Momentum!

Winter 2014

Strategic Growth Starts with Students

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Oregon State UNIVERSITY

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COVER PHOTO
College of Engineering ambassadors play an important role in the growth of enrollment. They provide information, community, and guidance to current and prospective students. (Photo by Hannah Gustin)

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Momentum! is published by the College of Engineering's Marketing Communications group. Comments and questions about this publication can be sent to the editor at **editor@engr.oregonstate.edu**

College of Engineering faculty and staff gathered at Reser Stadium for the 2013 Fall Awards Breakfast.

20 years later: Strategic growth provides key to transformation

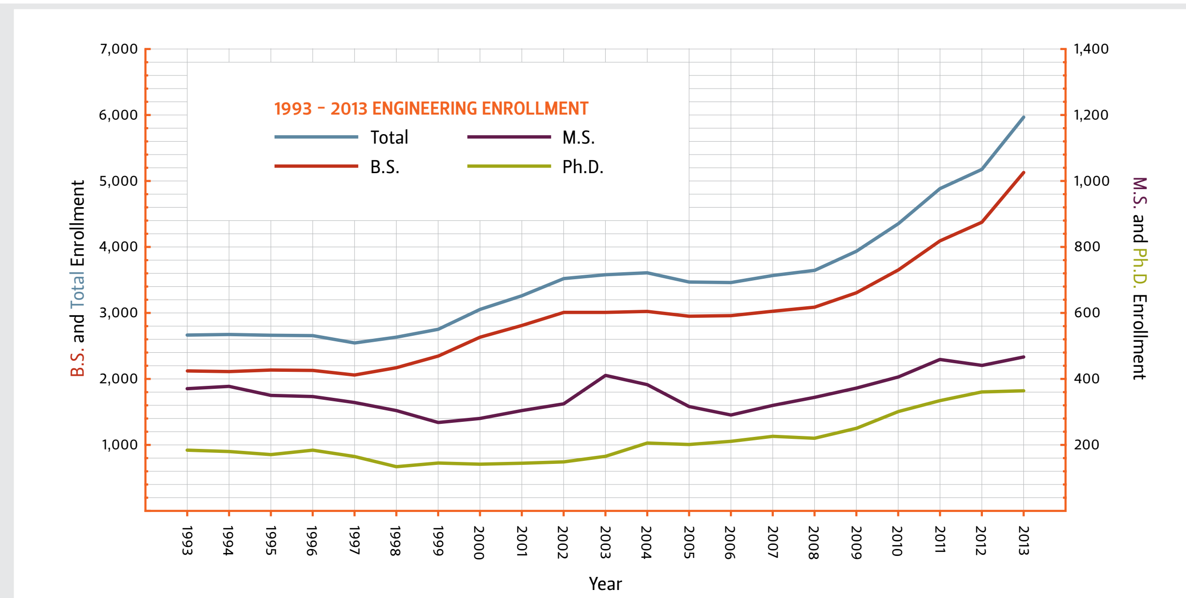
I love Oregon State University, and holding the deanship of the College of Engineering is a dream come true. After more than a year in the position, I have had many occasions to look back and reflect on this organization's past and present.

