

Civil and Environmental Engineering

Robert R. McCormick School of
Engineering and Applied Science
Northwestern University

SPRING 2011

Message from the Chair



With great pleasure I bring you this new issue of NU CEE newsletter. It has been another busy and exciting year for our students and faculty. Our student enrollment, both graduate and undergraduate, has remained at a record-breaking level for the past two years. This is a

reflection of the recent shift of our societal focus toward infrastructure and environment as well as of the increasing reputation of our faculty and educational programs.

Following the tradition, this issue again highlights scholarly work and activities of our faculty and students and the awards and recognitions they have received over the past year. These honors are testimonies of the accomplishments achieved by our faculty and students.

In addition to these awards and recognitions, I have several exciting pieces of news to report. Last year, the department added two new faculty members: Professors Karen Chou and Sinan Keten. In this newsletter, you can read more about their educational training, professional experience, and research interests. On the curriculum side, a certificate program in Architecture Engineering and Design was established. This new certificate program is

intended to provide the undergraduates with a design experience that prepares them for careers in structural design, construction management, and architecture. At the graduate level, the interest in our MS and PhD degree programs continues to rise. The number of applications to our graduate programs this year increased by more than 20 percent. The department also added a new Executive Project Management program starting this fall. Finally, I want to sincerely thank the alumni and friends who have supported our department in so many ways. Your support has made a tremendous positive impact on our ability to continue our effort in providing the best educational environment for our students.

Jianmin Qu
Walter P. Murphy Professor

New Executive Program in Project Management

This coming fall quarter the Master of Project Management (MPM) program will initiate a new and independent course of study in executive project management. Building on its highly successful, 20-year-old basic MPM program, which will continue in its present form, the new executive program will focus on developing the managerial and executive skills needed by an individual to function effectively in an upper management executive position or perhaps operate a branch office in the construction and engineering industry.

This new program was developed in close cooperation with the MPM advisory board, which devoted countless hours to every facet of its evolution, ranging from the detailed content of the courses comprising its nucleus to the overall marketing endeavor to launch it. The program has benefitted from the advice and guidance of the entire board but most especially from its co-chairs Rich Tilghman (who has taught in the program almost from its inception) and Rodrigo Perez (who completed his MPM degree in 2002 and now operates his own company).

The executive program consists of a fixed set of six courses to be taught on alternate Friday-Saturday sessions during the academic year, and it will lead to a certificate in executive project management (half of a master's degree). Pairs of courses in a given quarter will be taught

in five, three-hour Friday-Saturday sessions separated by two weeks each. For example, one course will be taught in the morning on Friday and Saturday, and the other course will be taught in the afternoon on the same days. Then there will be a two-week break before the process is repeated. Accordingly, students in the program will miss only one day of work every two weeks. Upon completion of the certificate program, an individual can elect to complete six additional courses to earn a master's degree. Similar to the model of the basic MPM program, its practitioner-oriented faculty members are some of Chicago's top managers and executives in the construction and engineering fields. Additional details about the program can be obtained from its website at <http://cepm.northwestern.edu>

McCormick Symposium Honored Toshio Mura

A symposium in honor of Toshio Mura, professor emeritus of civil and environmental engineering and mechanical engineering, was held at Northwestern University on May 24 and 25.

The theme of the symposium was, "Recent Advances in Nano-Micromechanics of Materials."

Mura, who passed away in August 2009, was born in Ono, a small port village of Kanazawa, Japan. He received a doctorate in the Department of Applied Mathematics of the University of Tokyo in 1954. He taught at Meiji University, Japan, from 1954 to 1958. In 1958, he came to the United States to work in the Department of Materials Science and Engineering at Northwestern. He became a professor in the Department of Civil Engineering in 1966 and also held an appointment in the Department of Mechanical Engineering. He retired from Northwestern in 1996.

In addition to numerous published research papers, he was the author of three books, including *Micromechanics of Defects in Solids*. For his achievements, he was appointed Walter P. Murphy Professor in the McCormick School of Engineering at Northwestern, was elected as a member of the National Academy of Engineering for his contributions to the field of micromechanics, and received many other accolades for his work.

