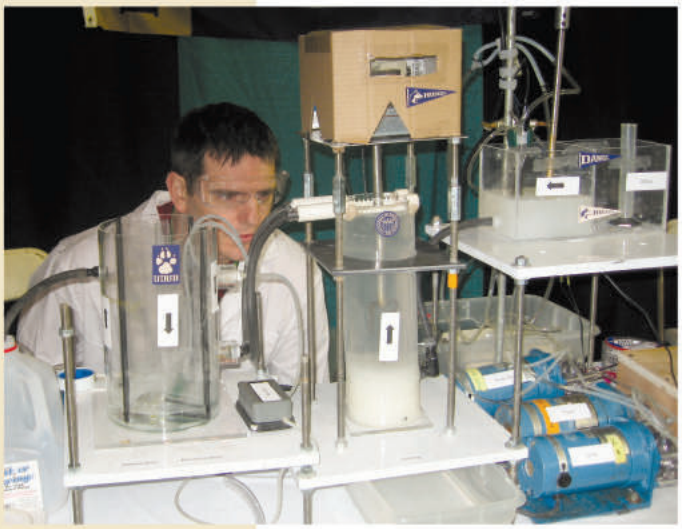
Civil & Environmental Engineering

Fall 2009

The Bridge

COLLEGE OF ENGINEERING
UNIVERSITY of WASHINGTON
A Community of Innovators

CEE Team Wins WERC Environmental Design Contest



Adam Price

Civil & Environmental Engineering students topped 45 other teams to win the best project award in the WERC Environmental Design Contest held last April at New Mexico State University. The contest annually draws hundreds of students from around the nation and abroad. CEE's team of undergraduates Zoe See and Adam Price, graduate student Zhenxiao Cai, and Chinese exchange student Peiran Zhou, were led to victory by their advisor, Professor Mark Benjamin.

For the past 19 years, the New Mexico-based Waste Management and Environmental Research Consortium (WERC), has run a design competition that poses real-world problems for which student teams design, build, and demonstrate proposed solutions. The teams write a 25-page paper describing the proposed design, and then travel to NMSU to demonstrate a bench-scale prototype and make oral and poster presentations.

"I am very proud of our team," said Benjamin. "They worked hard and made absolutely professional presentations at the competition. They were especially impressive when answering the judges' questions, many of which we

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Mahoney and Lettenmaier Awarded Professorships

CEE recently recognized two outstanding faculty members by awarding them coveted endowed professorships. Professor Joe P. Mahoney has been named the Bill and Marilyn Conner Endowed Professor. Mahoney's work focuses on transportation and construction engineering and he plans to use the funds to support his work to develop a renewable energy curriculum. Professor Dennis Lettenmaier has been named the Robert O. Sylvester Endowed Professor. He will use the funds to support his research in the areas of hydroclimatology, surface water

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Professor Joe Mahoney with endowment donors Bill (BSCE '53) and Marilyn Connor.

In this issue

Greg Miller Named Chair of CEE

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Greg Miller

Miller is New CEE Chair

Dean Matt O'Donnell has appointed long-time faculty member Gregory R. Miller to lead the department as chair. He moves into this role on December 1 after two years of serving the college as associate dean for infrastructure. Craig Benson resigned the chair position in late summer to return to Wisconsin. In the interim, CEE Professor Tim Larson has ably stepped in to serve as acting chair.

"I am confident in Greg's ability to build on the momentum developed in the last two years to move CEE forward to become a true national and international player in the world today," O'Donnell said.

Miller is in the structural engineering group and is a UW alumnus (BSCE '80) who joined the faculty in 1984 and became a full professor in 1995. He earned his doctorate at Northwestern University. Miller has won several distinguished teaching awards and held the J. Ray Bowen Endowed Professorship for Innovation in Engineering Education from 2000–2003.

"Having received my undergraduate degree from this department, I have a great respect for its long record of excellence, and I am quite excited to be working with everyone here as we move into what should prove to be a time of significant change and growth," Miller said.