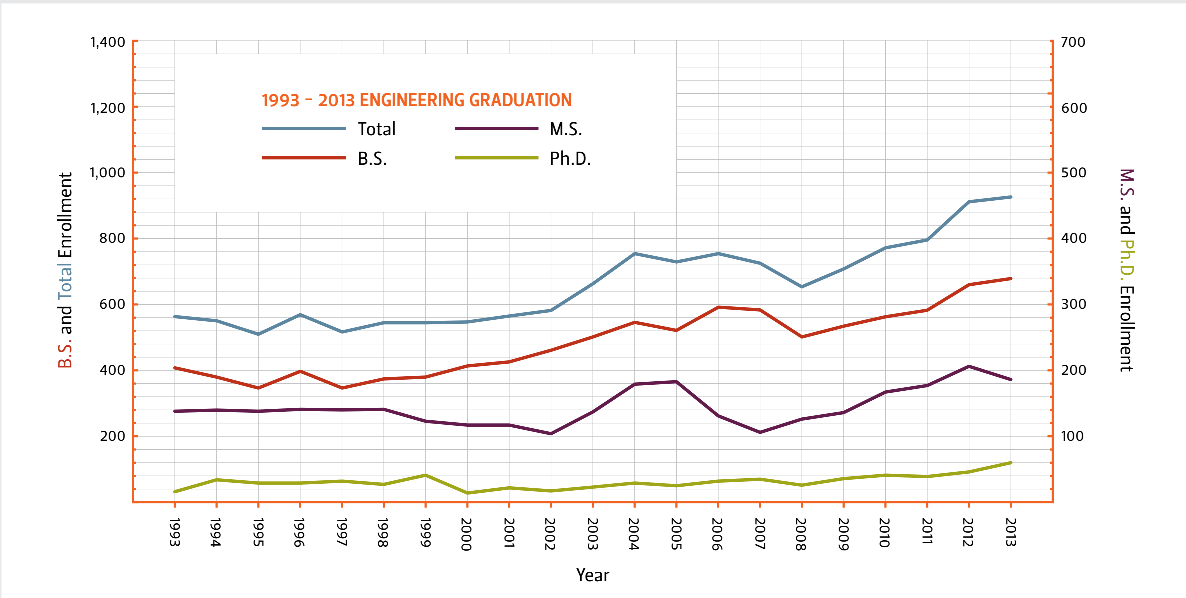
University-wide enrollment has nearly doubled in less than two decades, and much of that growth has been in the College of Engineering. Our enrollment and graduation numbers have doubled since I was a faculty member here from 1984 to 2001, and this past year we graduated the largest class in the college's history. (See the data in the accompanying charts.) But growth in numbers is only part of the story. We are also growing our reputation and influence nationally and internationally. Through our international collaborations, we attract top students from all corners of the earth and provide domestic students with invaluable overseas learning opportunities. As an example, read the story in this issue about Malwina Gradecka, who came from Warsaw, Poland, to pursue a Ph.D. in nuclear engineering.

Through a unique collaboration with the National Science Foundation's Center for Sustainable Materials Chemistry, we also provided hands-on research experience to Oregon State undergraduate students and their peers from across the nation. You'll get a glimpse of what they worked on and learned, and what surprised them most during their summer internships.

Since the college was established in 1889, our alumni have impacted society in major ways through contributions in science and technology. A few of their achievements include revolutionizing the computer industry by inventing the computer mouse and email, improving human health by creating the first artificial heart valve, and pioneering space exploration by helping to build Earth's largest telescope. In this issue, you can also read about one of our outstanding alumni, Jen-Hsun Huang ('84, B.S. Electrical Engineering), who transformed visual computing with the invention of the GPU and whose company, NVIDIA, continues to drive innovation in that field.

Our alumni and industry partners continue to help us deliver unsurpassed academic experiences through their steadfast support and their investment in our faculty and students. Donors to the College of Engineering have invested more than $200 million in private support during The Campaign for OSU. Twenty years ago, the college had one endowed faculty position. Today, our 16 endowed faculty positions and numerous state-of-the-art research and teaching facilities attract world-class researchers. Please see the article about Scott Ashford's important work in earthquake engineering, which was



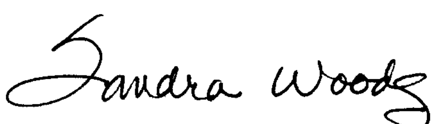


made possible by one such endowment: the Kearney Professorship of Engineering.

The college's five integrated engineering units share the goal of providing excellent education and pursuing top-notch, multidisciplinary research. Our emphasis on collaboration within a unified whole makes it easier for scientists to integrate their knowledge to find new solutions for complex problems. Strategic investments are building key areas of excellence, which allow renowned and emerging scholars to break new ground in their search for elegant solutions that promote a healthy planet, healthy people, and healthy economies around the world.