The symposium, organized by Morris Fine, Walter P. Murphy and Technological Institute Professor Emeritus of Materials Science and Engineering in Service, and Leon Keer, Walter P. Murphy Professor of Civil and Environmental Engineering and Mechanical Engineering, featured speakers from across the field and included such topics as nano-micromechanics of nano-materials and materials containing nano-features; computational nano-micromechanics; electronic devices with micro and nanosize components; and nano/micromechanics modeling and experiments.

Bill Baker Speaks at CEE Distinguished Lecture Series



Bill Baker, structural engineering partner at architectural and engineering firm Skidmore, Owings, and Merrill, was the inaugural speaker for the Department of Civil and Environmental Engineering's Distinguished Lecture Series on April 29.

In his lecture titled, "Theory is Practical: The Philosophy of Design," Baker proposed a design philosophy to bridge the divide between design and analysis.

Throughout his distinguished career, Baker has dedicated himself to structural innovation. His best known contribution has been to develop the "buttressed core" structural system for the Burj Khalifa, the world's tallest manmade structure. While widely regarded for his work on supertall buildings, his expertise also extends to a

wide variety of structures like the GM Entry Pavilion and Millennium Park's Jay Pritzker Pavilion and BP Pedestrian Bridge. Baker is also known for his work on long-span roof structures, such as the Korean Air Lines Operations Hangar and the Virginia Beach Convention Center, as well as for his collaboration with artists like Jamie Carpenter (Raspberry Island-Schubert Club Band Shell), Iñigo Manglano-Ovalle (Gravity is a Force to be Reckoned With), and James Turrell (Roden Crater).

A fellow of Structural Engineering Institute, Baker was elected to the National Academy of Engineering. He also received the OPAL award from the American Society of Civil Engineering recognizing his lifetime achievement in design.

CEE Welcomes Two New Professors



Department of Civil and Environmental Engineering welcomed two new faculty members this year: Karen Chou and Sinan Keten.

Karen Chou joined the department in July as assistant chair and clinical professor of civil and environmental engineering. Chou received her BSCE from Tufts University with a dual

Karen Chou joined the department in July as assistant chair and Sinan Keten joined the department in the fall as an assistant professor.

major in civil engineering and mathematics and her MS and PhD from Northwestern University in structural engineering.

Chou is a fellow of ASCE and registered professional engineer in seven states. In her 25 years of professional experience she has been a

faculty member at Syracuse University, University of Tennessee at Knoxville, and Minnesota State University, where she was the founding coordinator of the civil engineering program. She has also been a visiting and adjunct professor at the University of Minnesota - Twin Cities, summer faculty research fellow at various U.S. Air Force and U.S. Navy labs, a structural engineer at Harza Engineering (Chicago, IL), and a senior structural engineer with Paulsen Architects (Mankato, MN).

Chou's research and scholarly interest include structural reliability, applications of probability and statistics in constructed systems, structural health monitoring, development of learning tools, and engineering education. Her research was supported by NSF, U.S. AFOSR, U.S. Navy, and TN DOT.

Chou has served the profession in various capacities, including ABET evaluator, editorial board of the International Journal of Structural Safety, and Engineering Advisory Board of Aluminum Association. She was recognized by ASCE with the Certificate of Commendation for outstanding service as faculty adviser of ASCE Student Chapter and the Minnesota Federation of Engineering, Science, and Technology Societies with the Charles W. Britzius Distinguished Engineer Award.

Sinan Keten joined the Department of Civil and Environmental Engineering and Mechanical Engineering in the fall as an assistant professor in the theoretical and applied mechanics program. He received his BS in civil engineering at Bogazici University in Turkey, followed by a master's degree from MIT, focusing on structural mechanics and motion-based design of earthquake resistant structures. His doctoral research at MIT was on molecular modeling and mechanics of biological polymers, in particular the spider dragline silk.

