was just beginning to come out of a recession, and jobs were hard to come by. But even in those tough times, Houle had three job offers when he graduated. He turned down the opportunity to work on developing the space shuttle, and chose to go to work with Exxon doing research and development on sub-sea oil production systems in the North Sea. Houle’s salary upon graduation was the same as his father’s at that time, which greatly impressed his father who was raising ten kids.

Eventually, three younger brothers followed Houle’s lead. All four

“MY FATHER IS THE REASON I WENT INTO CIVIL ENGINEERING. WHEN I WAS BORN, MY FATHER WAS GOING BACK TO NIGHT SCHOOL TO FINISH OFF HIS DEGREE IN CIVIL ENGINEERING, BUT BECAUSE I WAS BORN, HE HAD TO QUIT AND GET ANOTHER JOB. HE BECAME THE PUBLIC WORKS DIRECTOR FOR THE CITY OF SHOREVIEW. I USED TO GO WITH HIM SUNDAY MORNINGS AFTER CHURCH, AS HE CHECKED LIFT STATIONS AND OTHER EQUIPMENT. HE WAS ALWAYS TALKING ABOUT ROADS AND CONSTRUCTION AND WATER PROJECTS AND ALL THAT ‘CIVIL’ STUFF.”
brothers went to the University of Minnesota, and all went into engineering: two brothers became mechanical engineers and the other an electrical engineer.

“Engineering has always been a nice connection between us. My dad was recently telling us about doing road design with a slide rule! We’ve come a long way since those days!”

At Exxon, Houle’s challenge was to construct oil-extracting structures the size of a three or four story building on the bottom of the ocean under 3,000 feet of water. At that depth, too deep for divers to descend, all manipulations, pipe hook ups, and electronic connections had to be performed remotely. Houle enjoyed applying the detailed design skills he learned at UMN. In this position, Houle also travelled to the United Kingdom one week each month to work with researchers there. Sharing knowledge with his European counterparts was required under Exxon’s lease for oil extraction in the North Sea.

As much as Houle was enjoying the work, his fiancée, Diane, was drawing him back to Minnesota. When Houle gave up his very good job with Exxon, his father was—shall we say—perplexed, but you cannot argue with a young man in love! John took a job with American Hoist (AmHoist), who moved him back to Minnesota.

At AmHoist, John continued doing very detailed engineering design, this time designing cranes to unload cargo in sea ports. But just four months after he started, upon returning from his honeymoon, AmHoist laid off 100 engineers. Because AmHoist had just paid to move Houle from Texas to Minnesota, his job was spared; however, it became clear that he needed to be looking for another job.

That is when Houle began working with 3M. He had been calling 3M for about a year. Finally, he called when they had an opening in the structural hoist department. Houle convinced 3M that his experience at American Hoist made him the perfect candidate for that position.

Once at 3M, Houle worked hard and was rewarded. Houle moved where he was needed. At one point, when his wife was seven months pregnant with their third child, John applied all his persuasive skill to convince her to move away from her family and go to Arkansas in the middle of the summer. The family—with two sons and one daughter—later spent a year and a half living in Japan. Houle took on difficult assignments, even overseeing the closing of a manufacturing plant that he had managed for several years. He was also eager to take on additional responsibilities, including environmental health and safety duties and running the Lean Six Sigma program.

Houle says, “I always thought of myself as a business leader no matter what function I was in.” He advanced from project manager, to product manager, to plant manager, and eventually to corporate leadership positions. Last fall, 3M underwent restructuring and Houle became the Division Vice President of the newly combined Traffic Safety and Security Division.

In this position, Houle works on products and systems to improve and save lives through innovative solutions for traffic safety, mobility, and security.

“I LOVE COMING TO WORK KNOWING THAT WE ARE WORKING ON THESE THINGS. I TELL OUR EMPLOYEES, YOU NEVER KNOW THE LIVES YOU ARE TOUCHING, BUT YOU ARE SAVING LIVES! IT IS VERY EXCITING COMING TO WORK EVERY DAY DOING THAT.”

Much of what Houle manages is visible and used daily by almost everyone: green traffic signs, reflective road markings, and license plates. In addition to these items, Houle is responsible for many products and software systems that support traffic safety or security behind the scenes. One system supports open road tolling by recognizing and classifying vehicles to determine appropriate toll rates. Another system supports license plate recognition, which can be used by police to identify vehicles in situations ranging from stolen property to Amber alerts. For example, police used 3M’s ALPR cameras to try to find the vehicle that was stolen after the Boston Marathon bombing incident.

Houle’s division also develops and supports secure identification and monitoring systems, and secure credentials like passports and drivers licenses. 3M produces biometric identification systems that can identify individuals from fingerprints, irises, or facial characteristics. Radio-frequency identification (RFID) systems are used to track materials, such as library books. Houle’s division brings these products and services together...
to create integrated solutions for tolling, parking, policing, and secure credentialing. To pull all these diverse materials, systems, and services together, John Houle manages a very large software development team that reaches around the world.

