

Department of Civil and Environmental Engineering

This has been an unusual year associated with great introspection among faculty regarding the future vision and goals for the [Department of Civil and Environmental Engineering](#) (CEE). Senior faculty members in the Parsons Laboratory for Environmental Science and Engineering expressed concern that the current structure of the department inhibits progress in environmental research and education. They also expressed their frustration about the continued indecision by MIT regarding the establishment of a broad Institute-wide environmental initiative. With the support of the CEE visiting committee, we established a faculty task force, chaired by associate dean Cynthia Barnhart, to conduct a strategic analysis of the vision, goals, and direction of the department. Unfortunately, the biennial visit of the visiting committee coincided with the landfall of Hurricane Sandy in New York on October 29, 2012, and only three of the expected 14 members of the committee were able to attend an abbreviated program of meetings.

Members of the task force reached broad agreement that the top priority for the department is to develop a new flexible undergraduate degree program that will more effectively exploit the opportunities for cross-disciplinary studies at MIT and more closely align with CEE faculty expertise, while taking advantage of the new pedagogies associated with online learning programs such as *MITx*. Subsequently, associate professor Markus Buehler chaired a curriculum development committee that mapped out an initial outline for the new program and presented it to the CEE faculty in the spring. Given the time and effort required to develop and implement these major changes to CEE's undergraduate programs, professor Andrew Whittle decided to step down as department head effective July 1, 2013. Markus Buehler agreed to serve as the new head, an especially positive development given his involvement in the task force and his leadership of the curriculum development committee.

This has also been a year of tremendous success for a number of faculty members in the department. We are very proud that professor Sallie W. (Penny) Chisholm was awarded the National Medal of Science by President Barack Obama in February 2013. The award recognizes Chisholm's work in biological oceanography relating to photosynthetic microbial organisms. This is the first time any faculty member in CEE has been so honored. Among numerous other awards, professor Charles Harvey and his colleagues received the Prince Sultan Bin Abdulaziz International Prize for Water for seminal work on diagnosing the causes of arsenic contamination in groundwater in Bangladesh; assistant professor Jesse Kroll was awarded the Kenneth T. Whitby Award from the American Association for Aerosol Research; and professor Martin Polz received the Eli Lilly and Company-Elanco Research Award from the American Society for Microbiology. Professor Buehler received the Robert Lansing Hardy Award from the Mineral, Metals & Materials Society (his ninth major research award in the last three years). We are also very pleased this year by internal MIT recognition for professor [Heidi Nepf](#), who received the Earll M. Murman Award for Excellence in Undergraduate Advising; for Professor Polz, who was awarded the Frank E. Perkins Award honoring

his excellence in advising and mentoring graduate students; and for professor Herbert Einstein, who received the School of Engineering's Samuel M. Seegal Prize in recognition of exceptional teaching, mentoring, and advising.

There were three successful faculty promotion cases this year: associate professor Ruben Juanes was awarded tenure, Jesse Kroll was promoted to associate professor without tenure, and Markus Buehler to full professor. Through a broad faculty search process we have also successfully recruited two new junior faculty members, Benjamin Kocar and Lydia Bourouiba. Ben Kocar is an environmental chemist and is currently a research scientist at the Stanford Synchrotron Radiation Lightsource. His research deals with the biogeochemical cycling of metals and contaminants, particularly measurements of redox processes at small scales (soil aggregates and pores). Lydia Bourouiba is a fluid mechanician and is currently a lecturer in the MIT Department of Mathematics. Her research combines fluid dynamics with disease transmission and epidemiology (transmission of pathogens in fluid droplets from sneezing and coughing). We look forward to their arrival in January 2014. We have also recruited Pierre Ghisbain as a lecturer in structures, effective September 2013. Ghisbain, who received his PhD from the department in 2013, will play a key role in the Master of Engineering program in high-performance structures.

We again salute our undergraduate student steel bridge team. This year (for the first time) they hosted the regional competition sponsored by the American Society for Civil Engineers. The event was held during the same week as the terrible bomb attacks at the Boston Marathon and was directly impacted by the subsequent citywide lockdown. We are very proud of the team of students, staff, and faculty, who managed to run a successful regional competition despite the difficult circumstances. We give particular thanks to students Leonidia Garbis '12 and Matthew Pires '10. It was a remarkable achievement, capped by a great performance and the high spirits of our own team, which won the regional competition and went on to place second at the national competition.

Educational Activities

Undergraduate Programs

Twenty-four freshmen selected CEE as their home department for 2014. During the 2012–2013 academic year, the department awarded 27 bachelor of science degrees: 14 in civil engineering (Course 1-C), 10 in environmental engineering (Course 1-E), and three in civil and environmental engineering (Course 1-A).

Undergraduate Research and Practical Applications

Coursework

As sophomores, the 1-A, 1-E, and 1-C majors take the common core classes together, including the sophomore engineering design lab. In their junior year they split into their respective majors, and in senior year they come together again for the capstone subject in civil and environmental engineering design.

This year sophomore students in 1.102 Introduction to Civil and Environmental Engineering Design II formed six teams to define, design, and build sensing technologies involving considerable electric design, measurement technology, and computer work. The projects were varied: one group focused on sensing changes in a bridge's behavior as abutment support was weakened; one focused on the efficiency of geodesic domes; another designed and constructed a solar-powered water purification system; one team constructed a control box to adjust street lighting according to weather conditions; another constructed a water-efficient garden watering system; and the sixth team built a system that sensed low-frequency vibrations as a means to evaluate the potential for energy harvesting. The course was taught by senior research associate and senior lecturer John Germaine and lecturer Amy Mueller.