Bill Dehn (BSCE '68, MSCE '71)

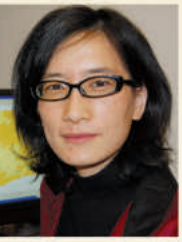
CEE graduates

CEE Recognizes 2008–09 Graduating Class

This year CEE's graduation count included 111 bachelors degrees, 86 masters degrees, and 10 doctoral degrees. The department celebrated this milestone with graduates and their families at a recognition ceremony and reception on Saturday, June 13, in Kane Hall.

William T. Dehn (BSCE '68, MSCE '71), president of CH2M Hill North American Regional Operations, opened the ceremony with his inspirational welcome to the profession address. Emeritus Professor Neil Hawkins presented the Neil and Ann Hawkins prize to the top two undergraduates, Jason R. Lee (1st place) and Adam H. Price (2nd place), in recognition of their academic achievement and leadership skills. Winners of the student-nominated awards were Brent S. Loukusa for Most Inspirational Student, Associate Professor Donald J. Janssen for Outstanding Mentor Award, and Associate Professor Pedro Arduino for Outstanding Teacher Award.

The ceremony closed with the procession of graduates, who walked across the stage to the overwhelming applause of more than 500 friends and family members.



Cynthia Chen

Welcome to New CEE Faculty

Associate Professor **Cynthia Chen** joins the faculty from the City College of New York. Her research interests range from land use and travel behavior to the use of technology in travel surveys, residential search and location decisions, and transportation safety using non-engineering methods. These studies often involve the collection of original data sets using a variety of methods including focus groups, verbal protocols, and interviews. Her work has appeared in numerous journals including *Transportation Research, Environment and Planning, Journal of Transport Geography, and Transportation Policy*.

Chen chairs the subcommittee on Time Use and Activity and Travel Patterns at the Transportation Research Board, a division of the National Research Council. She also is a member of two other Transportation Research Board committees.

She earned her BA from Nan Kai University in China, her MS from New Jersey Institute of Technology, and her doctorate in CEE at the University of California, Davis.

Erkan Istanbulluoglu

Assistant Professor **Erkan Istanbulluoglu** joins the Department of Civil and Environmental Engineering from the University of Nebraska where he was an assistant professor of natural resources and biological systems engineering. He previously was a postdoctoral associate and research affiliate at Massachusetts Institute of Technology.

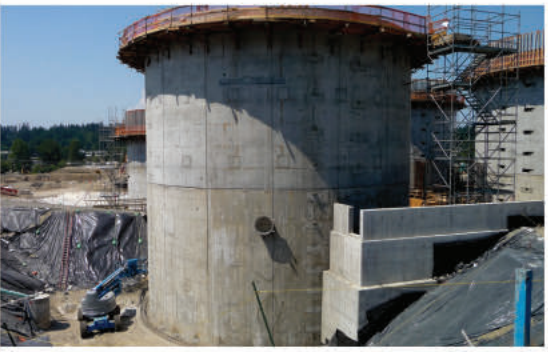
His highly interdisciplinary research aims to understand the role of climate on ecohydrological and geomorphological response of landscapes, sediment transport, and water balance of large basins. He uses empirical field observations, satellite-derived data, and numerical models to examine the response of a landscape system to disturbances.

Istanbulluoglu earned his BS and MS degrees in agricultural engineering at Uludag University in Turkey, and his doctorate in CEE at Utah State University. He received an NSF award for collaborative research on topographic imprint of hillslope aspect controls on vegetation and landforms in central New Mexico.

Building on a Partnership:

Civil Engineering and Construction Management

From the dawn of the profession, construction has been an integral part of civil engineering. As the practice became more refined and large-scale construction projects required advanced knowledge regarding management of disparate parts and people, the partnership between civil engineering and construction management evolved. At the University of Washington, faculty in the departments of Civil & Environmental Engineering and Construction Management (CM) in the College of Built Environments (formerly Architecture and Urban Planning) work together to provide students with a comprehensive and innovative approach to construction engineering.