One of the new products in Houle’s traffic safety and security toolbox is a whiter, brighter license plate, which will increase visibility and readability. Plates can be further enhanced by embedding additional identifying information. Special readers could then be used to allow license plates to function as a secure credential. Such information-enhanced license plates could be used for parking and tolling. Houle outlines one possibility of how this technology might be used to simplify parking situations. “Say a Gopher fan has season tickets and regularly needs to park in a ramp on the University of Minnesota campus. We could install a camera at the ramp that could read registered plates. So when the season ticket holder drives up, the license plate is recognized, the gate is opened, and the fan can park with no wait, eliminating lines.” How many Gopher fans and UMN visitors would love that?

This technology, along with electronic monitoring technology for offenders, can be helpful in more serious security situations. For law enforcement, 3M offers systems that are placed in police vehicles to read license plates. Using GPS electronic monitoring for offenders and license plate data, police can track people on parole or keep up with Amber alerts. Part of what law enforcement needs is information about who to eliminate from suspicion, so they can home in on more likely suspects. In the case of an incident like a kidnapping, police could access the GPS monitoring coordinates for offenders and monitor where and how often specific individuals were near that location. They could determine if an offender on electronic monitoring was in the area and for how long. Houle is proud to be part of the effort to create smarter, more efficient policing.

Drawing on his many and varied experiences, John Houle has some credibility in advising future engineers. Houle draws on his experience as a student athlete to impress upon young engineers the importance of teamwork.

“NO ONE DOES ANYTHING ALONE IN BUSINESS; NO ONE DOES ANYTHING ALONE—EVER! SO THE ABILITY TO WORK TOGETHER ON A TEAM, THE ABILITY TO THINK BEYOND ONESELF IS IMPORTANT. IT IS NOT ALL ABOUT YOU, IT IS ABOUT THE TEAM.”

When hiring for engineering or management positions, Houle says what he looks for is “smart athletes,” although he doesn’t necessarily have sports in mind. “It could be debate competition; it could be dance competition. Beyond technical skills, I look for people who are smart, competitive, can work on a team, and can be a good communicator.”

Houle notes that, oftentimes, an employee is first seen by executive management when giving a presentation. How one presents can have significant results. A good presenter attracts positive attention from upper management.

Looking toward the future, Houle sees many needs for infrastructure in the United States and in developing countries. Both areas will require significant numbers of civil, structural, and transportation engineers, along with engineers who have skills in the electronics, software, and system areas. For these reasons alone, there is significant motivation for young people to seek out a career in civil engineering.

But there is another reason that Houle never hesitates to recommend a career in civil engineering. “I think engineering is a fabulous profession, just look at the background you get! Engineering problem solving is a great foundation and can take you in a lot of directions. I’ve always encouraged my own kids to get a detailed, technical education. That thought process is valuable. Almost every job involves problem solving, and the engineering approach to problem solving can fit business problems or customer problems. And that is really what we do as business leaders, we solve problems. Engineering thinking is one of the best trainings in the world for solving problems.”
LAUREN LINDERMAN came to Minnesota from the University of Illinois at Urbana-Champaign, where she received her PhD degree. Linderman’s research interests include structural dynamics and smart structures technology with an emphasis on wireless sensor technology, vibration mitigation strategies, control algorithm development, vibration-based structural health monitoring (SHM), and experimental testing.

Wireless smart sensors originally gained popularity as a means to monitor the health of structures, that is, technology could send an alert when some problem (cracking or weakening, for example) occurred in a structure. Now, wireless smart sensors can also be used to control structures.

SHM technology can be used to monitor buildings and bridges. Structures can be built with control systems, which is similar to how one might think of shock absorbers in a car. When a building or bridge is being shaken by an earthquake or a strong wind, those “shock absorbers” will lessen the effect. “The sensors I work on can be used to adjust the control system performance.” Remote monitoring and control of buildings may not result in avoidance of all damage to the building, but should minimize or delay damage and allow people to get out in the event of a structural collapse.

When applied to bridges, wireless control systems help control stay cables. In the larger view, sensor and remote monitoring systems should help develop safer, more durable structures.

Linderman’s research on the use of wireless technologies to monitor the health of structures will be of interest to the whole state of Minnesota, where the failing state of our bridges has been a lively topic in the local news since the collapse of the I-35W bridge in 2007. The technologies that Linderman researches help monitor changes in load or movement in structures and, thus, identify potential problems. In the future, Linderman plans to apply wireless smart sensor technology to wind turbines and other energy harvesting systems.

One of the biggest challenges for Linderman in developing her research was the necessity to develop knowledge in several related areas. “My area of expertise may be structures, but I also had to learn about electrical engineering, computer science, and hardware design. Interdisciplinary studies seem to be a trend for the future—civil engineers may have one area of expertise, but they will also have to develop understanding in related areas in order to carry out complicated tasks that characterize the job of a civil engineer.”