CEE seniors in the capstone subject 1.013 led by Professor Einstein designed a new building at the corner of Massachusetts Avenue and Vassar Street that would house both CEE and the Department of Earth, Atmospheric and Planetary Sciences (EAPS). This "idea competition" gave the seniors the unique opportunity to design a facility that would be used by CEE faculty, teaching staff, and graduate students, as well as by the students' future peers. The seniors built and tested physical models of the structures that they designed and wrote reports about the products, incorporating feedback they received throughout the semester. The students also designed, assembled, and load-tested portable wooden bridges on the Stratton Student Center steps. The teaching staff included lecturers Peter Shanahan, David Langseth and Lisa O'Donnell, as well as technical instructor Stephen Rudolph.

This year the department again offered a freshmen seminar organized by associate professor Roman Stocker and Jesse Kroll during the spring term. Subject 1.007 EES-Lab: Engineering for Environment and Sustainability is a laboratory-based class centered on engineering problems organized around three themes: sustainable cities; energy and climate; and air, water and health.

Traveling Research Environmental Experiences

Traveling Research Environmental Experiences (TREX) is a six-credit field research subject offered during Independent Activities Period (IAP) to all Course 1 undergraduates. TREX (subject 1.992) gives students an opportunity to gain hands-on fieldwork and research experience in a global context.

Fourteen undergrads and five advisors participated in TREX 2013 from January 15 to 25. Their research on the big island of Hawaii focused on the atmospheric chemistry of the volcanic smog (vog) being emitted from a new vent that opened in the volcano Kilauea in 2008. After a week in the classroom, participants traveled to Hawaii to track the plume of the volcano and characterize the vog using instruments such as an aerosol mass spectrometer, sensors mounted on a remotely operated airplane, and other instruments in a mobile laboratory.

Jesse Kroll, an atmospheric chemist, planned and led TREX 2013 with the help of lecturer Sheila Frankel, assistant director of the Parsons Lab and director and founder of TREX. Kroll and associate professor Colette Heald, Frankel, postdoctoral associate Eben

Cross, and graduate student James Hunter accompanied the students to teach and direct their research activities.

The undergraduates presented their initial findings in a public lecture at the Kaloko-Honokohau National Historical Park in North Kona, Hawaii on January 24, as part of the ReefTalk series hosted by the University of Hawaii's Sea Grant program. About 60 people attended the 40-minute presentation, which was followed by 40 minutes of questions and answers. An [article](#) about the presentation appeared in the newspaper *West Hawaii Today*.

Steel Bridge Team

As mentioned above, this year our student-led [MIT Steel Bridge team](#) again won second place at the National Steel Bridge Competition held May 31–June 1 at the University of Washington in Seattle.

On April 20, CEE hosted the [regional competition](#), which had been scheduled to begin early that morning, but was delayed by the lockdown in the Boston area following the shooting death of MIT Police Officer [Sean Collier](#) and the Boston Marathon bombings. Although the annual conference of the regional student chapters of the American Society of Civil Engineers scheduled for Friday evening had to be canceled, the event organizers, Leonidia Garbis and Matthew Pires, along with CEE administrative officer Patricia Dixon, refused to give up on the competition. In the end, they were able to hold the event on Saturday with a delayed start. Nine of the 13 visiting teams that had registered for the event were on hand Saturday in Johnson Athletic Center.

The contest requires student teams to design an approximately 20-foot scale model of a bridge for a hypothetical site that meets specifications outlined in a request for proposals. Teams must fabricate steel pieces to build the bridge and, during the competition, be able to assemble it very quickly. The rules are rigid, reflecting the safety needs and landscape characteristics of an actual site. Bridges must be able to withstand a 2,500-pound load without sagging; a deflection of more than one centimeter, for instance, might be considered too large.

Team members earn four credit units for their work by enrolling in a steel bridge design competition (1.055 for undergraduates and 1.58 for graduate students) during the fall, IAP, and spring terms. Professor Jerome Connor leads the course.

Terrascope

CEE continues its involvement in the freshman learning community [Terrascope](#) through its codirection with EAPS of the spring subject 1.016 Communicating Complex Environmental Issues: Building Solutions and Communicating Ideas. This subject offers freshmen the opportunity to participate directly in faculty-guided research while working more rigorously on solutions to the problems they studied in the fall Terrascope class.

In AY2013, Professor Harvey and lecturer Ari Epstein taught the subject, with a focus on environmental and humanitarian issues associated with the abundance and distribution of strategic natural resources. Three teams of freshmen were formed (each with an undergraduate teaching fellow) and assigned to one of the following three projects.

- Exploring the use of red worms to break down phosphorus-rich algae for use as fertilizer, thus potentially addressing two complementary problems: a potential shortage of phosphorus, and runoff into rivers of phosphorus from chemical fertilizers.
- Experiments that test genetically engineered phage to see if they can be designed to bind to indium (a rare-earth element); such phage could then be used to extract and recycle indium in a variety of settings.
- A multiplayer game that teaches players firsthand about the trade-offs inherent in mining, using, and recycling strategic minerals.

Graduate Programs

During AY2013, the department awarded 118 graduate degrees: 13 doctorates, 34 master of science in transportation (MST) degrees, 24 master of science degrees, and 47 master of engineering (MEng) degrees.

While many of our graduate students go on to doctoral studies and careers in academia, most students in the MEng and MST programs typically accept jobs in industry or government.

Our doctoral students are critical to the department's mission to educate intellectual leaders for academia and national research laboratories. Although research is often interdisciplinary, the program curricula are organized around the following areas of study: aquatic sciences, hydrology, environmental fluid mechanics and coastal engineering, information technology, transportation, civil and environmental systems, geotechnical and geoenvironmental engineering, and structures and materials. During 2012–2013, CEE had 92 doctoral students in the total population of 243 graduate students. Of the 13 who received a PhD, eight accepted faculty or postdoctoral positions at academic institutions.

Master of Engineering Students

Student teams in the MEng water quality and engineering track spent January engaged in onsite research and fieldwork. Projects included working on small-scale drinking water and sanitation systems in Ghana, working with the Singapore Public Utility Board to measure and control bacterial pollution in surface waters of the Kranji Catchment, designing a precipitation-based flood warning system in Uganda, and analyzing schemes for conjunctive use of surface and groundwater in Arkansas.