Students taking CM courses visit sites such as the Brightwater Treatment Plant in Woodinville.

The current undergraduate enrollment (juniors and seniors) is about 230 students for CEE and 130 students for CM. CEE has about 200 graduate students and CM about 60.

Building on this strong tradition, CEE professors Joe Mahoney, Steve Muench, and Don Janssen provide comprehensive instruction in construction engineering. Courses help students develop their knowledge around such topics as planning, methods, contracts, specifications, manual and electronic scheduling, production estimates, equipment selection, ownership and operating costs, life-cycle cost analysis, and the role of the engineer in construction and cost estimating. Conversely, CEE seniors and graduate students can take selected classes in the department of Construction Management. In particular, seniors focusing in construction engineering can take CM courses as CEE technical electives, which count toward their eligibility for graduation. Many CEE graduate students interested in construction engineering take CM graduate courses to acquire additional project management knowledge.

The departments also cooperate in courses on construction materials. Professor Janssen teaches a primary materials course for Construction Management undergraduate students. It covers the physical and mechanical properties and engineering behavior of metals, wood, asphalt, and Portland cement concrete. The curriculum includes laboratory testing, instrumentation, and investigation into macrobehavior in the More Hall labs.

Distance Learning MS Degree

Advances in materials and processes, new management practices, legal issues, environmental concerns, and the broad societal impact of major infrastructure efforts such as roads, bridges, and ports, require professionals who are armed with the appropriate knowledge and skills. Six years ago, an interdisciplinary team of faculty from CEE and CM developed the Distance Learning Masters Degree in Construction Engineering. The only master's degree of its kind in the country, this program prepares professionals to deal with changes in the heavy construction industry. Students can set their own schedules and complete the degree from anywhere. Students come from a variety of backgrounds, including construction companies, contractors, consulting firms, public agencies, and the military, and bring with them years of industry experience.

Moving into a new phase of green and renewable construction practices offers opportunity for innovation and redesign of construction engineering. Through strong interdisciplinary partnerships like that between CEE and CM, the UW is at the forefront of emerging technologies and best practices. The continuation of this partnership will prepare future engineers for the challenges before them, and also help modernize the practice to make new advances in the field.

Emeritus Professor Gives Back to His Department

Water has always been a source of wonder for Emeritus Professor Ron Nece. Ron started his career at the University of Washington in 1959 and retired after 43 years of instruction and research in fluid mechanics, fluid dynamics, and studies of water flow. Now he is providing graduate students with support to follow their passion and help tackle some of the most pressing issues regarding clean water, energy, and healthy ecosystems.

Professor Nece has established the Ron and Mary Nece Endowed Fellowship in Water Engineering in Civil & Environmental Engineering. The fellowship will support graduate students studying in the areas of hydraulic engineering, environmental fluid mechanics, surface and ground water hydrology, water resources systems planning and management, and costal engineering. Fellowships such as these provide critical funding to recruit and retain exceptional students whose research talent shows promise for great societal impact. We thank Professor Nece for supporting future engineers and an important field that can enhance the quality of life for everyone.

WERC Environmental Design Contest (from page 1)

had not anticipated."

Of the six design challenges presented this year, the CEE team selected a project that required pretreating brackish water from Alamagordo in preparation for a desalination process. The teams were charged with developing and demonstrating a low-cost, energy-efficient, simple, and reliable pretreatment system using electrodialysis reversal (EDR) and reverse osmosis (RO). The proposed solution would remove particulates, aluminum, manganese, and iron to specified levels using commercially available crossover or new innovative technologies applicable for

Peiran Zhou answering judges questions (Adam Price and Zhenxiao Cai are looking on from behind the judges).

use at the Tularosa Basin desalination facility in Alamogordo. The solution had to respect the specified EDR and RO feedwater requirements.

Options for inland desalinization to supply fresh water are becoming increasingly important in regions that lack sufficient natural water resources. This issue is specifically critical in arid and semi-arid areas experiencing population growth, economic development, and expanding agricultural needs. Electrodialysis reversal and reverse osmosis systems show potential; however, pretreatment of brackish water would greatly enhance the ability of these systems to remove particulates and troublesome inorganic pollutants.