Linderman’s work reaches beyond the boundaries of the United States. She worked on extending her research to semi-active control of stay cables in Harbin, China, with Professor Li Hui. Her China-US partnerships will be a welcome expansion for the Department of Civil Engineering’s research programs.

Linderman is excited to be preparing engineers for the future through her duties as a teacher and a mentor. This fall, Linderman is teaching Structural Dynamics, which is her favorite course because “it changes the way students look at their work.” In earlier courses students think about structures as static, but in Structural Dynamics Linderman helps students begin to look at the dynamics or movement within seemingly static structures.

With the innovation of her research, its practical applications, her international research partnerships, and her excitement about teaching, Linderman will be a strong addition to the Department.
DOMINIK SCHILLINGER completed his PhD at the Technische Universität München in Germany. He has most recently been doing post-doctoral research with Professor Thomas Hughes at the Institute for Computational Engineering and Sciences of the University of Texas at Austin. He researches novel discretization techniques for the analysis of solids and structures, striving to overcome limitations of standard numerical tools.

Schillinger was persuaded to move from Texas to the University of Minnesota because of the Department’s strong reputation for top level research and education in engineering. He was impressed with the large variety of areas in which faculty members are doing fundamental research.

His own research is in computational engineering and predictive modeling and simulation, an interdisciplinary area of research that combines aspects of engineering, computer science and applied mathematics. Schillinger’s work in computational mechanics is of key importance for many future technologies and will have a broad range of applications. For example, Schillinger has worked on traditional civil engineering problems, like developing fast methods for simulating structural dynamics to determine the optimal design of wind turbines; he has also worked on biomedical applications, developing computational tools that can help find the best position for a patient’s hip implant or help predict liver deformations based on CT scan data.

Schillinger believes that the Department of Civil Engineering at Minnesota is a very good place for his interdisciplinary research. Many Civil Engineering faculty members are working in a similar direction, and he feels that they will be able to work together to support and supplement one another’s research. Moreover, he feels the University of Minnesota offers many opportunities for collaborations outside the Department of Civil Engineering with the Medical School, the Institute for Mathematics and its Applications, the Mayo Clinic in Rochester, or the many biomedical companies that are located in the Twin Cities area. Schillinger hopes to continue working with his research partners and connections at Texas, as well as those in Germany, the Netherlands, and Italy.

While Schillinger acknowledges that the most exciting and challenging aspect of his job will be continuing his research, he is looking forward to teaching fundamental classes for undergraduates and probabilistic engineering for graduate students.

Schillinger has come to believe that his decision to pursue civil engineering (his original goal was to be an architect) was one of the best decisions he ever made. His colleagues and students will soon come to the same conclusion.

In addition to a strong focus on research and teaching the fundamentals of engineering, the Department of Civil Engineering is committed to developing the important professional skills that help engineers communicate. Communication is one of the key criteria for certification from the Engineering Accreditation Commission of ABET, and MERRY RENDAHL is here to help all students develop strong writing skills. She joined the Department in June as a Teaching Specialist for Writing and will be teaching the writing intensive portions of the Capstone Design and Civil Engineering Materials courses.

Rendahl earned her doctorate in Rhetoric and Scientific and Technical Communication from the Department of Writing Studies here at the University of Minnesota. Before coming to the Department, Rendahl was teaching advanced writing for engineers at the University of Minnesota Duluth. She also has experience working and writing in corporate settings.

“One of my students described me as ‘happy to be teaching future engineers;’ that is an epigraph that I embrace. That may not be true of all writing teachers, but I find the precision and clarity required in engineering writing to be challenging, creative, and, ultimately, useful. Helping students grow into professional engineers who can write clearly about their work makes a valuable contribution to the profession and to society. Success in that goal is very satisfying for the students and for me, too.’’

In addition to her teaching duties, Rendahl is interested in pursuing research on lifelong learning and on empathy and empathic design in engineering.

Merry Rendahl will also be writing for future editions of Civil Engineering magazine. Story ideas can be sent to her at civenews@umn.edu.

These new hires demonstrate the Department’s commitment to developing students who are well prepared to solve the complicated problems facing our world in the 21st century.
It is rare that a geoengineering process reaches such heights of popular interest that it is even written about in *Vanity Fair*, but the topic of hydraulic fracturing has reached that level of cultural impact (see *Vanity Fair*, June 21, 2010). Hydraulic fracturing comes up frequently in the context of producing oil and gas from previously unproductive shale reservoirs. In Minnesota, we hear a lot about the oil fields in North Dakota and the related sand mining in southeastern Minnesota. However, it is not widely known that hydraulic fracturing has been studied and refined at the University of Minnesota since the 1960s. And that research is still going strong as researchers continue to develop the processes and uses of hydraulic fracturing, related technologies, and methods for practicing hydraulic fracturing in sustainable ways.