I hope you are as impressed as I am by our transformation during the past 20 years, and that you share my excitement about the vibrant opportunities yet to come.

Sincerely,



Sandra L. Woods, Dean
Oregon State University
College of Engineering

Lessons on life and lifework

By Gregg Kleiner

Jen-Hsun Huang was a 32-year-old entrepreneur at the helm of a startup company he'd launched in the high-stakes, high-tech, high-failure-rate heart of Silicon Valley when he found himself and his fledgling company on the brink of total disaster.

The two years of intense design innovation Huang's company had invested as a way to get around the high price of DRAM memory was suddenly irrelevant when the price of DRAM went into free fall. It went from $50 a megabyte to $5 as more than 80 competitor companies jumped into the 3D graphics chip race. Huang's venture funding and personal savings had all but evaporated, leaving him, his wife Lori ('85, B.S. Electrical Engineering), and their two small children vulnerable.

"Until that moment, I don't know that I'd ever experienced failure," said Huang ('84, B.S. Electrical Engineering), who came to Oregon State University at age 17, graduated with honors, and worked at several high-tech jobs before co-founding NVIDIA in 1993.

Jen-Hsun Huang, president and CEO of NVIDIA

Jen-Hsun Huang works with employees at Project Inspire, the annual charity event NVIDIA sponsors instead of hosting a traditional holiday party.

The Huang family (from left) Madison, Jen-Hsun, Lori, and Spencer.

NVIDIA invented the graphics processing unit (GPU) and today is one of the world's most successful technology companies, but "back then, we were surrounded by competition, our company was the smallest of all of them, and the first product we built after two years was a failure of spectacular proportions — spectacular because we took a gigantic risk, and it didn't work out," said Huang.

Failure transformed

As Huang and his company teetered on the precipice of collapse, he experienced something he still taps into today as chief executive officer of NVIDIA.

"I think the defining moment of any career or company is when everything's on the line for the first time — all the people you've convinced to fund your idea, all the people you've hired, your family, everything," he said. "That's when you're truly at the brink."

He compares his experience to the moment when a world-class athlete is competing on a level so extreme that you can almost see them reach down and access something extra to get them through.

"They seem to have an ability to dig deeper when times are really, really tough and tap some extra gear, a spare tank, some special reserve that makes them seem super human, super capable," Huang said. "Well, we found that. When I was 32, I experienced it, and we learned as a company how to tap into it and find a winning strategy to get out of where we were."

NVIDIA's latest product, SHIELD, is the company's first gaming and entertainment device.

Huang said he and the people he worked with — many of whom are still with the company today — reinvented themselves and the company, and their true character came out.

"That moment taught us how to tap the greatest strength in ourselves," he said. "I know exactly where that extra reserve is now, what it looks like, and when to go to it. And the company knows that, too, and it's great to have. But you won't have it — you won't discover it — unless you're at the brink."

The rest, as they say, is history. Huang and his team were able to pull the company back from the edge of failure, and today NVIDIA employs 8,500 people, owns more than 5,500 granted and pending U.S. patents, and has its ubiquitous graphics processing technologies embedded in everything from smartphones and supercomputers to medical imaging devices, NASA workstations, and new cars.

Competition reimagined

Huang agrees that he's competitive, but he said it's not in the traditional way.

"I'm competitive, but I don't feel a great desire to need to win at everything — I'm not competitive like that," he said. "I just want to make sure I've done the best I could. And my definition of doing the best I could happens to have a very high standard."

He said his high standard probably comes from his father, a chemical engineer, and his mother.

"My dad's a perfectionist," he explained. "Nobody's got better handwriting than my dad. When he fixes something, he fixes it perfectly. When he works on something, it's always perfect. He's an engineer's engineer. My mom, on the other hand, is a little more random, but nothing's ever quite good enough for her. So she's always nitpicking this and nitpicking that. So I'm probably a combination of both of them."