CEE's team approach involved lime/soda-ash softening followed by recarbonation and filtration through granular pyrolucite. The softening process removed calcium, magnesium, aluminum, and silica, and the filtration step removed manganese, iron, and turbidity.

At NMSU, the students gave a 15-min PowerPoint presentation, followed by a Q&A session with the judges. The next day, the judges came to the demos, where the students presented a poster, made another presentation, and answered additional questions about their design process. In addition to technical issues, the paper and presentations had to address cost, community involvement, health and safety, and other topics.

Finally, the team demonstrated the prototype by treating a sample of the water for which the design was intended. The effluent was then sent to a lab, with the success of the process accounting for one-third of the total team score. The judging was serious, with 10 judges evaluating each project, including professionals directly involved in making the decisions about how to solve the real-world problem.

CEE's team bested the eight other teams that chose to compete on the brackish water pretreatment task. As an added bonus, the judges who work at the desalination facility said they are interested in scaling up the proposed process to implement at their site. To win overall top honors was the ultimate validation for their excellent work.

Awards and Accolades

Professor **Joe P. Mahoney** and Assistant Professor **Stephen T. Muench** received the Best Paper award at the 2009 Southern African Transport Conference for their paper titled "Implementation of Interactive Web-Based Tools in Pavement Engineering." Co-authors were Professor Wynand Steyn, University of Pretoria, and George White, Pavia Systems. The theme for this year's conference was *Sustainable Development*.

Professor **Steven L. Kramer** has been awarded the Normal Medal of the American Society of Engineers for his paper titled "Return Period of Soil Liquefaction," co-authored with former CEE PhD student Roy Mayfield. The paper illustrates how conventional procedures for evaluating liquefaction potential produce inconsistent likelihoods of liquefaction in different seismic environments and introduces a more complete and consistent procedure for use in engineering practice. The Norman Medal was instituted and endowed in 1872 by George H. Norman, M.ASCE, and recognizes a paper that makes a definitive contribution to engineering science.

Robert D. Holtz, professor emeritus of geotechnical engineering, recently toured four cities in Columbia to present a four-hour mini short course on geosynthetics engineering. In Bogota, Baranquilla, Medellin, and Cali, Holtz lectured to audiences of 95 to 300 practicing engineers and consultants. Holtz was invited to present this lecture series by Pavco, a geosynthetics manufacturer that he first met in 1998 and encountered again at a conference in Mexico last March. Holtz says it must be the "missionary" in him that compels him to continue presenting the newer technologies to practicing engineers.

Affiliate professor **Neil M. Hawkins** was honored with the Academic Engineer-of-the-Year award by the

Puget Sound Engineering Council. Hawkins was nominated by the American Society of Civil Engineers (ASCE) and Structural Engineers Association of Washington (SEAW). Hawkins held an associate professor appointment with CEE from 1968 to 1991, served as department chair from 1978 to 1987, and as associate dean for research and facilities for the College of Engineering from 1986 to 1991.

CEE senior **Joshua Hatfield** joined the ranks of former President Theodore Roosevelt, Supreme Court Justice Sonia Sotomayor, and Amazon.com founder Jeff Bezos when he was initiated into Phi Beta Kappa, the oldest and most respected undergraduate honors organization in the nation. PBK has fostered and recognized excellence in the liberal arts and sciences since 1776 and at the UW since the Washington Alpha Chapter was established in 1914.

Stephanie Abegg, masters student in geotechnical engineering and Valle Fellowship recipient, and **Jenna Forsyth**, masters student in hydrology, water resources, and environmental fluid mechanics, have received 2009 National Science Foundation Graduate Research Fellowships. The program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines.