The earliest documented application of hydraulic fracturing might be T. L. Watson’s 1910 description of induced “sheeting” in granite quarrying operations. Hydraulic fracturing was used to “cleave” granite during quarrying to create smooth sheets of mined rock (see Figure 1). Watson (1910) described how compressed air injected into a lift-hole was capable of cleaving (fracturing) the rock a distance of more than 70 meters (roughly 230 feet) from the lift-hole. Another early mention of hydraulic fracturing is contained in a 1935 paper by Grebe and Stoesser that was published in...
Hydraulic fracturing is an engineering process that involves aspects of chemistry, fluid mechanics, and rock mechanics. Stated simply, hydraulic fracturing is a process by which fluid is pumped underground at sufficient rates and pressures to break rock formations. A fracture is generated in a rock by increasing the fluid pressure until a crack extends away from the point where the fluid is being injected. This process is now used extensively to break rock underground to help free oil or gas trapped in the rock formations (see Figure 2).

Like any industrial process, hydraulic fracturing efforts are carefully designed and executed; however, because of the complexities of the earth systems involved, design and execution are complicated.

A typical hydraulic fracturing process involves drilling a vertical borehole into the ground to the top of an oil or gas bearing rock formation and placing a steel casing in the hole. The hole is then sealed using cement slurry, which is pumped through the casing until it flows around the outside of the casing back to the surface. Once the seal is formed, a hole or wellbore is drilled through the oil or gas formation.

When a fluid is injected down the wellbore, pressure builds in the rock until it breaks (or existing fractures open). The width, direction, and length of cracks depend on the stress field, material properties, and fluid coupling. Cracking—or fracturing—is also influenced by the porosity, permeability, and natural fracture pattern of the rock formation. Following the initial “breakdown” of the rock formation, various fluids and rates of injection are used to extend the fractures. Sand or other material is used to keep the fractures from closing when the pressure from the injected liquid is released.

Flow of fluid in the created fractures is governed by classical Reynolds fluid flow equations. The pressure drop along a fracture depends on the viscosity of the fluid used to create the fracture and the permeability of the rock, which could lead to the fluid leaking off. The size of the fracture aperture depends on the stiffness of the rock mass and the distribution of fluid pressure along the crack. Extension of the fracture depends on the mechanical energy supplied to the region around the crack tip. The crack tip may propagate ahead of the fluid, leading to a lag—a dry region between the fluid front and the tip of the resulting crack. Figure 3 illustrates the classical radial fracture model, in which it is assumed that the fracture propagates symmetrically away from the borehole in a plane normal to the minimum (least compressive) principal in-situ stress, \( \sigma_o \).

Geoengineers at UMN seek to understand the behavior of rock and fluid in order to predict the hydraulic fracturing process and use it productively and sustainably.
World Petroleum (August 1935): “In the experiments on treating wells..., it was discovered that a fluid pressure at the bottom of the well sufficient to counter-balance the weight of the rock above it plus an additional pressure required for actually breaking (cracking) the formation, makes possible the introduction of fluids into new crevices thus created.”

In 1949, the term “hydrafrac process” was introduced in a paper written by J.B. Clark, who together with F.R. Farris, both from Stanolind Oil and Gas Corporation, conceived the idea of hydraulically fracturing a rock formation to enhance production from oil and gas wells. Theoretical analyses soon followed (Hubbert and Willis 1957; Perkins and Kern 1961) and set the foundation for modeling the shape of a hydraulic fracture system in two dimensions.

It was the possibility of using hydraulic fracturing to measure stress in underground rock formations that spurred the development in relation to the fracturing process. This is the point where the University of Minnesota (UMN) became deeply involved in hydraulic fracturing research.

In 1966, the US Army Corps of Engineers asked Professor Charles Fairhurst of UMN to design and build equipment capable of determining the state of stress in rock at depths of several hundred meters. After careful study of various possibilities, hydraulic fracturing—where the fluid pressure developed during fracture (or opening of existing fractures) of the rock around the borehole could be interpreted in terms of the pre-existing stress field in the rock mass—was determined to be the most promising procedure. Several UMN students, who are now world leaders in the field, wrote dissertations on issues related to hydraulic fracturing, from theoretical analysis and laboratory experiments, to small- and full-scale field testing, to rock fracture modeling and solid-fluid coupling effects (Haimson 1968; Von Schoenfeldt 1970; Hardy 1973; Roegiers 1974; Cornet 1975; Leonard 1985).

In 1993, Professor Emmanuel Detournay arrived at the Department of Civil Engineering at UMN and brought new life to the study of hydraulic fracturing. Detournay directs a comprehensive research program aimed at developing rigorous reference solutions and robust numerical methods for the coupled rock-fluid process.

Two hallmarks of this research activity are (i) the construction of multi-scale tip asymptotics for fluid-driven fractures and (ii) the parametric organization of reference solutions for plane or radial fracture geometries using scaling analysis. Many of Detournay’s PhD students are contributing to the industry (Carbonell 1996; Garagash 1998; Savitski 2000; Adachi 2001; Burger 2005; Kovalyshen 2010).