Students in the high-performance structures and geotechnical tracks designed bridge crossings for the Charles River and a new CEE headquarters building on the Charles River. They also joined Professor Connor on a January study tour in New York, which culminated in a master of engineering reunion.

Students in the transportation track explored ways to improve public transportation to Logan Airport and attended the annual Transportation Research Board (TRB) meeting in Washington DC.

Interdepartmental Transportation Students

Interdepartmental transportation students enjoyed an active and busy academic year. In January, transportation alumni, faculty and students attended the TRB meeting, where many presented papers and posters. MST student Ryan Westrom, who held the Dwight David Eisenhower Transportation Fellowship, kept a [blog](#) while in attendance.

Several students in the MIT Transportation Club helped plan the annual Transportation Showcase held at the MIT Museum in November. The showcase brought together more than 250 students, faculty, alumni, and representatives of transportation companies and agencies for an evening featuring transportation research posters and industry networking.

Lectures and Symposia

The department sponsored the first event in the Chiang C. Mei Lecture in Applied Mechanics, which was established in spring 2011 to honor Professor Mei on his retirement after 44 years on the faculty. Professor Mei is widely known and praised for his contributions to wave and fluid mechanics and hydrodynamics. The annual lecture, endowed by contributions from Mei's former students, colleagues, and friends, will bring leading academicians from around the world to MIT to share their research. On October 3, Julian Hunt, professor of climate modeling in the Department of Space and Climate Physics and Department of Earth Sciences at University College London, spoke on "Fluid Mechanics and Public Policy: Environmental Impacts and Change."

CEE held its third [Research Speed Dating Day](#) in the Skyline Room of the New Media Lab Building on February 10. During this event, organized by the junior faculty, 22 faculty members and postdoctoral associates gave four-minute research presentations. This year the talks were grouped into themed trios in sessions chaired by undergraduates. The themes were:

- Vegetation: Interactions in the Earth System
- Urban Dynamics
- Microbes in the Environment
- Mechanics for Energy
- Electricity Infrastructures
- Measuring Chemicals in the Environment
- Large-Scale Transportation Systems
- Active Mixing and Mixing-Induced Activity

The department co-hosted the annual [John R. Freeman Lecture](#) with the Boston Society of Civil Engineers on April 18 in Wong Auditorium. The lecture series is named for the MIT alumnus who designed the original Charles River Dam. Lawrence J. Murphy, an engineer at CDM Smith in New York, and Michael Bachand of the US Army Corps of Engineers, spoke on “Hurricane Storm Barrier Design and Operation.”

Lawrence Bacow, president emeritus of Tufts University and former MIT chancellor, gave the annual [Charles L. Miller Lecture](#) (co-hosted with the Engineering Systems Division) on April 22 at the MIT Faculty Club. Bacow spoke on “The Research University in the Digital Age.”

Research

The department’s research is both broad and deep and covers a wide variety of focal areas in civil and environmental engineering. The monthly research newsletter, [On Balance](#), focuses on one research story each month. The titles of the 2012–2013 issues and the researchers’ names follow.

- [“Connectivity, Traffic and Geography Determine How Diseases Spread through Air Transportation Network,”](#) Ruben Juanes and assistant professor Marta González, graduate student Christos Nicolaides, and research associate Luis Cueto-Felgueroso, October 2012.
- [“Size Diversity in Cement Nanoparticles Optimizes Their Packing Density to Give Concrete Its Strength,”](#) professor Franz-Josef Ulm, postdoctoral associate Enrico Masoero, senior research scientist Roland Pellenq, and coauthors, November 2012.
- [“Research Shows Why Slight Increase in Flexibility of Manufacturing Plants Optimizes Efficiency and Cost,”](#) professor David Simchi-Levi and doctoral student Yehua Wei, December 2012.
- [“Phone Data Helps Pinpoint Source of Traffic Congestion,”](#) Marta González, former postdoctoral associate Pu Wang, and coauthors, January 2013.
- [“Scientists Create a ‘Day in the Life’ Microbial Montage,”](#) professor Edward DeLong, former postdoctoral associate Elizabeth Ottesen, postdoctoral associate Curtis Young, research engineer John Eppley, and coauthor, February 2013
- [“Marine Microbes Display Social Cooperation in Warfare,”](#) Martin Polz, postdoctoral associate Otto Cordero, alumni Sarah Proehl, Lynn Ngo and Fatima Hussain, former postdoctoral associates Hans Wildschutte and Benjamin Kirkup, and coauthors, March 2013.
- [“Effect of Seismic Activity on MIT Building to be Detailed,”](#) professor Oral Buyukozturk and coauthors, April 2013.
- [“Simplifying Models of Human Mobility at the Daily Scale,”](#) Marta González, postdoctoral associate Christian Schneider, former postdoctoral associate Vitaly Belik, and coauthors, May 2013.
- [“Tough, Bio-inspired Composites Print Rapidly in 3-D,”](#) Markus Buehler, graduate students Leon Dimas and Graham Bratze, and coauthor, Summer 2013.

Below are some of the MIT news stories and MIT news releases about CEE research published during the past academic year.