Rebecca Rule (MSE 2009) was a co-recipient of the 2009 Harrison Prescott Eddy Medal for Outstanding Contribution to Wastewater Principles/Processes Research. As a University of Idaho undergraduate student and later as a junior engineer for Blue Water Technologies, Rule was a part of UI's interdisciplinary research team that worked to identify abiotic and biotic mechanisms in a new water treatment process. The Eddy Medal is a prestigious international research award bestowed by the 35,000-member Water Environment Federation following a blind nomination and review process.

Complex Dynamics of Tidal Flats Draw New Doctoral Student

J. Paul Rinehimer

J. Paul Rinehimer, a first-year CEE doctoral student, spent most of the past summer wading around on intertidal flats. When not on the flats, he was flying above them in a small plane for hours at a time. From either vantage point, he was looking for heat. As part of a large, multi-investigator project funded by the Office of Naval Research, J. Paul is using infrared sensing to detect physical processes and properties of tidal flats. The infrared signals result from strong solar heating of sediments exposed during low tides and the temperature differences between the cold river discharge and the relatively warmer bay water.

For flats located by a river mouth, such as the Skagit River, the incoming tidewater mixing with the outgoing river water creates striking infrared patterns. In regions with less river flow, such as the Willapa Bay on the southwest Washington coast, infrared signals result from the mixing of tidewater and groundwater. Rinehimer is using the infrared observations to quantify the mixing and to understand the importance of channel network geometries.

J. Paul is new to Northwest waters. The Pennsylvania native earned his BS in environmental geosciences at Boston College and an MS in marine science with a concentration in physical oceanography from The Virginia Institute of Marine Science at the College of William and Mary. On the East Coast he primarily studied estuaries. Now, tidal flats are his focus.

"The interface between rivers and the sea is an interesting place due to the dynamics of mixing between salt and fresh water, and the complex effects of wind and currents," Rinehimer said.

Wading around tidal flats has its challenges. The sheer size of the flats can require lengthy walks to place instruments, or hopping in and out of the boat to drag it over sandbars through water that may be knee deep.

"The channels through the braided flats are constantly changing, so navigating through them in an inflatable dinghy is an exercise in reading surface water patterns and trying to discern the location of the channel" he said.

Most of the flats at Skagit are sandy and easy to traverse on foot, while the flats at Willapa consist of deep, unconsolidated mud. "You sink in them halfway to your knee or more. They may be flat, but crossing the muddy areas is like climbing stairs while fighting the force of suction and the extra weight of mud clinging to your feet," Rinehimer noted.

Rinehimer is working with assistant professors James Thomson and Alexander Horner-Devine. Practical applications from their work include improved remote sensing and improved predictive models of tidal flats. These advanced tools can be used to inform decisions on environmental projects such as habitat restoration, and on naval operations such as shore landings. Rinehimer's research is at the intersection of several active areas in environmental fluid mechanics, including sediment transport, estuarine circulation, and coastal morphology.

More information on the project is available at www.tidalflats.org.

Berg Endowment Converts to Professorship

A donor's flexibility and forward thinking has led to the establishment of another new CEE professorship. The Henry Roy Berg Endowment was established in 1985 through Berg's estate to support professional development for faculty. It also provided a faculty award in conjunction with a public lecture to academic and professional colleagues on the recipient's topic of choice. A clause in Berg's will allowed the department to convert the fund into a professorship when the fund exceeded the minimum amount required to do so. CEE recently amended the endowment to establish the Henry Roy Berg Endowed Professorship and will name the first recipient next year.

Henry Roy Berg studied civil engineering at the University of Washington for approximately three years, then left to take a job with Western Electric. Next, after a brief stint working for the City of Seattle, he entered the military during World War II. After the war, he returned to Seattle and worked for the city until his retirement. We welcome any additional information about Mr. Berg, as our records reveal only this basic outline of his life and career.

If you can provide more information or would like to learn more about establishing an endowment in the Department of Civil & Environmental Engineering, please contact Megan Kagel at (206) 685-1378 or mkkagel@uw.edu.