Huang's obsession with doing the best he can is recharged and refocused every day when he wakes and asks himself three questions: "What could I do better? What are the most important things I could do that will make a contribution to the world? And what are the things I love to spend my time doing and that I want to fill my day with?"

NVIDIA's president and CEO Jen-Hsun Huang plays a game, powered by Physx technology, at the 2009 International Consumer Electronics Show in Las Vegas. NVIDIA invented the Physx graphics chip technology to enhance gaming. (AP Photo/ Paul Sakuma)

Those three questions also inform NVIDIA's business operations. "We ask ourselves some permutation of those same questions almost every single day," Huang said. "And our answers can't possibly be the same answers as Intel or Qualcomm or AMD or others, right? Because we're different people and we have different skills and different perspectives on life."

And this is where Huang's distinctive orientation to competition comes in. "Ultimately, it's not about beating our competitors, but it's really about making a contribution that's unique among them," he explained. "Doing what they do better is not a likely outcome for success."

Sharing the passion

Huang believes that many of his top management team and others have stayed with NVIDIA over the years because they're doing their lifework.

"We're not just working anymore," he said. "I think for me, and for many on my management team, and for the really, really passionate computer graphics engineers in the company, we're all doing our lifework here. There are many companies who can run a very good business, but there are very few who can say they are the world's best at what they do."

Huang is quick to credit Lori, whom he met at Oregon State in an electrical fundamentals class, for the role she has played in his success.

"It's good to have someone in your life who unconditionally believes in you, who believes you're doing your best," he said. "You need people like that, and Lori's always been that person for me — ever since I was 18, she was there believing in me and knowing I could do it. Even when I had self-doubts, she didn't." **M!**

Brenna Baker weighs out a precise amount of hafnium oxychloride.

Postdoctoral fellow Rose Ruther (left) answers questions as Brittany Kern and her project partner, Nathan Lazaroff, process $LaFeO_3$ solutions.

Summer research experience surprises students, teaches mentors

By Thuy T. Tran

Brittany Kern, a senior from the Alabama Agricultural and Mechanical University, spent last summer in a lab in the School of Chemical, Biological, and Environmental Engineering at Oregon State University attempting to synthesize a unique type of photocatalyst that more efficiently absorbs the visible spectrum of light. Photocatalysts are used in many applications, including carbon dioxide reduction and water purification.

Kern was one of 23 science and engineering students from academic institutions across the United States who were selected through a competitive process to participate in a nine-week research experience sponsored by the Center for Sustainable Materials Chemistry (CSMC) called the Undergraduate Summer Research Program. The program is funded by the National Science Foundation, and this year was hosted in labs at Oregon State, the University of Oregon, and the University of California – Davis. It initiates undergraduates into the research culture, teaches research basics, and provides graduate students and postdocs with mentorship experience.

As a chemistry student, Kern was surprised at the amount of engineering she was learning and doing. "I had no idea how closely the two fields are related and dependent upon each other," she said. "What was even more surprising was that I had such a hard time with the solution chemistry aspect of the project, even though I had spent three years doing that very thing."

Brenna Baker, an Oregon State chemical engineering junior, investigated the cluster formation and stability of precursors for inorganic photo- and electron-beam resists. Inorganic resists are expected to enable high-volume fabrication of nanoscale electronic devices.

Baker was surprised at how the interaction with her mentors — graduate students and postdocs — differed from past experiences. "I was able to discuss how to proceed in our research with my mentors rather than being told what to do next," she said. "From that, I took away a lot of knowledge about considerations and steps in the research process."

In addition to getting hands-on experience with new analytical techniques, Baker credits her mentors with creating a comfortable and fun work environment. "I felt I could be creative," she said. "This positive atmosphere is something I will strive to contribute to in any future work experience."

Postdoctoral fellow Rose Ruther, who served as Kern's mentor, was impressed by the students' resilience. "They could handle everything that was thrown at them, even really complicated subjects — inorganic chemistry, solution processing, spectroscopy," she said. "With only nine weeks, they had a remarkably good understanding of, not only the laboratory techniques, but also the motivations for the work, experimental design, and data analysis. It was really rewarding to see them take ownership of their projects. They asked a lot of great questions, did a lot of independent literature searching, and weren't afraid to just go in the lab and try something new."