- [“New Study of Disease Contagion Ranks US Airports in Terms of their Spreading Influence,”](#) July 23, 2012
- [“Weapon-Wielding Marine Microbes May Protect Populations from Foes,”](#) September 7, 2012
- [“Department Snapshot: Civil and Environmental Engineering: From Bacteria to Bridges, CEE Researchers Tackle Natural and Built Environments,”](#) October 25, 2012
- [“Sitting Still or Going Hunting: Which Works Better? If you’re a microbe floating in the ocean, there’s no single best strategy for getting food, MIT research shows,”](#) November 1, 2012
- [“Size Diversity in Cement Nanoparticles Optimizes Packing Density to Give Concrete Its Strength,”](#) November 8, 2012
- [“The Music of the Silks: Researchers synthesize a new kind of silk fiber—and find that music can help fine-tune the material’s properties,”](#) November 28, 2012
- [“In Profile: Roman Stocker Finds Big Effects from Tiny Organisms: From microbes in the ocean to cats in the kitchen, MIT researcher uncovers surprising phenomena where biology meets fluid mechanics,”](#) December 13, 2012
- [“Cellphone Data Helps Pinpoint Source of Traffic Tie-Ups,”](#) December 20, 2012
- [“Scientists Eavesdrop on the Hidden Lives of Microbes,”](#) January 21, 2013
- [“CEE Students Build Replica of Guastavino Vaulted Ceiling at Boston Public Library,”](#) February 6, 2013
- [“Sallie \(Penny\) Chisholm Awarded the National Medal of Science, the Nation’s Highest Honor for Scientists,”](#) February 19, 2013
- [“Legos and Leaves Help Inspire Children to Learn Science During AAAS Event,”](#) February 21, 2013
- [“Polz to Receive the American Society for Microbiology’s Elanco Award,”](#) March 29, 2013
- [“Ulm and Concrete Sustainability Hub Named to Engineering List of Top Newsmakers,”](#) April 5, 2013
- [“A New Wrinkle in Online Education: An experimental online course gives some students scheduling freedom,”](#) April 3, 2013
- [“Professor Markus Buehler Named 2013 Recipient of the Robert Lansing Hardy Award,”](#) April 11, 2013
- [“Simchi-Levi Honored by Production and Operations Management Society,”](#) April 26, 2013
- [“Decoding the Structure of Bone: MIT researchers decipher the molecular basis of bone’s remarkable strength and resiliency; work could lead to new treatments and materials,”](#) April 16, 2013

- [“CEE’s Saurabh Amin is Chief Scientist on Project to Improve Security and Operations of Civil and Environmental Engineering Structures and Systems,”](#) May 7, 2013
- [“Study Shows That People Organize Daily Travel Efficiently,”](#) May 8, 2013
- [“Researchers Develop Method to Design Synthetic Bone and Quickly Turn the Design into Reality Using Computer Optimization and 3-D Printing,”](#) June 17, 2013

Faculty and Staff Awards and Notes

Senior lecturer Eric Adams was the subject of a news story on the MIT Industrial Liaison Program website, describing how his research in environmental fluid mechanics has helped engineers better understand oil spills.

Assistant professor Saurabh Amin appeared on a panel at the MIT-Stanford Game-Changers workshop Energy on the Move on March 7 at the Woodrow Wilson International Center for Scholars in Washington, DC. He discussed resilient infrastructures during the panel discussion on “Infrastructure/Supply Chains: 21st-Century Efficient and Resilient Energy Infrastructures.”

Professor Amin is chief scientist and lead MIT principal investigator on a multi-institutional grant from the National Science Foundation, one of two awards expected to make significant advances in energy and transportation infrastructures and health technology. The MIT team—Amin, associate professor Hamsa Balakrishnan of the Department of Aeronautics and Astronautics, and professor Asuman Ozdaglar of the Department of Electrical Engineering and Computer Science (EECS)—will work with three universities on the \$9 million project, “Foundations of Resilient Cyber-Physical Systems,” to improve the operational resilience of civil and environmental structures and systems that have electronic networking components.

A story about work done by professor Moshe Ben-Akiva and Maya Abou-Zeid SM '03, PhD '09 appeared in the December 12 issue of *The Atlantic Cities*. The article, “Even American Drivers Like Mass Transit More Than They Think,” focused on a study run by Ben-Akiva and Abou-Zeid in 2008 encouraging MIT employees with full-time parking permits to commute by transit for a one-week trial period. The study found that nearly 30% of participants had switched to public transit after the trial ended, and 25% continued to use public transit six months later.

Professor Ben-Akiva is coeditor of a book with Hilde Meersman and Eddy van de Voorde of the University of Antwerp, Belgium. *Freight Transport Modeling* is a reference book for experienced researchers and doctoral students that looks at transportation modeling at the local, regional, and global scales, and includes discussion of transport policy. Ben-Akiva is also a contributor to the book.

Markus Buehler received the 2013 Robert Lansing Hardy Award from The Mineral, Metals & Materials Society, the oldest and second largest materials research society in the country. This prestigious honor, given to researchers under age 35, recognizes the

impact of Buehler's work in the field of materials science and engineering. The award cited his "innovative work in computational materials science of biological, bio-inspired, and synthetic materials, focused on mechanical properties and in particular deformation and failure."

A paper by Professor Buehler, postdoctoral associate Arun Nair, and former postdoctoral fellow Alfonso Gautieri appeared in *Nature Communications* in April. The article described how — after many years of analysis by some of the world's most powerful computers — the team of researchers unraveled the structure of bone with almost atom-by-atom precision, and confirmed the computed results with laboratory experiments.

A podcast featuring Professor Buehler discussing his work on spider web strength made the top five list of the American Society of Mechanical Engineers' most popular videos and podcasts of 2012.

Collaborative work by Buehler, postdoctoral associate Seunghwa Ryu, and researchers at Duke University demonstrating the use of mechanical instabilities in graphene to reversibly control its surface properties was published online in January in *Nature Materials*.

Professor Buehler co-chaired the American Society of Mechanical Engineers 2013 Global Congress on Nano-engineering for Medicine and Biology, held February 4–6 in Boston. The conference focused on the integration of engineering, materials science, and nanotechnology to address challenges in biology and medicine, including development of devices, materials, and methods for detecting and treating disease.

The proceedings of the May 2011 conference on the Nondestructive Testing of Materials and Structures have been published as a book edited by Professor Buyukozturk and Mehmet Ali Tasdemir, Oguz Gunes, and Yilmaz Akkaya. *Nondestructive Testing of Materials and Structures* is the sixth volume in the RILEM series on construction materials, systems and structures.

Professor Buyukozturk is principal investigator on a new research project focused on sustainable development in Kuwait's built environment. The \$3.76-million project is funded by the Kuwait Foundation for the Advancement of Sciences through the Kuwait-MIT Center for Natural Resources and the Environment.