Wenk Lecture Puts Puget Sound Air Quality in the Spotlight

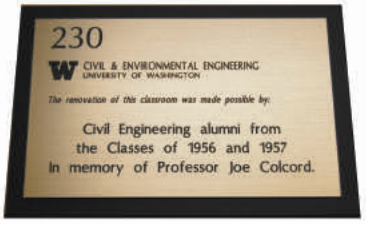
Thursday, December 3, 4 pm

Kane Hall 220, reception in foyer following lecture
Please join us for this free public lecture

Dennis McLerran, executive director of the Puget Sound Clean Air Agency, is the featured speaker for a talk titled "Innovation and Collaboration Leading to Cleaner Air in the Puget Sound Region." McLerran is a board member of the National Association of Clean Air Agencies and a member of the EPA's Clean Air Act Advisory Committee. He participated in the West Coast Governors' Global Warming Initiative and Governor Gregoire's Climate Action Team.

The Edward Wenk Jr. Endowed Lectureship in Technology and Public Policy brings to the University distinguished practitioners in the aeas of civil and environment engineering and public policy who engage the context of social, economic, political, and environmental impacts.

Memory of Joe Colcord Lives on In More Hall



Dedication plaque honoring Joe Colcord

Old friends from the classes of 1956 and 1957 gathered on August 3 to dedicate the More 230 classroom in memory of Professor Joe Colcord. Alumni Howard Wahl and Kay Jones co-hosted the event and welcomed their old chums for this occasion. The two classes successfully raised funds for the classroom remodel with dual goals to recognize their favorite professor and help current students excel in their studies.

Their generous gifts and additional support from the college enabled CEE to combine two small classrooms to create a spacious one that can seat 60 students. The

CEE student utilizes the new modernized classroom

room has new ergonomic seating with curved work tables, dual PowerPoint projectors and projection screens, a new teacher's podium, a 10-foot sliding white board, new flooring and window treatments, and a new coat of paint. When funds are available, the department would like to add a tablet PC and digital visual presenter (also known as a document camera) to help professors with their instruction.

Professors Joe Mahoney and Marc Eberhard were on hand to express their thanks to the group and detail how this new classroom will benefit students. More Hall facilities manager Jack Herndon presented the technical side of the modifications and answered questions. The group was treated to a nostalgic PowerPoint presentation of campus scenes from the 1950s and then adjourned for lunch at the UW Club. It is not too late to contribute to this 1956–57 class gift. If you would like to make a gift in memory of Joe Colcord to complete the renovations to his namesake classroom, please contact Megan Kagel at (206) 685-1378 or mkkagel@uw.edu.

Three Alums Return to More Hall with Words of Wisdom for Students

Civil & Environmental Engineering's inaugural Leadership Lecture Seminar Series drew an attentive group of juniors and seniors Spring quarter. CEE alums Tom Draeger (BSCE '68), George Bye (BSCE '80), and Tom Gibbs (BSCE '54, MSCE '66) returned to More Hall to talk with students about their careers and to share advice on how to be strong leaders in industry.

The series is designed to demonstrate that a CEE degree can be a foundation for success in a wide-variety of industries and careers. From business management to innovative technology and entrepreneurial ventures, industry executives share their stories and convey insights on the skills, attributes, and approaches that can lead to outstanding careers for future graduates.

A dedicated mentor to countless young engineers, **Tom Draeger** was senior vice president of the Bechtel Group, Inc., and president of Bechtel Construction Operations, Inc., where he was responsible for the functional direction, personnel administration, and operations of Bechtel's global construction activities. He was a 2007 recipient of ASCE's OPAL Lifetime Achievement Award and is head of The Beavers, a heavy construction professional association for the West Coast. He shared with the class his insights on balancing a career with family and reaching out across traditional roles to develop meaningful and loyal relationships with colleagues.

George Bye, founder of Bye Aerospace and Bye Energy, has two decades of experience as an aerospace entrepreneur, manager, and executive. He recognized the market urgency and technology advances in alternative energy with aviation applications and recently formed Bye Energy, Inc. Bye pulled from his military leadership experience to demonstrate to the class the importance of teamwork, active listening, and grace under pressure. Sharing his experiences as an entrepreneur exemplified that an engineering degree can prepare students for a wide variety of career choices.