Research topics related to hydraulic fracturing have grown. Professors Roberto Ballarini, Jia-Liang Le, Sofia Mogilevskaya, and Vaughan Voller study sophisticated analytical and numerical models for fracture propagation.

Professors Stefano Gonella, Bojan Guzina, and Joseph Labuz study the critical aspect of monitoring crack growth in the process of hydraulic fracturing. As a rock fractures, energy is released in the form of stress waves that travel through the rock. These stress waves can be used to map the growth of a fracture. The vision of this group of researchers is to transform hydraulic fracturing into a controllable process for responsible and efficient harvesting of resources. Computational algorithms and software are being developed to provide mechanically rigorous and statistically meaningful predictions of subsurface fractures. Seismic imaging techniques are being formulated to track the propagation and characteristics of fractures in 3D and real time.

Hydraulic fracturing is being applied to wider and wider areas and in situations where there is little prior experience, so a deep understanding of the fracture process in rock is imperative. The geoengineers at UMN are developing that understanding and preparing future researchers to carry this work forward.

See the list of works cited in the online version available at www.ce.umn.edu/news/magazine.html
Spring 2013

If you missed any of these lectures presented during the last spring semester, you can catch the replay on our website, ce.umn.edu.

The Sehlin Lecture, which is presented in Civil Engineering every other year, was held here on April 26, 2013. **ROSS COROTIS** of the Department of Civil, Environmental, and Architectural Engineering at the University of Colorado-Boulder presented on “Public Perception and Political Challenge of Natural Hazard Risk in the Built Environment.”

The Warren Lecture Series is made possible by a generous, renewing gift given by Alice Warren Gaarden in 1961. Each year we are able to bring distinguished scholars to our campus to address important issues in engineering. The following scholars presented during spring semester of 2013.

**JOE LABUZ**, Department of Civil Engineering, University of Minnesota, “Experiments with Rock: Observations of Fracture.”

**JOE GODDARD**, Department of Mechanical & Aerospace Engineering, University of California, San Diego, “Playing in Sand for Science, Engineering, and Fun.”

**HENRYK STOLARSKI**, Department of Civil Engineering, University of Minnesota, “Rotation-Free Large Deformation Finite Element Analysis of Shells.”


**JOEL BURKEN**, Department of Civil, Architectural and Environmental Engineering, Missouri University of Science and Technology, “Phytoforensics: Mother Nature as Both Witness and Engineer.”

**LEV KHAZANOVICH**, Department of Civil Engineering, University of Minnesota, “Micromechanical Modeling of Concrete Creep at Early Age.”

**CLIFF DAVIDSON**, Civil and Environmental Engineering Department, Syracuse University, “Three Case Studies in Atmosphere-Surface Exchange: Resuspension of Gasoline-Derived Lead from Years Past, Soiling of Limestone Buildings, and Chemical Constituents in the Greenland Ice Sheet.”


This lecture was presented along with a Lorenz G. Straub Award, given for the most meritorious thesis in hydraulic engineering, ecohydraulics, or related fields.

**ANDREW NORRIS**, Department of Mechanical Engineering, Rutgers University, “Transformation Acoustics and Applications to Acoustic Cloaking.”

**DES LAWLER**, Department of Civil, Architectural and Environmental Engineering, University of Texas at Austin, “Particles, Particles, and More Particles.”


**MICHAEL TRIANTAFYLLOU**, William I. Koch Professor of Marine Technology, Professor of Mechanical and Ocean Engineering and Director, Center for Ocean Engineering, Massachusetts Institute of Technology, “Vanishing and Shrinking Bodies, Global Vorticity Shedding, and Biomimetics.”

This lecture was presented along with a Lorenz G. Straub Award Ceremony.

Upcoming Lectures

Fall 2013 promises to be equally interesting. You can find a listing of the current series on the Department’s web site (ce.umn.edu). Please join us Fridays at 3:30 (Room 210 of the Civil Engineering Building). We look forward to seeing many of you on campus for these events!
MICHELLE MACIEJ

THE DEPARTMENT OF CIVIL ENGINEERING IS ATTRACTING BRIGHT AND MOTIVATED STUDENTS WHO HAVE A MULTITUDE OF TALENTS AND INTERESTS. THE OPPORTUNITIES OPEN TO THESE STUDENTS CAN BE EXCITING, BUT CAN ALSO MAKE IT DIFFICULT TO CHOOSE WHICH OF THEIR PASSIONS TO FOLLOW.

MICHELLE MACIEJ (PRONOUNCED MAH-CHEE, LIKE “MACHO WITH AN “EEE”), WHO WILL GRADUATE IN DECEMBER, FACES SUCH CHOICES.