Student participants were not the only ones who benefited from the program, however. Ruther said the best part of mentoring the students is the energy and enthusiasm they bring into the lab. "They're seeing everything for the first time, and their excitement reminds me how much fun research really is." She is pleased that several program participants will continue to work in the lab this fall.

Doctoral candidate Richard Oleksak, Baker's mentor, appreciated the opportunity to work with students who showed great initiative and genuine interest in the project. "Inquisitive students like Brenna forced me to answer big-picture questions about the research and gave me a more balanced perspective of the work," he said.

Oleksak hopes to become a professor, and the program gave him a valuable opportunity to gain experience working with students and managing a project. "For many of these undergraduates, we are their first research mentors and may have a huge impact on their chosen career paths. It is our responsibility to provide not only a challenging and engaging project, but a positive and respectful work environment so that this experience may guide them in choosing a profession," he said.

The 23 participants in the Undergraduate Summer Research Program were chosen from a pool of 126 applicants, which reflected an 85 percent increase in applications from 2012, when it was first launched.

"Applicants are selected based on their academics and their interest in eventually becoming a researcher," said Andy Bedingfield, the CSMC's director of outreach and education. "We also broaden the group to include participants from underrepresented groups and community college students to foster their interest in completing a four-year degree." **M!**

Associate Professor Brian Woods and Malwina Gradecka discuss safety and design considerations relevant to high temperature gas-cooled reactors.

Internationalizing nuclear engineering: U.S. - Poland cooperation creates unique student opportunities

By Abby P. Metzger

Malwina Gradecka came to the United States from Poland with a single suitcase in hand, ready to start a Ph.D. program in nuclear engineering at Oregon State University. Although her possessions were modest, her arrival signaled the beginning of something significant: an international cooperation between the Faculty of Power and Aeronautical Engineering at the Warsaw University of Technology (WUT) and Oregon State's Department of Nuclear Engineering and Radiation Health Physics. The partnership aims to advance next-generation nuclear power technologies and provide expert training for future practitioners, leaders, and scientists.

The collaboration also has the goal of addressing important global energy challenges, said Brian Woods, an associate professor and research adviser for Gradecka. "The problems of energy and the environment are not ones affecting the U.S. alone but are global problems," he said. "Partnerships of the type between Oregon State and WUT represent the future of how these problems will be addressed and ultimately solved."

Gradecka first began researching nuclear power as a master's student at WUT. Nuclear energy is a relatively untapped industry in Poland, with most electricity coming from coal. But after joining the European Union in 2004, Poland has been diversifying its energy portfolio to support a 20 percent reduction in carbon dioxide emissions among member states by 2020.

Nuclear power seemed like a ripe opportunity for Gradecka. "Nuclear engineering became a chance for me to help make electricity cheaper, more efficient, and cleaner. I would like to do something that matters, something that serves the world," she said.

Gradecka is on her way to doing just that. She is working with Woods on a cutting-edge project called a High Temperature Test Facility, an electrically powered model of a high-temperature gas-cooled reactor. The test facility uses helium as a coolant rather than water; it is not a reactor and contains no nuclear material. The $4.9 million project is part of an ambitious effort to bring the technology to market by 2030.

High-temperature gas-cooled reactors have several unique features that give them an advantage over traditional reactors. Power production density is lower, making it much easier to cool the reactor and thus improve safety. In addition, they achieve really high temperatures and produce large amounts of heat.

Woods explains that high-temperature gas-cooled reactors have the potential to expand the use of nuclear power into markets beyond electricity production. For example, they could be used to produce heat and steam in industrial applications, or to produce hydrogen for various purposes. "However, before high-temperature gas-cooled reactors get licensed for operation, there are a number of safety and design questions that need to be answered," he said, "and the test facility will be a crucial tool in finding those answers."