Professor Oral Buyukozturk and professor William Freeman of EECS and the Computer Science and Artificial Intelligence Laboratory are principal investigators on an \$8 million, five-year collaborative research project funded by Shell. The project builds on the concept of previous research on MIT's Green Building. With the new grant, the researchers will create a wireless version of a sensor network that monitors the building's response to disturbance, and develop pattern recognition/motion magnification algorithms and build 3-D computational models that can predict a building's response to disturbances and detect anomalies and damage.

Sallie W. (Penny) Chisholm was awarded the National Medal of Science, the nation's highest honor for scientists and engineers. President Barack Obama presented the medal to Chisholm in a ceremony at the White House on February 1.

Ocean Sunlight: How Tiny Plants Feed the Seas a book coauthored by Chisholm and Molly Bang and illustrated by Bang, received the American Association for the Advancement of Science's [AAAS/Subaru Science Books & Films Prize for Excellence in Science Books](#), which celebrates outstanding science writing and illustration for children and young adults.

In late September, a book by Jerome Connor and coauthor Susan Faraji was published. *Fundamentals of Structural Engineering* is the sixth book Connor has authored or coauthored, but it is his first textbook for undergraduates. It can be used for teaching structural analysis and structural engineering.

Professors Richard de Neufville and Amedeo Odoni and research scientists Peter Belobaba of the Department of Aeronautics and Astronautics and Tom Reynolds of Lincoln Laboratory wrote a revised second edition of the textbook *Airport Systems Planning, Design and Management* published in April by McGraw Hill Educational.

The International Society for Rock Mechanics (ISRM) selected Herbert Einstein as an ISRM Fellow, honoring his outstanding accomplishments in rock mechanics and rock engineering. Einstein will be inducted formally in September during the ISRM International Symposium Eurock 2013 in Wroclaw, Poland.

Professor Einstein received the School of Engineering's 2013 Samuel M. Seegal Prize in recognition of his exceptional teaching, mentoring, and advising. Einstein was lead teacher of the senior capstone subject, 1.013 Civil and Environmental Engineering Design, from 2000 to 2013, and taught introductory design for sophomores from 1998 to 2005 and 2007 to 2012. He also teaches graduate subjects 1.38 Engineering Geology, 1.381 Rock Mechanics, and 1.383 Underground Construction, in addition to his thesis supervision and student advising.

John Germaine is chair of the new ASTM International (formerly known as the American Society for Testing and Materials) subcommittee D18.26 on hydraulic fracturing, which has about 200 members representing industry and government agencies. ASTM International formed the subcommittee within committee D18 to develop industry standards for the rapid-growth area of hydraulic fracturing.

Research by Marta González and Pu Wang was the topic of an article in the February 17 issue of the *Boston Sunday Globe* Ideas section. González's work using cellphone data to map traffic congestion showed that canceling or delaying the trips of one percent of drivers from carefully selected neighborhoods in five Boston-area cities would reduce the extra travel time for all other drivers in Greater Boston by 18 percent.

The prize council of the [Prince Sultan Bin Abdulaziz International Prize for Water](#) announced that Charles Harvey and his research team will receive the Groundwater Prize for determining the likely pathway by which arsenic has been contaminating the drinking water in Bangladesh. This phenomenon, referred to as “the largest mass poisoning of a population in history” puzzled scientists, world health agencies and the Bangladeshi government for nearly 30 years.

A research paper, “Capillary Fracturing in Granular Media,” by former postdoctoral associate Ran Holtzman, graduate student Michael Szulczewski and Professor Juanes published in the June 28 issue of *Physical Review Letters* was subsequently highlighted in *Physics*, an online publication of the American Physical Society that presents physics research to a broad audience. The topic of the paper, capillary fracturing, is related to the extraction of oil from the deep seas, CO₂ sequestration and fracking.

Carolyn Jundzilo-Comer, an administrative assistant who has worked in CEE since 1977, was the winner of a [School of Engineering Infinite Mile Award for Excellence](#). One nominator wrote, “Carolyn is not only a tireless and hard-working assistant, she is also a friend who cares about everyone in the CEE department, especially the students.” Jundzilo-Comer works with Professor Einstein and his research group.

Lecturer Paul Kassabian developed an iPhone/iPad app based on MIT CEE subjects. “Structures: A Visual Exploration” teaches the behavior of structures through visuals such as diagrams, animations and comparisons.

Jesse Kroll received the Kenneth T. Whitby Award from the American Association for Aerosol Research in October. Nominators said of Kroll’s work: “His recent paper in *Nature Chemistry* (2011) titled ‘Carbon Oxidation State as a Metric for Describing the Chemistry of Atmospheric Organic Aerosol’ will soon be considered a classic ... His work has introduced new paradigms.”

The American Society of Civil Engineers’ magazine *Geo-Strata* ran an article about professor emeritus Charles C. Ladd. The article, which appeared in the January/February issue, is the fifth in a series called “Lessons Learned From Geo-Legends.”

In November, senior lecturer Susan Murcott gave a keynote speech at the World Science for Peace Conference in Milan. Murcott addressed problems of water scarcity and water access in the developing world. Her new book, *Arsenic Contamination in the World: An International Sourcebook* (IWA Publishing, 2012), details arsenic contamination by source and region in 105 countries and territories, providing a larger database than any previously published work.

Murcott served on a panel and gave a talk at the 2013 Environmental Protection Agency’s Federal Women’s Program Retreat held March 12 at the EPA’s regional office in Boston. The retreat’s theme was women in science, technology, engineering and math. Murcott spoke on “Women, Water, Environment: Our Misguided Financial Priorities and the Urgency of Women’s Equal Representation in Government, Science, Technology, Engineering and Math.”

At the MIT Awards Convocation on April 25, Heidi Nepf received the Earl M. Murman Award for Excellence in Undergraduate Advising. The Murman Award honors a faculty member who has had significant impact on the personal life and academic success of her undergraduate advisees.