MICHELLE MACIEJ credits her family with much of her success. Her mom, Cathy Maciej, is her constant and consistent rooting section. Her father, Gary Maciej, is her number one motivator. He always encouraged her to be the best she could be and never settle for less. Her two older brothers, John and Joe (UMN ’08 Construction Management), challenged her by setting a high bar in both athletic and professional achievement, but Maciej was able to keep up. On her high school track team, Maciej trained with Minnesotan Shani Marks, who went to the Beijing Olympics. Under Marks’ coaching, Maciej became the Minnesota State Champion for Triple Jump in 2009. Maciej continued to compete in the triple jump at UMN.

In spite of the high expectations, Maciej’s family was also supportive and always shared a lot of laughs. Maciej says, “There is never a dull moment and that’s where my upbeat personality comes from.” Her upbeat personality is definitely a factor in the success she has experienced so far and portends more good things to come.

Like many students entering the College of Science and Engineering, Maciej discovered in high school that she was skilled in the highly desired areas of math and science. When Maciej arrived at the University of Minnesota, she was open to exploring several options in engineering, from biomedical to mechanical. She was deliberate and analytical in her exploration. After each course, she would consider her levels of interest and enjoyment, and how satisfying that field would be for her as a career. Being a curious sort, she found that most classes passed on the interest and enjoyment scales, so her vision of her future self often became the deciding factor. “I like to work with people. I like a challenge. I guess I’ve considered all types of engineering at one point!” As she paid attention, the pieces began to fit together.

A friend told her about the broad opportunities available with a degree in civil engineering. Maciej sought out and met with Associate Professor Randal Barnes. She asked several questions about classes and the advisability of switching majors. Barnes helped her understand the demands and rewards of a career in civil engineering. After further careful analysis, Maciej declared a major in Civil Engineering. She has
found the program to be a great fit with her skills and interests.

In the civil engineering program all students are required to have a broad foundation in five essential areas: environmental, geomechanics, structures, transportation, and water resources. After establishing this base, students can focus their elective classes to develop a specialization. Because of this approach, Michelle Maciej—like all UMN graduates—will graduate with strong abilities in engineering fundamentals.

THE CIVIL ENGINEERING DEPARTMENT IS 100 TIMES BETTER THAN OTHER DEPARTMENTS I’VE EXPLORED. THE STAFF AND FACULTY ARE REALLY HELPFUL AND HELP CONNECT ME TO A LOT OF THINGS. THE STUDENTS ARE GREAT TO WORK WITH.”

Within her Civil Engineering major, Maciej continued to explore options for specialization by talking with professors and getting involved in student organizations. Maciej declares that talking with professors was perhaps the most helpful activity of her time at UMN. “Professors helped me through everything and connected me with other people, with opportunities in school, and with jobs.”

Maciej has a lot of natural abilities, but she also worked hard for her success. She has some practical suggestions to help other students be successful. One of the simplest: sit in the front of the class. Maciej was required to do so as a member of the track team, and she learned to like it! “It keeps me attentive—and the professors recognize your face. I know almost everyone in the building, now, and it is fun to see people and say ‘Hi’ throughout the day.”

She also encourages students to go to professors’ office hours. “In challenging courses, I would talk to the professor a lot. Solid waste was a challenging course for me, and I got to know Professor Paige Novak very well! Even if you don’t need help in the course, go to office hours at least once or twice just so they know who you are.”

Maciej made special connections with several of her teachers. Ann Johnson, who teaches about highways and has her own consulting company in construction management, knew Maciej’s brother Joe from his time at UMN. Professor Barnes was the first person Maciej connected with in Civil Engineering. She also had him for two challenging classes, statistics and computer applications.

“I was in his office almost every day for those classes! I am not afraid to ask questions, and Barnes appreciated that. He once wrote me a recommendation and said I was not afraid to admit ignorance—I guess he meant that in a good way! I learn a lot by asking questions.”

Professors also opened Maciej to other opportunities. Professor Joe Labuz hired her to organize the 61st Annual Geotechnical Engineering Conference held on campus in 2013. “That experience exposed me to more people and made me think more about geotechnical engineering,” says Maciej. She was responsible for “basically everything” dealing with conference arrangements. She contacted speakers, collected papers, produced the proceedings book, and registered all 260 attendees. She is also working on the 2014 conference and training someone new to take over.

“I enjoyed going to the conference and meeting people I’d worked with over the phone. The last week before the conference, I was quite stressed, trying to get everything ready and keeping up with school. One of the conference sponsors had contacted me to say I was doing an awesome job. That was great to hear because I didn’t know how it was all going, so it was great to meet him at the conference.”

Professors were also helpful in connecting Maciej with internships. One thing she learned is that her interactions with professors helped them to write good recommendation letters and to lead her to appropriate and advantageous internships. “My internships really helped me understand the kind of work a civil engineer does. My first internship was with Cretex Concrete Products. I learned about storm sewers and sanitary sewers. I did some inventory, which helped me learn about the concrete parts they sell and how much steel and rebar is needed for different projects. After my internship with Cretex, I thought I would like structural engineering. I became interested in pavement and concrete, too, through my work at Cretex.”