Keten's work has led to more than a dozen publications in journals including the *Journal of the Royal Society – Interface*, *Nano Letters*, *Proceedings of the National Academy of Science*, *Nature Materials*, *Nature Physics*, *Applied Physics Letters*, *Cellular and Molecular Bioengineering*, *Progress in Material Science*, and *Physical Review Letters*. His doctoral work has been recognized with a MRS Graduate Student Award from the Materials Research Society. Keten has a wealth of experience in advising students through research programs such as NSF-REU and MIT-UROP, and will be teaching mechanics as well as molecular simulation of materials failure at undergraduate and graduate levels.

Department Adds Architectural Engineering & Design Certificate

The Architectural Engineering and Design (AE & D) Program provides undergraduates in civil and environmental engineering and other engineering fields with a design experience that prepares them for graduate study and professional careers in structural design, construction management, architecture, and elsewhere in the building industry. The six-course certificate program in AE&D is built on the McCormick School of Engineering basic studies program and the basic civil engineering curriculum. Engineering students completing this program will meet all requirements for the BS degree in civil engineering. Other Northwestern engineering students may earn the certificate by taking two additional courses (eight courses total).



Yonggang Huang Uses Flexible Electronics to Create New Devices

Yonggang Huang, Joseph Cummings Professor of Civil and Environmental Engineering and Mechanical Engineering, has had a successful year collaborating with John Rogers, the Flory-Founder Chair Professor of Materials Science and Engineering at the University of Illinois, on several new, innovative electronic devices.

The duo has designed a new catheter for cardiac ablation therapy, a new method to print electronics on complex surfaces, and a new tiny “eyeball” camera with an adjustable zoom.

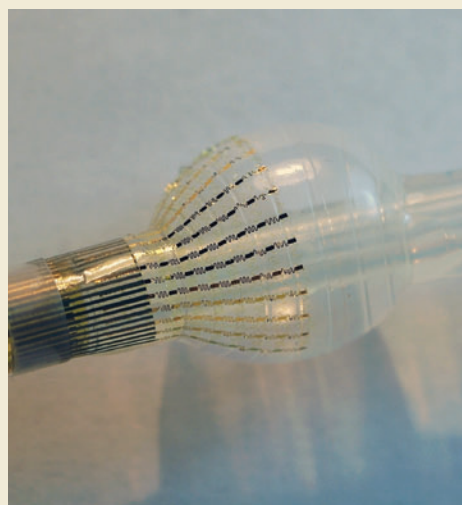
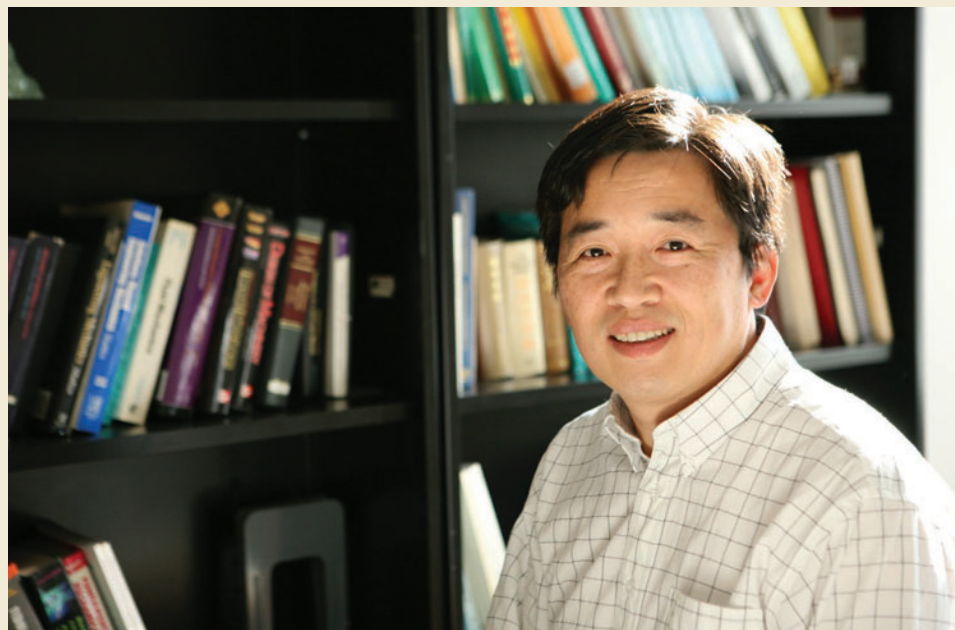
In an improvement over open-heart surgery, cardiologists now use catheters to eliminate damaged heart tissue in certain patients, such as those with arrhythmias. But this, too, can be a long and painful procedure as many catheters, with different functions, need to be inserted sequentially. Huang and his collaborators have used their “pop out” design of stretchable electronics to create stretchable catheter that has all necessary medical devices printed on it: a device for eliminating damaged tissue using heat, temperature and pressure sensors, an LED and an electrocardiogram (EKG) sensor.