In July, assistant professor Carolina Osorio received the prestigious Association of European Operational Research Societies' (EURO's) Doctoral Dissertation Award for her thesis "Mitigating Network Congestion: Analytical Models, Optimization Methods and Their Applications." The award recognizes the best thesis from EURO's 30 member countries.

In May, the American Society for Microbiology (ASM) awarded Martin Polz the Eli Lilly and Company-Elanco Research Award, ASM's oldest and most prestigious prize. Polz was the first ecologist to be selected in the 77-year history of the award, which rewards fundamental research in microbiology or immunology by a scientist not yet 45 years old.

At the MIT Awards Convocation, Professor Polz was awarded the Frank E. Perkins Award honoring excellence in advising and mentoring graduate students. The Perkins Award is given each year to a professor who has served as an excellent advisor and mentor for graduate students.

Assistant professor Pedro Reis and assistant professor Kenneth Kamrin of the Department of Mechanical Engineering developed a new online version of 2.002 Mechanics and Materials II, a core requirement in mechanical engineering. The online course, i2.002, features videotaped lectures from 2.002, as well as recitations and a discussion forum.

The Production and Operations Management Society honored David Simchi-Levi with an article about his professional achievements published in the January/February issue of *Production and Operations Management*.

Professor Simchi-Levi was elected a 2013 fellow of the Manufacturing and Service Operations Management (MSOM) Society of the Institute for Operations Research and the Management Sciences. The MSOM Distinguished Fellow Award recognizes outstanding research and scholarship in operations management.

The supply chain management operations blog "SCM-Operations.com" named the 10 Greatest Supply Chain Management Books of All Time, based on the number of citations for books found by Google Scholar. Professor Simchi-Levi's *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies* appears on the list. Simchi-Levi was also included in the blog's list of the top 10 thought leaders in supply chain management.

MIT and Accenture formed a five-year collaboration in March to help close the gap between development of business analytics technologies and their successful application in industry and government. The Accenture and MIT Alliance in Business Analytics

collaboration will be led by Simchi-Levi and Narendra Mulani, senior managing director for Accenture Analytics.

Roman Stocker and Edward DeLong and were named Marine Microbiology Initiative investigators by the Gordon and Betty Moore Foundation, an honor that includes funding for pioneering research in the field of marine microbial ecology.

A November 26 article in *Live Science* described professor Stocker's research on "interactions between the tiniest marine organisms, their fluid dynamical environment, and their food sources."

Stocker and Michael Wagner of the University of Vienna were selected to receive one of six grants in the inaugural cycle of the US Department of Energy Joint Genome Institute's new Emerging Technologies Opportunity Program. Stocker and Wagner will develop a method for the high-throughput sorting of microbial cells with specific functional traits using microspectroscopy, microfluidics, and flow cytometry. This technology could accelerate the functional characterization of genes from metagenomic sequencing experiments, one of the Joint Genome Institute's highest priorities.

Professor Joseph Sussman delivered a presentation titled "[Understanding and Designing Complex Sociotechnical Systems](#)" in April as part of the MIT System Design and Management Systems Thinking webinar series.

A story about research by Franz-Josef Ulm and doctoral student Mehdi Akbarian on pavement deflection appeared in a recent issue of Southwest Airline's *Spirit* magazine. The article was titled, "Using Firmer Pavement Could Save US \$15.6 Billion per Year in Fuel Costs."

Engineering News Record, a weekly magazine for the construction industry, named Professor Ulm to its list of 25 top newsmakers for his work establishing the MIT Concrete Sustainability Hub (CSH). An article about CSH appeared in the February 21 issue of *Nature*. Writer Ivan Amato describes CSH's research initiative to gain an understanding of cement at the atomic scale as part of its larger goal to create a more environmentally friendly product. The story includes interviews with professor Hamlin Jennings, director of CSH, and Roland Pellenq.

Postdoctoral Associate Awards and Notes

At the American Association for the Advancement of Science's Family Science Days in February, Jesse Kroll's research group, working with the MIT Center for Environmental Health Science, presented "Understanding Air: Climate Change and Air Pollution." This activity booth taught visitors about the chemistry of the air and the origin of certain air pollutants. Kroll's group also demonstrated how particulate matter sensors work. Planners included Kroll and Eben Cross. Participants included graduate student Kelsey Boulanger, postdoctoral associate Ellie Browne, and undergraduates Teri Oehmke, Sid Pai, and Alex Severt.

Postdoctoral associate Melissa Garren, who works in Roman Stocker's lab, won the award for best talk by a junior scientist at the symposium, *Microscale Interactions in Aquatic Microenvironments*, held at the School of Physics in Les Houches, France, March 10–15. The title of Garren's talk was "A Coral Pathogen Uses Chemotaxis and Chemokinesis to Target the Mucus of Its Host." The journal *Limnology and Oceanography: Fluids and Environments* sponsors the award.

Two postdoctoral researchers in Stocker's research group received awards August 24 at the International Symposium on Microbial Ecology in Copenhagen. Melissa Garren received the J.W. Costerton Award for research that advances a new theory in microbial ecology that also has interdisciplinary significance. Her poster was titled, "The Need for Speed: A Marine Pathogen Uses Rapid Chemotaxis and Chemokinesis to Target its Host." Yutaka Yawata won the Brock Postdoctoral Research Award for his talk "Mapping Genotypic Diversity Onto Niche Adaptation."

Postdoctoral associate Gabriel Juarez received a grant from the MIT Postdoctoral Association's Professional Development Committee to attend the annual meeting of the American Physical Society Division of Fluid Dynamics in San Diego in November. Juarez delivered a talk titled, "Bacteria Motility at Oil-Water Interfaces." He works in Professor Stocker's Environmental Microfluidics Group.

A poster by Juarez won first prize in the MIT "Postdocs Share Their Science" event held June 18 in Morss Hall. The poster "Biophysics of Microbial Oil Degradation" was selected from 44 entries.