Even heat distribution is one critical aspect to enhancing reactor performance and maintaining structural integrity. As gas heats up in the core and exits to a mixing chamber called a plenum, it can become uneven in temperature and develop "hotspots." Gradecka is investigating ways to optimize gas mixing in the lower plenum to improve thermal uniformity.

"We would like the gas in the plenum to be as well-mixed as possible, because the idea with gas reactors is to connect them to gas turbines," she said. "Those are very, very sensitive devices, and they are very expensive. Any fluctuation would reduce performance. The more uniform the exiting gas is, the longer the turbine's lifespan."

Gradecka's research in thermal fluid-mixing has given her essential hands-on experience. She helped assemble the test facility core and handled the instrumentation and ceramic blocks — an opportunity that, she said, comes only once in a lifetime.

Given the project's scope and international importance, Gradecka points out that her contribution can feel relatively insignificant at times, but she is able to remember the larger picture. "Sometimes I ask myself, 'is this really tiny piece of work I'm doing important?' But then I realize it has to be done, and it's an important step toward more efficient and better electricity production," she said. "It's my contribution to pushing things toward a reliable source of energy for the future."

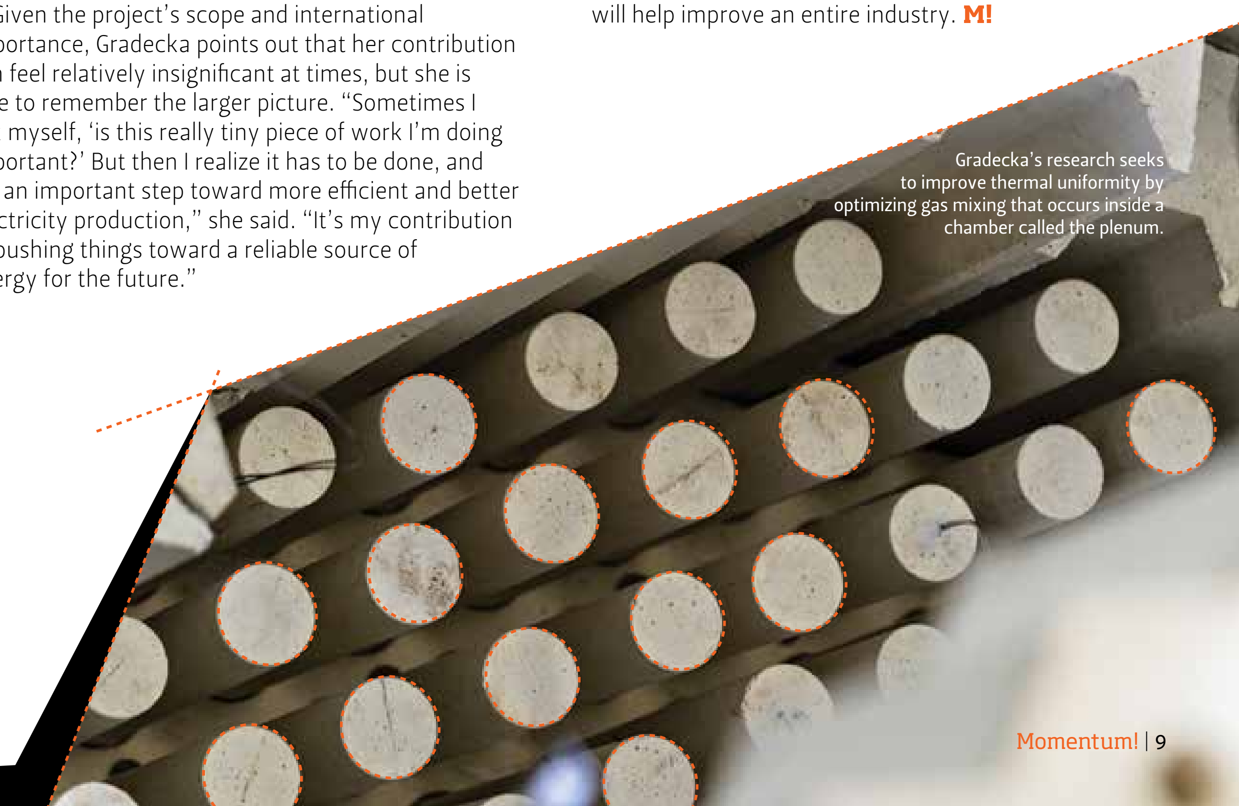
Gradecka will be one of the first graduates of the program, simultaneously earning degrees from WUT and Oregon State.

