

## Department of Civil and Environmental Engineering

### Overview

The undergraduate curriculum in civil and environmental engineering is changing significantly and is well on its way to becoming an integrated program that stresses interactions between the built and natural environments. The foundation of the new curriculum is a unified sophomore year that features “hands-on” design modules, as well as subjects in mechanics and ecology. We are also working to bring the junior and senior curricula into alignment with the new sophomore core. We have renovated key classrooms and laboratories and are planning additional teaching-space renovations to meet the particular challenges that these new curricula will bring. Thanks to these efforts, together with successful marketing, we will see an increase of about 50 percent in the sophomore enrollment in Course 1 for AY2007.

The Department of Civil and Environmental Engineering (CEE) continues to evaluate its graduate programs, with the particular aim of staying relevant in ever-evolving fields. We also seek ways to attract the best graduate students, especially those from underrepresented populations. To that end, the MEng program has fostered relationships with corporate sponsors of fellowships to facilitate recruitment of promising MEng applicants.

In 2006, CEE faculty and students were involved in various efforts to study and improve conditions in New Orleans, which was devastated by Hurricane Katrina.

We have also been successful with current faculty promotions and recent hiring. Professor Franz Ulm was promoted to the rank of full professor, and Dr. Jack Germaine was promoted to the rank of senior research associate. Professor Eric Alm joined the department as an assistant professor, effective January 1, 2006, with a dual position shared with the Biological Engineering Division. He is interested in computational microbial biology and genomics. Professor Markus Buehler joined the department as an assistant professor, effective July 2006. His interests include mechanical properties of solids, multi-scale modeling of dynamic materials phenomena, and interfaces of physics, chemistry, and biology. Professor Ruben Juanes will join the department as an assistant professor, effective August 2006. His research includes the analysis of multiphase flow models driven by various applications, such as enhanced petroleum recovery and CO<sub>2</sub> sequestration.

The excellence and effectiveness of our department’s faculty members and students has been recognized through the many honors and awards bestowed on individuals from both groups, some of which are listed in this report.

## Educational Activities

### Student Enrollment over the Past Five Years

	AY 2002 (Fall 2001)	AY 2003 Fall (2002)	AY 2004 Fall (2003)	AY 2005 Fall (2004)	AY 2006 Fall (2005)
<b>Total</b>					
<b>Undergraduates</b>	<b>62</b>	<b>77</b>	<b>80</b>	<b>75</b>	<b>66</b>
MEng	38	61	33	24	31
MST	46	44	40	43	35
SM	119	116	95	61	53
PhD	71	68	71	74	61
<b>Total Graduates</b>	<b>274</b>	<b>289</b>	<b>239</b>	<b>202</b>	<b>180</b>

### Undergraduate Programs

In fall 2005, the Department of Civil and Environmental Engineering began a major initiative to deliver a new integrated sophomore curriculum that stresses interaction between the built and natural environments. This new sophomore core will be implemented in fall 2006 thanks to the extraordinary energy, care, and dedication of many faculty and staff. Subsequent changes in the junior and senior curricula for Courses 1C and 1E are scheduled for implementation in fall 2007.

The new program and associated marketing efforts have been successful in attracting new undergraduate majors. We will see an increase of about 50 percent in the number of sophomores joining the department in the coming academic year. But in addition to the increased faculty investment in the new curricula, the department is also devoting significant funds to renovating the undergraduate teaching facilities that are vital to this program.

In FY2006 we sought help with respect to the staff support associated with the year-long subject Introduction to Civil and Environmental Engineering Design (6+6), a centerpiece of the new common sophomore core, which requires significant resource allocation. The development of this subject has been the work of a curriculum committee led by Professor Harold Hemond. The department provided significant financial resources for the start-up and recurring costs associated with this subject, as well as a salary for technical staff support. Because the availability of technical staff is indispensable for setting up and facilitating multiple laboratory and shop sessions and for prototyping the design projects, funding to continue this support will be needed again in FY2007.

### Undergraduate Research and Practical Applications

In March 2006, Professors Heidi Nepf and Philip Gschwend and research associate Sheila Frankel traveled to New Orleans with eight CEE undergraduate students to study the impact of the New Orleans dewatering operation on the Lake Pontchartrain ecosystem. The trip was the culmination of a subject and lab in aquatic chemistry and biology, in which the curriculum had been tailored for a timely study of the hurricane disaster.

The students will present their findings at an aquatic science seminar and communicate their results to their Southeastern Louisiana University collaborators. A grant from the Kurtz Family Foundation, given for Hurricane Katrina relief to the MIT President's Office, paid for the group's travel and living expenses. The group and the department are grateful for the opportunity to contribute to recovery efforts, and they extend their thanks to those who made the research possible.