The Blue Lobster Bowl, Massachusetts' marine science quiz bowl, is one of 25 regional competitions leading up to the National Ocean Sciences Bowl. As part of this year's competition, held at MIT March 3, postdoctoral fellow Steven Smriga and graduate student Jessica Thompson offered outreach activities focused on marine microbiology.

Graduate Student Awards and Notes

About 200 people attended the MIT Water Club's inaugural MIT Water Night, which was held in Walker Memorial on March 21 to coincide with the United Nations World Water Day. The event's organizers—four CEE graduate students—hoped to enhance collaboration among people at MIT and in industry who conduct water-related research. Areas of research represented in the 34-poster presentations included desalination, water resource management, climate change, nanotechnologies, wastewater treatment, and environmental microbiology. Organizers were Hamed Alemohammad, director; Jennifer Apell, operations director; John Kondziolka, marketing director; and Xin Xu, content director.

Doctoral student Zeid Alghareeb, who works with professor John Williams in the MIT Geospatial Data Center, has been awarded a seed fund grant of \$150,000 from the MIT Energy Initiative for his research proposal, "Optimum Decision-Making in Reservoir Management Using Reduced-Order Models." Alghareeb's research for this grant focuses on broadening the application of oil reservoir simulation for decision making in light of geological and financial uncertainties using fast physics-based, reduced-order models.

The MIT International Development Initiative gave Master of Science in Transportation student Andrés Felipe Archila a 2013 Carroll L. Wilson Award for his project to develop a framework for transportation planning in Colombia. Archila, who works with Professor Sussman, will also provide feedback on Colombia's current rail infrastructure plans while working with the Colombian National Infrastructure Agency. "The framework will have a special focus on improved project evaluation guidelines, on increased attention to multi-modal system performance, and on recognition of uncertainty in large infrastructure projects," said Archila.

A poster by three MEng students—Fidele Bingwa, Francesca Cecinati, and Yan Ma—won first place in a competition at the annual Interdisciplinary Water Symposium held April 5 at Tufts University. The winning poster, "Precipitation-Based Flood Early Warning System in the Manafwa River Basin for the Uganda Red Cross Society," was based on fieldwork the three performed in Uganda in January, and on their research, supervised by senior lecturer Richard Schuhmann.

MST student Joel Carlson won an essay competition and was selected to receive a scholarship to attend the International Union of Railways 8th World Congress on High Speed Rail in Philadelphia, PA, in July 2012.

An article and photos by doctoral student Zenzile Brooks about the 1986 rebirth of the MIT Glass Lab, "A Gift of Glass," appeared in the November issue of the *MRS Bulletin*, a publication of the Materials Research Society. Brooks, who graduated in June, plans to be a science writer. She worked with professors Ulm and Einstein researching rock fracturing at the micro- and nanoscale.

Transportation graduate student Franco Chingcuanco, who works with professor Osorio, received the Natural Sciences and Engineering Research Council of Canada's Alexander Graham Bell Canada Graduate Scholarship for his ongoing MST/Technology and Policy Program thesis project, "A Parallelized Simulation-Based Optimization Framework for Traffic-Responsive Control."

A paper based on work by graduate student (and first-time author) Amer Deirieh SM '12 and former postdoctoral associate J. Alberto Ortega SM '06, PhD '10, Franz-Josef Ulm and Younane Abousleiman of the University of Oklahoma received the Best Paper Prize for 2012 from *Acta Geotechnica*. "[Nanochemomechanical Assessment of Shale: A Coupled WDS-Indentation Analysis](#)," appeared in the December 2012 issue of the journal.

CEE graduate student Leon Dimas helped organize Math Day Treasure Hunt, an event for elementary school children presented by MITxplore, an outreach program co-founded by Dimas and graduate students Narges Kaynia and Debbie Nguyen of mechanical engineering. On Sunday, May 12, about 90 fourth, fifth, and sixth graders and their parents from Massachusetts, New Hampshire, New York, and Rhode Island participated in the Math Day Treasure Hunt in the Media Lab Complex. The MIT student organizers divided the sixth floor of the building into three mathematical islands where participants engaged in activities in three categories: probability, geometry and topology, and numbers and limits.

William “Mack” Durham SM ’07, PhD ’12, who worked with Professor Stocker, received the 2012 American Physical Society/Division of Fluid Dynamics’ (APS/DFD) Andreas Acrivos Dissertation Award for the best thesis in fluid dynamics in September 2012. Durham, now a research lecturer at Oxford University, gave the Acrivos Award Lecture during the APS/DFD annual meeting in November in San Diego. His thesis is titled “Phytoplankton in Flow.”

First-year MST student Krishna Kumar Selvam was awarded a 2013 Dwight David Eisenhower Graduate Fellowship, a competitive fellowship for transportation-related studies administered by the Federal Highway Administration for the US Department of Transportation. With the fellowship, Selvam will continue his work on multi-model simulation-based optimization algorithms to solve traffic control problems, as a member of Professor Osorio’s research group.

MST students Naomi Stein and Allison (Sunny) Vanderboll were honored as MIT Graduate Women of Excellence on April 23 by the Office of the Dean for Graduate Education. Stein works in Professor Sussman’s group researching the interactions between different geographic scales of transportation planning and the relationship between transportation systems and urban and regional development patterns. Vanderboll is a member of Professor Barnhart’s research group. Her research focuses on the evaluation of the impacts of various air transportation policies on passenger delays.

Graduate student Anna Tarakanova and Professor Buehler were selected as recipients of the 2012 Minerals, Metals & Materials Society Structural Materials Division JOM Best Paper Award. The paper, “A Materiomics Approach to Spider Silk: Protein Molecules to Webs,” was published in February 2012. Tarakanova and Buehler also co-authored an article that appeared on the cover of *Nature* on February 2, 2012.

Doctoral student Jameson Toole, a member of Professor González’s research group, was the subject of a feature article on MIT News, “[Making Sense of Big Data.](#)” Toole works with large data sets, often collected from cellphones, to create models of transportation and online community networks.