When it came time for her second internship, Maciej had several options in municipal, transportation, and environmental areas. “I had gone to a career fair, and several companies contacted me after that. All the options were interesting—it was a very tough choice.” She chose to work with the municipal engineering group at WSB & Associates, Incorporated.

Municipal engineering, Maciej discovered, includes a variety of work: water resources, storm sewers, building of roads, transportation, and the design of these things. “As
an intern, I got to work on feasibility reports, to determine, for example, if the city would be able to fund a whole project. I also did some computer aided design (CAD) work. With the water resource group, I took water samples out of storm sewers and determined if the water needed to be treated. I designed a storm sewer on an Excel® sheet; I didn’t design the actual sewer, but I helped the team determine what to design, the specifications, etc. I definitely learned a lot! They inquired about me coming back after graduation, so I guess that means I did a good job!"

The student chapter of ASCE helps students make connections between course work and professional applications. Students support one another through tutoring groups, social events, and professional networking. Maciej helped organize the ASCE Brown Bag Sessions, weekly informal conversations over lunch. She coordinated with companies coming to campus, for example, the City of Minneapolis came and talked about possible internships. Sometimes professors would talk, which helped students understand and keep up with research trends. Both types of events proved to be an excellent way to build professional networks.

Outside of school, Maciej participates in the International Concrete Repair Institute (ICRI). “I was introduced through one of my dad’s friends, Terry Babcock, who works at CMI (Construction Midwest, Inc.) and is a board member of ICRI. I attend meetings and sometimes work special events, like their golf event last summer.”

Maciej’s many activities and connections also served to bring her to mind when someone was needed to speak to alumni about student experiences or to escort visitors on campus. On one occasion, she toured alumnus Bret Weiss (BCE ’87) and his nephew on their campus visit. Weiss, who is now the president of WSB & Associates, remembered Maciej when she interviewed there for an internship.

Now, Maciej is adding some construction management courses. “I think those [construction management] classes on top of my CE degree will be a good fit for me.” She is learning valuable information that applies to a lot of different types of engineering. “In my Capstone course, we were talking about the different processes of design-bid-build and design-build. I knew the differences because I had taken a construction management class on all the processes and documents related to construction engineering."

“I LIKE HOW THE CE BUILDING WORKS, HOW ALL THE PROFESSORS ARE ALL PRETTY CLOSE. IF YOU HAVE A QUESTION, THEY ARE CLOSE ENOUGH WITH OTHER PROFESSORS THAT THEY CAN TELL YOU WHO TO TALK TO. I ALSO LIKE WORKING WITH OTHER STUDENTS DOWN IN THE LOUNGE.”

In her time at UMN, Maciej pursued many opportunities and delved into multiple aspects of civil engineering to determine her best path. Her approach to this decision displays how her personality and skills will help her be successful as a civil engineer. Maciej will graduate in December after four and a half years. She is well-prepared and has several options. “I’m feeling excited about graduation. A couple of companies have contacted me—some where I worked or applied as an intern and some that contacted me through LinkedIn. I am looking for something that will allow me to do all that I am interested in! Municipal engineering seems like a good fit because of the variety it offers.”

Maciej’s talents, broad interests, and solid foundation in civil engineering basics make her a desirable candidate for engineering firms—and a good example of what is possible for students in the Civil Engineering program at the University of Minnesota.
SCHOLARSHIPS & AWARDS

Each year the Department of Civil Engineering awards one of the largest numbers of undergraduate scholarships within the College of Science and Engineering. These scholarships are made possible by our generous donors. The department and our students are extremely grateful for their generosity.

American Council of Engineering Companies of Minnesota (ACEC/MN) Scholarships are available to US citizens pursuing a bachelor’s degree in an accredited Master of Science (MS) program in engineering or land surveying.

Eric Vavra (Earl Oxley Scholarship)

Eric McElrath (Bob Rosene Scholarship)

Richard (RJ) Kakach

Nathan Warner

The Clifton T. Barker Scholarship is awarded to sophomores or juniors with an average GPA of 3.5 or higher.

Justice Harvieux

Kipp Sande

Anthony Vecchi

Nathan B. Warner

Guy N. Bjorge Scholarship is awarded to a junior or senior in geoenvironmental engineering.

Kendra Schiell

Department of Civil Engineering Scholarships are awarded to undergraduate students in geo- or civil engineering based on merit.

Lindsay Gaines

Kok Keong Khor

Michael John Kondziolka

Michelle Maciej

Robb James Roy, Jr.

Theodore V. Galambos Scholarship honors Professor Emeritus Ted Galambos and the Department’s structural engineering program.

Kok Keong Khor

Jedidiah Holmerg Dordal

Gustave Perron

Hunter Holmerg

Andrew Drescher Scholarship is awarded to undergraduate students with an interest in geotechnical engineering.