“The use of one catheter to achieve all these functions will significantly improve clinical arrhythmia therapy by reducing the number of steps in the procedure, thereby saving time and reducing costs,” Huang said.

Huang and Rogers also developed a reversible adhesion method for printing electronics on a variety of tricky surfaces such as clothes, plastic and leather. They designed a clever square polymer stamp that allows them to vary its adhesion strength. The stamp can easily pick up an array of electronic devices from a silicon surface and move and print them on a curved surface.

Key to the square and squeezable polymer stamp are four pyramid-shaped tips on the stamp’s bottom, one in each corner. They mimic, in a way, the micro- and nano-filaments on the gecko’s foot, which the animal uses to control adhesion by increasing or decreasing contact area with a surface.

Pressing the stamp against the electronics causes the soft tips to collapse up against the stamp’s body, maximizing the contact area between the stamp and the electronics and creating adhesion. The electronics are picked up in a complete batch, and, with the force removed, the



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soft tips snap back to their original shape. The electronics now are held in place by just the four tips, a small contact area. This allows the electronics to be easily transferred to a new surface.

“Our work proposes a very robust method to transfer and print electronics on complex surfaces,” Huang said.

Huang and his collaborators are also the first to develop a curvilinear camera, much like the human eye, with the significant feature of a zoom capability, unlike the human eye. The “eyeball camera” has a 3.5x optical zoom, takes sharp images, is inexpensive to make and is only the size of a nickel.

While the camera won’t be appearing at Best Buy any time soon, the tunable camera — once optimized — should be useful in many applications, including night-vision surveil-

lance, robotic vision, endoscopic imaging and consumer electronics. The tiny camera combines the best of both the human eye and an expensive single-lens reflex (SLR) camera with a zoom lens. It has the simple lens of the human eye, allowing the device to be small, and the zoom capability of the SLR camera without the bulk and weight of a complex lens. The key is that both the simple lens and photodetectors are on flexible substrates, and a hydraulic system can change the shape of the substrates appropriately, enabling a variable zoom.

“We were inspired by the human eye, but we wanted to go beyond the human eye,” said Huang, who led the theory and design work. “Our goal was to develop something simple that can zoom and capture good images, and we’ve achieved that.”

Global Architecture Brigades Students Build School in Honduras

It began with an email: Would you like to be part of Global Architecture Brigades? Yes, said McCormick civil engineering students Mehri Paydar and junior Elif Koru, who had lamented the lack of architecture student groups on campus. So in late 2009, they created a Northwestern chapter of the international student organization and recruited students to join.

But in the end, they got more than just a community of like-minded peers: they and seven other students spent a week of their winter break on a mountain in Honduras, cutting rebar with hacksaws and mixing concrete with shovels, building a new elementary school for a local village.

"It was eye-opening," said group member Frank Cummins. "Every night I would lie in bed and look out the window and think about what I'd done that day. I got a lot of satisfaction from that."

Global Brigades is the world's largest student-led global health and sustainable development organization. One of its programs, Architecture Brigades, offers students a way to design and construct socially responsible and sustainable architecture solutions in Honduras.