"Oregon State is giving me opportunities to perform applied research, and the university in Poland provided the basis of my studies in nuclear power," said Gradecka. "It's a bridging experience that also offers an international perspective."

Looking ahead, Gradecka plans to take the lessons learned at Oregon State home with her and continue her work as a researcher in Poland. She hopes that the cooperation between WUT and Oregon State will provide an equally vibrant opportunity for future students.

"It's been a lot of work to establish this cooperation, and we couldn't have done it without the leadership of department heads and other officials from Oregon State and WUT," she said. "It's been a really positive experience. I've changed a lot. My horizons are broader. Traveling and working in another country opens your eyes to many other aspects of life, and I would love it if other students also benefited from this opportunity. It would be my little gift," she said.

Although she may have come to the United States with just a suitcase and a desire to study nuclear engineering, Gradecka will leave having participated in a cooperative program between two nations that will help improve an entire industry. **M!**



Gradecka's research seeks to improve thermal uniformity by optimizing gas mixing that occurs inside a chamber called the plenum.

Building for the Big One: Kearney Professor of Engineering travels the world to study earthquake resilience

By Warren Volkmann

Two hundred miles north of Tokyo, on a barren coastal plain where a thriving city recently stood, Scott Ashford stopped in front of the skeleton of a three-story building. Its rusting I-beams and floors rose 30 feet above the denuded surroundings. Until the morning of March 11, 2011, it had been the Disaster Preparedness Office for the region called Tohoku.

As he studied the structure, Ashford reconstructed in his mind's eye the events of that devastating morning more than two years ago.

Offshore, tectonic plates that had been locked in place for centuries suddenly released, and the ground shook with one of the most powerful earthquakes ever recorded. Workers in the building ducked under desks and braced themselves in doorways. When the shaking finally stopped, instead of running for the hills, they ran for the roof. They knew the building was built to withstand tsunamis, and they placed their faith in it. From their vantage, they would have seen the ocean draw back. They would have watched the long-awaited tsunami — a great wall of mud and debris — surge over the beach, scraping away everything in its path. They would have felt the building shudder under the impact, but hold fast.

Then they would have witnessed the unimaginable: water rising floor by floor until it poured over the roof and swept everyone away.

The building survived, but the people it had been intended to protect did not. The engineers who designed it had not expected the water to rise an almost incomprehensible 35 feet. Today, it stands as a monument to the power of the sea and a shrine to those who lost their lives.

Learning from destruction

For Ashford, head of the Oregon State University School of Civil and Construction Engineering, the Disaster Preparedness Office is one of the most dramatic and ironic examples of seismic performance he found on a five-month tour of the destruction caused by the worst earthquakes in recent years. In addition to the 9.0 quake in Japan, he studied Chile's recovery from an 8.8 magnitude temblor in 2010, and New Zealand's struggles after a swarm of earthquakes hit, including a 7.0 in 2010 and 6.3 in 2011.

Ashford's earthquake resiliency sabbatical was funded by an endowment created by Connie and Lee Kearney. The endowed faculty position allows him to expand his research beyond civil and construction engineering to "lifeline infrastructure" — the systems essential to modern life: water, electricity, fuel, transportation, communication, and wastewater treatment. As the inaugural Kearney Professor of Engineering, Ashford is receiving support for his far-reaching research efforts over the next 10 years.