Brian Folta

Noah Kimmis

James C. Olson Memorial Undergraduate Scholarship assists undergraduate students.

Kristin Carlson

AI Johnson Construction Company Scholarship is awarded to students who exhibit leadership, outstanding scholarship, boundless curiosity, and an untiring work ethic.

Andrew Boyle

Laina Breidenbach

Chris Iverson

Kathryn Klarich

Samuel Koniczczny

Gwyneth Perry

John Elwood Holmberg Scholarship is awarded in memory of John Holmberg and supports part-time civil engineering students who are working their way through school.

Jedidiah Dordal

Gustave Hunter Perron

Florence Hanson Waits Scholarship is awarded to honor James Grant Waits.

Joshua E. Balzer

Spencer Borchardt

Elizabeth J. Burton

Zachary Cotter

Matthew Jon Dalsymple

Christopher Erickson

Brad Fisher

Robert Goughnour

Alexander Hoppes

Craig Huhtala

Richard J. Kakach

Erin Kayser

Tyler Krage

Veronica Kubicek

Shelly Matsuda

Alexandra Keoheen Miller

Andrew Morgan

Chelsey Renee Palmateer

Kipp Sande

Anthony Vecchi

The James and Sharon Weinei/Chi Epsilon Scholarship is awarded to senior Chi Epsilon students.

Victoria Larson

James Arthur Pierson

Chester D. Okerlund Award is given each spring to the civil engineering student who graduated with the highest GPA during the preceding year.

Marie DesHarnais

City Engineers Association of Minnesota Scholarship benefits students focusing in areas closely aligned with city engineering.

Michael Kondziolka

Anthony Vecchi

WSB & Associates Scholarship is awarded to full-time, undergraduate civil engineering students who have completed half of the curriculum and have at least one year of schooling remaining.

Kristin Carlson

Anthony Vecchi

The ASCE Minnesota Scholarship is awarded by the Structural Committee of ASCE Minnesota to undergraduate civil engineering students concentrating in structural engineering.

Kathryn Klarich

Natalie Lindsey

The Minnesota County Engineers Association Scholarships are awarded to full-time civil engineering students who are residents of Minnesota and are a sophomore, junior, senior, or graduate student at the time of the award.

Chad Booth

Joshua Blazer

The Cornwell Scholarship provides scholarships in the Department of Civil Engineering with preference for Civil Engineering majors and students who demonstrate financial need or high academic achievement.

Michael J. Larson

The Costello Scholarship provides financial assistance to full-time, undergraduate students enrolled in the College of Science and Engineering, studying Civil Engineering, who demonstrate academic merit and financial need. A preference is given to students studying Geo-engineering.

Lydia K. Jacobs

The Dexter Scholarship supports undergraduates in Civil Engineering.

Reuben Verdoljak

The Ruhnke Scholarships in the Mineral or Geological Engineering Programs are selected by the Department’s Scholarship Committee.

Tierney Broberg

Jacqueline Ann Nowak

Matthew Bonnema

Javier Campos

Yanting Wang

The Sedam Scholarship benefits the mining and metallurgy program.

Garrett Deick

President’s Match Scholarships are awarded through the College of Science and Engineering. Funds for these scholarships are initiated by a generous donor and then matched by the University.

3M Coleman Scholarships

Zachary Cotter

Matthew Duff

Lindsay Gaines

Ryan Howard Kelly

Avi Kumar

Colin Paarmann

Kelsey Jo Peterson

Gebi Jemma Tahiro

Lucian and Genevieve Vorpahl Scholarship

Derek Walden

R. Lucian and Maye Vorpahl Memorial Scholarships

Matthew Dalrymple

Steven Johnson

Everson and Ames Construction Scholarships

Rachael E. Acevedo

Kelsey Cox

Morgan Johanna Kuehn

Charles R. Vermace

Westwood Professional Services Scholarships

Adam Kirchoff

Raymond Thelier

Miles Kersten Memorial Scholarships

Robert Reski

James Strehle

Lloyd A. Nelson Memorial Scholarship

David Thomes
Fairhurst to Receive Medal from French Légion d’honneur

Charles Fairhurst, Professor Emeritus of the Department of Civil Engineering, will be inducted as an Officer into the French National Order of the Legion of Honor (Ordre national de la Légion d’honneur) by decree of the President of the French Republic. The Legion of Honor is the highest national decoration in France. (For comparison, one might liken it to the United States’ National Medal of Science, which is awarded to leading scientists and engineers in a formal ceremony at the White House.) The French Medal of Honor rewards outstanding merits of citizens in all areas.

Fairhurst was selected for this honor based on his personal commitment to French-American relations, his exceptional cooperation with French companies, and his contributions to many public-private partnerships in the field of rock mechanics, which he studied and taught at the University of Minnesota.

The Légion d’honneur medal will be presented to Fairhurst in a formal ceremony in France on December 3, 2013.
REFERENCES and hydraulic fracturing related sources