After establishing the chapter at Northwestern, both Paydar and Koru, students in the Architectural Engineering and Design program, realized they wanted the group to be more than a volunteer trip — they wanted to provide a community for students interested in architecture. They organized activities like design charrettes, where students were given a design problem to solve.

But they quickly focused on fundraising for the group's ultimate purpose — a seven-



day school, you have to help construct it.) For the next five days, the students went about laying floors, building cinderblock walls, mixing concrete and cutting rebar — something both Koru and Paydar became experts at.

"We were the smaller ones, and we were sent to cut rebar with a hacksaw," Koru said. "And we did it. We were in the dirt, sawing the rebar, and it was cold and windy, but we did it."

Frank Cummins, a biomedical engineering sophomore, spent much of his time hand-mixing cement with filtered dirt from the local riverbed.



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day brigade to Zurzular, Honduras, where they were charged with helping to build a new school. Days after finishing up their fall quarter, they flew to Honduras and found themselves riding in a van up a Honduran mountain to the school construction site.

Construction on the new school was already begun by a brigade before them, and the students were helped by a bevy of local volunteer fathers. (The organization's deal with the village: if you want your students to attend

"It gets heavy pretty quickly," he said. "It was exhausting work."

At night, they took the hour-and-a-half van ride back down the mountain (before dark, as there are no lights along the road) and ate their daily dinner of beans and rice. They spent their evenings talking with the GAB coordinator who designed the school.

By the time they headed back home for winter break, the students had built most of the walls and laid most of the floor. For Cummins,

the experience galvanized him to lead the group forward to help build and design for developing communities.

"I now have a greater will to help developing communities like this in the future," he said. "I hope our group will grow so we can do even more."

Other civil engineering students worked on the project were senior Jessica Chen and juniors Galen Reed and Chanhon Lee.

Student News

EE Student Wins Fulbright

Environmental Engineering senior **Kyle Simonson** was awarded a Fulbright Grant for 2011-12 academic year. Kyle will conduct research in Chile. He will study the arsenic absorption capacity of Chile's Atacama Wetlands. Kyle will be graduating in June with a bachelor of science in environmental engineering.

CEE Students Win First Prize in Drinking Water at 2011 Illinois Section AWWA Conference

The Northwestern Engineers for a Sustainable World team, composed of students from civil and environmental engineering and biological anthropology, presented their project at the recent Watercon 2011 meeting of the Illinois Section American Water Works Association (AWWA) and the Illinois Water Environment Association in Springfield. The students' poster presentation, "The Thirst Project: Arsenic and Boron Removal from the Lluta River, Chile," won first prize in the Fresh Ideas Poster Competition. The team was invited to attend the AWWA National meeting in June to compete for the national award.

The ESW team members are: Junzi Shi, senior in biological anthropology; **Brooke Jarrett**, graduate student in civil and environmental engineering; **Sloane McNulty**, **Sasha Letuchy**, and **Kaleb Tsang**, undergraduates in environmental engineering. The team's faculty adviser is Professor Aaron Packman and they are collaborating with Professors Pablo Pastén and Gonzalo Pizarro of Católica University in Chile.

Ben Shorofsky Wins 2011 Circumnavigators Travel-Study Award

Environmental engineering student **Ben Shorofsky** won the 2011 Circumnavigators Travel-Study Award. The award is co-sponsored by the Chicago Chapter of Circumnavigator Club and Northwestern University Office of the Provost. Next summer he will travel to Ecuador, Ghana, England, Denmark, United Arab Emirates, and Indonesia to conduct his research on sustainable development. His faculty sponsors are Professors Jean François Gaillard and Kimberly Gray.