A study by first-year MST student Mike Wittman and aeronautics/astronautics researcher Bill Swelbar was cited in a *Wall Street Journal* article and on National Public Radio in May. The study shows that the health of the airline industry has improved since 2007 in part because large airlines are consolidating flights to larger airports and eliminating flights to midsize and small airports. The overall effect has been to help the industry, but decrease options and increase fares somewhat for air passengers flying to or from smaller airports.

Shengkun Yang, an MEng student in the environmental and water quality engineering track, took part in the Global Social Entrepreneurship Competition at his alma mater, the University of Washington, in February. Yang’s team, AquaFiltro, designed a drinking-water ceramic-filtering system for use in Ghanaian households. The team made it into the semifinals from a pool of 91 competitors.

Undergraduate Student Awards and Notes

The MIT chapter of the civil engineering honor society, Chi Epsilon, welcomed seven new initiates at its banquet, held April 25 at the MIT Faculty Club. The CEE students joining the honor society were seniors Zara L'Heureux, Andrew Sang, Marisa Simmons, Nicole Wang, and Jaclyn Wilson, along with juniors Catherine Cheng, Linda Seymour, and Sharone Small.

Seniors Di Jin, Andrew Sang, and Jibo Wen were elected to Phi Beta Kappa, the nation's oldest honor society.

At the American Association of Aerosol Research's annual meeting in October, senior Zara L'Heureux presented a poster based on the fieldwork of undergraduates in TREX 2012. The poster, "Online, Mobile Measurements of the Chemical Composition of Volcanic Smog (Vog)," described the TREX work in characterizing the evolving composition of vog coming from Kilauea on the island of Hawaii. Co-authors of the poster were Eben Cross, L'Heureux, Lisa Wallace, Anna Kelly, Kelly Daumit, Philip Croteau, John Jayne, Douglas Worsnop and Professor Kroll.

As part of the ReefTalk series hosted by the University of Hawaii's Sea Grant program, undergraduates in TREX 2013 studying vog on Hawaii presented their findings to the public on January 24 at the Kaloko-Honokohau National Historical Park in North Kona. An article about the students' presentation appeared in the newspaper *West Hawaii Today*.

As part of the "broader impacts" component of a National Science Foundation research grant, junior Linda Seymour, sophomore Shante Stowell, and Elise Hens '12, are working with Ari Epstein to make a series of three podcasts about the research of professors Polz and Scott Manalis (Biological Engineering). Episode 1, World's Tiniest Diving Board, tells how the researchers are using microfluidics technology and a miniature diving board to measure the mass of microbes to learn how much a microbe grows before it splits apart to replicate. Episode 2 will focus on the recent findings that microbes exhibit social cooperation, episode 3 on the ways scientists communicate their research findings—formally and informally—within the scientific community and to the public, and episode 4 will summarize the research supported by the grant.

Juhee Bae, a junior with a double major in civil engineering and city planning, won an Alva Emerging Fellowship, which includes a \$13,500 seed grant for OpenIR (Open Infrared). OpenIR is Bae's project to democratize infrared satellite data, and by doing so, increase awareness of environmental risks from flooding, volcanic activity, and other such events by making infrared satellite data available in an easy-to-use, web-based map format.

Senior Nicky Soane, sophomore Simon Okaine, and junior Carmen Castaños helped create a museum exhibit on designer Rafael Guastavino as a UROP project. "Palaces for the People: Guastavino and America's Great Public Spaces," an exhibit by architecture professor John Ochsendorf, opened at the Boston Public Library in Copley Square, then traveled to the National Building Museum in Washington, DC, with plans to continue to the Museum of the City of New York in early 2014.

Juniors Tara Soni and Theresa Santiano-McHatton, the former and current presidents respectively of the MIT chapter of the American Society of Civil Engineers, organized CEE's participation in Family Science Days during the American Association for the Advancement of Science's annual meeting in Boston, which included a demonstration of photosynthesis and an exhibit about the properties of materials at different scales.

MIT News featured a story, "Better Buildings, Better Lives," about senior Marisa Simmons (1C), including her personal and professional interests, her work with the MIT chapter of Engineers Without Borders, and her research on alternative concretes in the Building Technology Lab at MIT.

Annual Department Awards

Ruben Juanes and John Germaine were recognized with the Maseeh Award for Excellence in Teaching.

The Maseeh Award for Excellence as a Teaching Assistant went to doctoral student Pierre Ghisbain, who graduated in 2013. He was a teaching assistant for graduate subjects 1.571 Structural Analysis and Control, and 1.561 Motion Based-Design, and for 1.562 High-Performance Structures Master of Engineering Project. He also was teaching assistant for 1.00 Introduction to Computers and Engineering Problem Solving for four semesters, and served as the head TA for three of those years.

Senior Tara Soni received the Paul L. Busch (1958) Prize, which is presented to an undergraduate student in environmental engineering science for academic achievement and contributions to the CEE community. Soni led a number of initiatives as president of the MIT student chapter of the American Society of Civil Engineers.

The Leo (Class of 1924) and Mary Grossman Award went to Linda Seymour, a civil engineering junior, for her excellent academic record and strong interest in transportation.

Master of Engineering student Zahraa Nasim Saiyed received the Tucker-Voss Award, established in memory of Professor Ross F. Tucker and Professor Walter C. Voss, the first two heads of the Department of Building Construction (Course 17), which merged with the Department of Civil Engineering in the 1950s. The award is given to a student who shows particular promise in the field of building construction. The title of Saiyed's thesis is "Performance-Based Structural Design Optimization for Residential Housing in San Francisco, California."

The Trond Kaalstad (Class of 1957) Fellowship was awarded to MEng students Leonidia Garbis and Matthew Pires. The award is named for a long-time administrative officer of CEE and recognizes graduate students who display leadership and/or contribute significantly to the well being of the CEE community.

Andrew J. Whittle
Department Head
Edmund K. Turner Professor