In January 2006, Professor Hemond and the researcher/lecturer team of Don and Sheila Frankel guided 17 CEE undergraduate students on the seventh annual Traveling Research Environmental Xperiences (TREX) undergraduate research excursion. The TREX group continued the research of prior groups at Kaloko fishpond, a pristine pond in Kaloko-Honokohau National Historical Park in Kona, Hawaii. For a comparison study of salinity and sediment they expanded the research to include the more impacted He'eia fishpond. The results of these studies will help caretakers to maintain both sites, and the cumulative work will result in the publication of a case study in the journal *Limnology and Oceanography*. This year's TREX excursion was funded entirely by the department.

### **Summer Internships**

Now in its ninth year, the CEE summer internship program (<http://cee.mit.edu/internship/>) continues to strengthen ties with dozens of prominent engineering firms around the world, many of which were founded by department alumni. Under the guidance of senior research associate Carl Martland, students are able to find internships that often result in job offers after graduation.

### **Graduate Programs**

#### ***Master of Engineering, Master of Science, and Doctoral Programs***

In the course of the 2005–2006 academic year, a total of 105 graduate students earned degrees through our department. We awarded 21 PhDs, 32 masters of science, 30 masters of engineering, 21 masters of science in transportation, and one degree to a civil engineer (these figures do not include dual-program students such as those enrolled in Leaders for Manufacturing, the Joint Program with the Woods Hole Oceanographic Institution, and the like).

Our graduate students continue to be engaged in cutting-edge research in a variety of disciplines. While many students in our graduate programs go on to doctoral studies and then to careers in academe, the majority of students in two of our programs (the master of engineering and the master of science in transportation) move on to leading jobs in industry and government after completing their degrees.

Both professional degrees have recently undergone reviews. Following the review of the MEng program in 2003–2004, we continue to work on a plan to increase its viability and financial support substantially. Last year, we received MEng fellowship funds from Gradient, our first-ever corporate sponsor. The corporate sponsorship program has continued, and we are pleased to announce CDM as our second sponsor.

Following the work of a transportation curriculum committee, co-chaired by Professors Nigel Wilson and Amedeo Odoni, the faculty involved in the interdepartmental master of science in transportation (MST) approved a broad revision of the MST program. Most notably, the set of required core subjects is now composed of two new 12-unit subjects: 1.200 Transportation Systems Analysis and 1.201 Introduction to Transportation Systems. Both subjects are revised, integrated, and enhanced versions of four six-unit subjects that were part of the old requirements. Both will be offered for the first time this coming fall.

The PhD remains the ultimate research degree and is critical to our mission to educate intellectual leaders for academe and national research laboratories. We have many areas of specialization.

The level of funding for doctoral students continues to be a priority for FY2007. CEE received four academic presidential fellowships from the Institute (two Edward Linde Fellowships, plus two additional fellowships funded by the provost). Maintaining this level of support is a very high priority for the department. In order to attract the best graduate students, the department began in FY2002 to fund more students than it had in previous years. The department has maintained this level of support in all subsequent years to FY2002, and intends to maintain it again in 2007.

### Lectures

On Friday, April 21, and Saturday, April 22, 2006, the MIT Alumni Association hosted a Graduate Alumni Convocation and Reunion, the first of its kind. For that occasion, the CEE department was pleased to have Bernard Kasriel, former CEO and current vice-chairman of the board at the Lafarge group, give a lecture entitled "Sustainable Development: Threat or Opportunity for a Building Materials Company?"

Professor Uri Shamir from Technion gave a lecture in memory of his doctoral supervisor, Professor Donald Harleman, on Friday, June 16. This lecture reflected Professor Shamir's experiences over the past four decades in managing sustainable resources for the Israeli water sector and international waters.

The Boston Society of Civil Engineers hosted the John R. Freeman Lecture at MIT. This year's lecture featured Dr. Eugene Stakhiv of the US Army Corps of Engineers' Institute for Water Resources, reconciling the concepts of integrated water resources management with the realities of social, political, and economic constraints. This was a particularly timely and germane topic in the aftermath of Hurricane Katrina.

### Faculty Notes

Cynthia Barnhart was co-winner of the Women in Operations Research and the Management Sciences (WORMS) Award for the Advancement of Women in OR/MS. The award recognized Professor Barnhart's professional success and her contributions toward improving the environment for women in her field. On July 1, 2006, Professor Barnhart will begin her tenure as co-director of the Operations Research Center.

Rafael Bras was named a fellow of the American Association for the Advancement of Science and received the 2006 Hydrology Days Award from Colorado State University. He also received the MIT Alumni Association's highest award, the Bronze Beaver.

Rafael Bras and Andrew Whittle are invited members of the NRC/NAE committee, which investigates the impacts of Hurricane Katrina in New Orleans. We look forward to their perspectives.

Dr. Jack Germaine was promoted to the rank of senior research associate.

Markus Buehler was appointed assistant professor, effective July 1, 2006. He was a postdoctoral associate from September 1, 2005 to June 30, 2006.

Eric Alm was appointed assistant professor, effective January 1, 2006. His interests include mechanical properties of solids, multi-scale modeling of dynamic materials phenomena, and interfaces of physics, chemistry, and biology.