Engineers for a Sustainable World Builds Ram Pumps in Philippines

Students involved in Engineers for a Sustainable World spent three weeks last summer in the rural village of Tres Hermanos in the Philippines colleagues building a ram pump, which saved villagers the need to walk a half hour to get to fresh water. The students spent the previ-



Engineers for a Sustainable World members pose with a new ram pump they helped build in the Philippines.

ous year creating a new lever mechanism that would make the valve of the ram pump safer, which won them a \$10,000 prize in the Dow Sustainability Innovation Challenge. "I am very proud of the team and how much we were able to accomplish in the field, in large part due to the hospitality of our hosts, AIDFI and Tres Hermanos," said team member Junzi Shi. "We made really strong bonds on this trip, and all groups involved feel the desire to continue the relationship."

Undergraduate Students Receive Scholarships and Awards from Professional Organizations

Three civil and environmental engineering undergraduates received scholarships from the Illinois Section American Society of Civil Engineers (ASCE) during a scholarship dinner on April 6, 2011 in Chicago. **Sebastian Galvez**, a civil engineering junior, received the Structural Engineering Scholarship. **Hannah Iezzoni**, a civil engineering junior, received the Geotechnical Engineering Scholarship. **Kyle Simonson**, an environmental engineering senior, received the Environmental and Water Resources Engineering Scholarship.

Ken Fuller, a civil engineering senior, received the Containerization and Intermodal Institute Award during the Institute's award dinner on April 6, 2011. In January, Ken received the Infrastructure Technology Institute (ITI) Student of the Year Award and a scholarship at the 14th Annual Council of University Transportation Centers Awards Banquet.

Alexandra (Sasha) Letuchy Receives ISWWA Safe Water Scholarship

Sasha Letuchy, a senior in environmental engineering, received the Illinois Section of the American Water Works (ISWWA) Outreach Committee's Safe Water Scholarship Award.

The award was presented in a recent ISWWA annual conference in Springfield, IL. She is currently enrolled in the BS/MS program and is a member of the ESW team that won the first prize for their poster presentation, "The Thirst Project: Arsenic and Boron Removal from the Lluta River, Chile" during the same conference.

PhD Student Zitao (Arthur) Zhang Receives Transportation Scholarship

Transportation PhD candidate **Zitao (Arthur) Zhang** was awarded the Terry E. Priest Scholarship in January at the Operation Stimulus 2011 sponsored by the Denver Transportation Club. The scholarship is awarded to students who have shown great potential through their study and plan to pursue a career in the field of transportation, logistics, or supply chain management.

Zhang is a fifth year PhD candidate specializes in transportation and logistics. His research topic is focused on the transportation investment and pricing decision. Zhang's dissertation adviser is Professor Pablo Durango-Cohen.

Isabelle Ji Awarded Udall Scholarship

Isabelle Ji was awarded the 2010 Udall Scholarship. The award is given to sophomores and juniors committed to careers related to the environment, tribal public policy or Native American health care. Ji, who is also working on the Kellogg School of Management's certificate for managerial analytics, is interested in a career in business strategies for sustainable development. On campus she leads education and outreach for Engineers for a Sustainable World. She has traveled to China to teach English and environmental classes.

Diverse Artistic Talents among NU Civil & Environmental Engineering Students

Engineers often been perceived as having no interest in the arts, but several civil and environmental engineering students have diverse artistic talents. **Mehri Paydar**, '11, is a former professional ballet dancer who now dances with Northwestern. "My life was art," she said. "It was music, aesthetics. And then when I came here I went the engineering path because I liked math and science. But I had a need for the arts. The Architecture Engineering and Design program is perfect for that." **Corey Bertelsen**, '11, is majoring in both civil engineering and music. He plays percussion in a band called the Gentlemen of NUCO, which performed on America's Got Talent. "I knew from the get-go that I wanted to do music and engineering," he said. "I've always been into both art and science." Here is a list of some other civil and environmental engineering students who performed regularly with their artistic talents.

Yikai Chen, graduate student, does ballroom, latin, and swing dance with many groups.

Francesca Ferrero, '11, plays alto saxophone.

Joel Fenner, graduate student, is a composer.

Madison Fitzpatrick, graduate student, plays bass and is a producer.

Ken Fuller, '11, plays bass.

Shaina Fuller, '14, dances with NU ReFresh.