As a champion of clean water issues, **Tom Gibbs** served as executive director of Seattle Metro at its infancy and helped finish the cleanup of Lake Washington and adjacent Puget Sound waters, and created what is now called Metro Transit. In the 1970s he founded the Association of Metropolitan Sewerage Agencies (AMSA), helped write parts of the Clean Water Act, and became program director for Milwaukee's Water Pollution Abatement Program. Draeger completed his career at CH2M Hill as executive vice president and director of water practice and continued to serve as a consultant on large water-related projects across the globe. Draeger stressed the importance of demonstrating leadership by giving back to the community. He emphasized that students will need to work with a variety of stakeholders across organizations and that they should be prepared to use their communication, delegation, and leadership skills to be successful in their careers.

Thank you to the outstanding alumni who participated in this lecture series. Sharing their years of experience truly demonstrated to students the meaning of leadership.

We want to hear from you! Please send your alumni updates to comments@ce.washington.edu. To learn more about making a gift or to establish an endowment in CEE, please contact Megan Kagel at mkkagel@u.washington.edu or (206) 685-1378.

Endowed Professorships

(from page 1)

hydrology, GIS, and remote sensing.

The Conner and Sylvester families gathered on campus on October 5th for a reception celebrating the professorship installations. The donors and their guests met their recipient professors and spoke to attendees about their philanthropy. CEE faculty and staff joined in to pay tribute to these special alumni and distinguished professors.

Professorships are vital to the academic advancement of the department. These funds help recruit and retain top faculty, who in turn attract

Bob O. Sylvester (BSCE '36), Bob J. Sylvester (BSCE '71, MSCE '78), Michelle Sylvester, Jim Sylvester (BA '76, MA '71), Dennis Lettenmaier (BSCE '70, PhD CE '75)

bright students, build robust research programs, and spur innovation in the classroom. Professorships provide significant financial support to a faculty member in the area or program specialization of the donor's choice. The income from this type of endowment typically provides additional support for special purposes related to instruction and research. Examples include facilitation of professional seminars, purchase of publications to complement the professor's work, travel for meetings or research, and hiring students to assist the professor in research projects.

We thank the families for their generous support of the department.

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The Bridge

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Masthead photo: WSDOT

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Canoe Team Powers Through Challenges to Compete at Nationals

Neither rain nor snow nor a leaking canoe could keep ASCE Concrete Canoe captains Seth Thomas and Kasey Faust from leading their team to nationals this year. It all began with a treacherous, 5-mph drive over the Cascade Mountains, in near-blizzard conditions, while hauling the 300-pound *Evergreen* and trailer to the regional competition held April 2–4 at Carroll College in Helena, Mont.

"There is always a rivalry with WSU, but this year Idaho's boat and racing team proved to be our toughest competition at regionals," said team member Melissa Tremayne. The UW team placed first in the races and second in the overall competition, behind the University of Idaho. The team was chosen to represent the Northwest region at nationals based on a ruling from the nationals judges.

The national competition, June 11–13 at the University of Alabama in Tuscaloosa, coincided with UW finals week and graduation festivities, so the canoe had to be shipped to nationals. Upon arrival, the team found it had been damaged during transport. With the help of several other teams, they were able to repair the canoe sufficiently to compete.

The canoe team with the "Evergreen" at the regionals in Montana.

With duct tape and plastic bags in place, team *Evergreen* took to the water with a desire to succeed, placing sixteenth overall and eighth in the oral presentation — "a great achievement for us," said team member Elyse Hanson. The winner was the University of California, Berkeley.

Each year the competition rules and regulations change in an effort to improve the event and ensure that competitors design and build new canoes. This year's changes included adding a "green" element to the canoe, requiring a recycled materials content of at least 25% for the aggregate(s), based on the total amount in the concrete mixture. "Seeing all the creative 'green' work by the teams, both regional and national, shed new light on the different ways to become environmentally friendly and have fun at the same time," said Tremayne.