Ruben Juanes will join the department as an assistant professor, effective August 2006. His research includes the analysis of multiphase flow models driven by various applications, such as enhanced petroleum recovery and CO<sub>2</sub> sequestration.

Steven Lerman was selected for the Microsoft Education Award by the Tech Museum Awards, an international program to honor innovators from around the world who apply technology to benefit humanity. The award recognizes Professor Lerman's work with MIT's OpenCourseWare program.

Heidi Nepf received the Samuel M. Seegal Prize for inspiring students in the pursuit of excellence.

Yossi Sheffi's highly acclaimed book *The Resilient Enterprise* (MIT Press, October 2005) shows that companies' fortunes in the face of business shocks depend more on choices made before the disruption than they do on actions taken in the midst of it.

David Simchi-Levi was named editor-in-chief of *Operations Research*, the flagship journal of the Institute for Operations Research and the Management Sciences, starting January 1, 2006.

Richard Larson was named director of the newly established Center for Engineering Systems Fundamentals (CESF), which started up September 1, 2005.

Franz Ulm was promoted to full professor, effective July 1, 2006. He received the Walter L. Huber Prize from the American Society of Civil Engineers in October 2005.

Andrew Whittle received the Thomas A. Middlebrooks Award from the American Society of Civil Engineers for a paper that earned a special commendation as a contribution to geotechnical engineering.

John Williams was recently named by *Network World* as one of the 50 most powerful people in computer networks in recognition of his work in radio frequency identification.

### Student Notes

Brian Robinson, Pragnya Alekal, and Xanat Flores have again won awards in April's annual IDEAS competition at MIT for their work in water and sanitation.

Holly Krambeck received the Claire Barrett Memorial Scholarship Award from the Women's Transportation Seminar, based on her demonstrated leadership, scholarship, contributions to the community, and dedication to the field of transportation.

Holly Michael and Ann Mulligan of the Woods Hole Oceanographic Institution, along with Professor Charles Harvey, published "Seasonal Oscillations in Water Exchange Between Aquifers and the Coastal Ocean" in the August 2005 letters section of *Nature*.

Helen McCreery received the Joseph D. Everingham Award in recognition of her outstanding creative performances in theater arts.

Amy Mueller was honored by the Public Service Center and was also a third place winner in the MIT Enterprise Forum 2005: Ignite Clean Energy. Mueller was a member of the Parabolic Power interdisciplinary team, which won a \$2,000 award in the MIT IDEAS Competition in 2004–2005. Building on previous award-winning work on a solar energy concentrator, which they built in Lesotho, they will connect it to an innovative steam engine to produce off-grid electricity for the local community.

Matt Orosz and Amy Mueller have won a 2006 World Bank Development Marketplace grant to develop a solar microgenerator to provide affordable energy to Lesotho, where just 10 percent of the population is connected to the energy grid. Out of 2,500 teams competing for funds, only 30 were chosen by the World Bank.

Laura Stonehill was inducted into Phi Beta Kappa, the national academic honor society.

### Departmental Awards

The Department of Civil and Environmental Engineering held its Annual Awards Dinner on May 10, 2006. Many students, faculty and staff were honored for their achievements and accomplishments over this past academic year.

Peter Shanahan received the 2006 Maseeh Excellence in Teaching Award for 1.096 Environmental Engineering Clinic, 1.34 Waste Containment and Remediation Technology, and 1.725 Chemicals in the Environment: Fate and Transport.

Anne Lightbody received the 2006 Maseeh Annual Award for Excellence as a Teaching Assistant. She was praised for always being well prepared as the TA for 1.061 Transport Processes in the Environment, explaining the material clearly, helping anyone who needed extra time, and caring so much about what she did.

Alejandro “Lejo” Flores received the Trond Kaalstad ‘57 Award, created to recognize an outstanding graduate student who has displayed leadership and/or contributed significantly to the well-being of the CEE community.

Luis Vidal Liceaga received the Steinberg Prize for academic achievement and demonstrable interest in construction management.

Todd Radford and Jai Choi received the Professor Stephen D. Senturia Award for Interdisciplinary Studies, established for graduate students in CEE pursuing interdisciplinary cross-departmental studies. Radford is working on a PhD with Professor Jerry Connor and is jointly supervised by faculty in the Department of Architecture. Choi is working on his PhD in CEE with Professor Christine Ortiz in the Department of Materials Science and Engineering.

Laura Stonehill received the Leo ‘24 and Mary Grossman Award, given to an undergraduate with a strong interest in transportation and a strong academic record. Stonehill also received the Richard Lee Russell Award, given to an outstanding undergraduate who plans to continue with graduate school.

I-Tsung Tsai was awarded the Tucker-Voss Award for a student who shows particular promise in the field of building construction.

**Patrick Jaillet**  
**Department Head**

*More information about the Department of Civil and Environmental Engineering can be found at <http://cee.mit.edu/>.*