Beau Garrett, '12, is the musical director for NU Brown Sugar, a South Asian A Cappella group.

Erik Herberg, '11, plays French horn with the Northwestern marching band.

Frank Kaufhold, '14, plays alto saxophone and clarinet with the Northwestern marching band.

Brian Kerr, '11, plays violin.

Chanhan Lee, '12, sings Harmony in Spirit, an a cappella group.

Nana Ohene-Adu, '12, sings with the NU Community Ensemble.

Ismail Ömer Verbas, graduate student, plays classical guitar.

Galen Reed, '12, plays trumpet with the Northwestern marching band.

Matt Rote, '13, plays snare drum in the Northwestern marching band.

Meead Saberi K., graduate student, does dance and photography.

Oliver Williams, '12, plays piano.



Mehri Paydar, '11, performing in Joel-Valentin Martinez's "Underneath" at Northwestern's Danceworks 2010 production.

Students Compete in ASCE Great Lake Regional Student Conference Steel Bridge Competition



For the first time since 2003 a group of enthusiastic and energized students revived the NU American Society of Civil Engineers (ASCE) Student Chapter from two members to 40 and competed in the ASCE Great Lake Regional Student Conference with their steel bridge in Milwaukee in April.

The group designed and fabricated a 21-foot bridge with a 16-foot main span and a 5-foot cantilever. Due to a dispute in the interpretation of a dimension, however, the head judge disqualified the team's bridge. The NU bridge was competitive in two categories. The bridge weighed in at 154.2 lbs, which was the lightest raw weight among the 14 bridges in the competition. The team's total construction time was the fourth fastest.

Despite the disappointment, the bridge team, led by seniors Francesca Ferrero in design and Ken Fuller in finance, was in high spirits and fully enjoyed the experience. Other team

members were senior Patrick Rice; juniors Galen Reed, Hannah Iezzoni, and Kendra Pickard; sophomores Daniel Lambson, Kelly Au, and Adrienne Masterton; and freshman Timothy Clark. In a true multi-disciplinary team effort, the students collaborated with the American Welding Society Student Chapter at Kankakee Technical College on the welding of the bridge components.

The students have already selected a new captain, junior Galen Reed, for next year's competition in steel bridge. They will also expand their preparation to compete in other events, including concrete canoe, geotechnical and environmental engineering. In addition to the steel bridge, the students also competed in the technical paper category. This year's topic was "Is it ethical for ASCE to do a report card on infrastructure?" Sophomore Adrienne Masterton submitted the paper and presented it during the conference. The paper placed fourth.

McCormick

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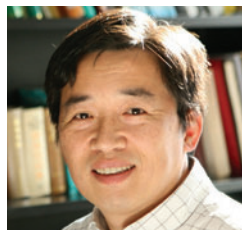
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Faculty Honors and Awards



Jan Achenbach was elected honorary member of the National Academy of Science of Korea.



Yonggang Huang received SPIE's Green Photonics Award and the America Society of Mechanical Engineer's Charles Russ Richards Memorial Award.

He was appointed editor-in-chief of *Theoretical and Applied Mechanics Letters* and technical editor of the *Journal of Applied Mechanics*. He gave the plenary lecture at the International Conference on Mechanical Properties and at the NSF CMMI Research and Innovation Conference.



Surendra Shah gave keynote lectures at the European Conference on Fracture and the International Conference on Serviceability. He was also the College of

Engineering Lecture Series speaker; co-chaired an INDO-U.S. Workshop on Nanotechnology Applied to Concrete; and was awarded an honorary membership to RILEM.

Associated Student Government Faculty Honor Roll: **Larry Booth, Pablo Durango-Cohen, David Corr, Kimberly Gray, and John Rudnicki.**



Zdenek Bazant was elected honorary member of the American Concrete International.

Charles Dowding received the International Society of Explosive Engineer President's Distinguished Service Award.

We are always interested in how our alumni are doing. Let us know about you! Keep in touch by e-mailing us at civil-info@northwestern.edu with your current contact information and what you are doing.