"I had been able to visit these countries previously, just two or three weeks after the earthquakes, with funding from the National Science Foundation," said Ashford, "but I wanted to see them after two to three years to see how they had done. How were they recovering? What worked? What didn't? What can we learn from their experience?"

Bringing the knowledge home

The last major offshore earthquake and tsunami along the Northwest coast of the United States was in 1700. That means Oregon is due for the next Big One, and it is important to take this time to prepare, Ashford said.

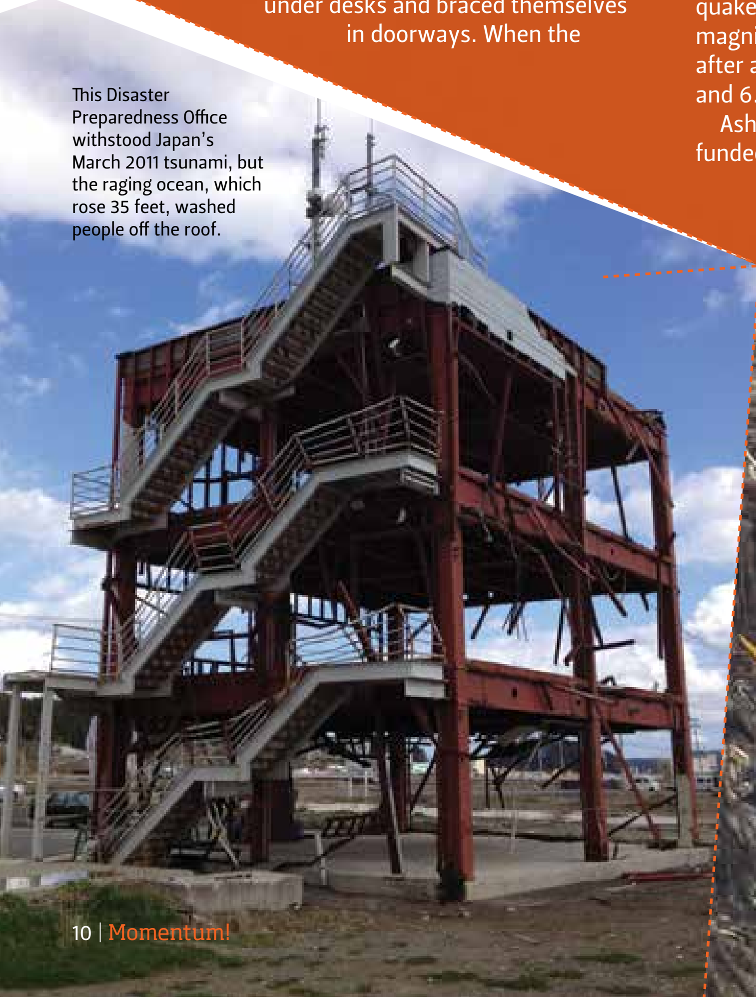
"To prepare for a subduction zone event like the one in Japan, you need to plan decades in advance," he said. "New Zealand had a 20-year effort that, frankly, helped them get through the earthquakes better than they would have. For Oregon, we need to think 50 years in advance." Ashford is an advisor to the Oregon Resilience Plan, and his position as the Kearney Professor of Engineering allows him to apply his findings to the preparedness effort.

Ashford's specialty is bridge design (for example, he worked on parts of the upgraded Bay Bridge, which just opened between San Francisco and Oakland), and the case histories he collected on his travels enable him to bring new information to the table. "I collected a lot of data on bridge performance — data that would have been very difficult to obtain sitting in Corvallis," he said. "I came back with an understanding that we can have bridges that perform pretty well in lateral spreading zones. In Oregon, we have a great deal of work to do, and I am working with ODOT to make our system more resilient."

By returning to the earthquake sites and visiting leaders in engineering, government, and business, Ashford established Oregon State's College of Engineering as a world leader in earthquake preparedness and recovery, but he did not limit himself to earthquake studies while abroad.

"My second objective on this sabbatical was to develop relationships with universities around the world, to provide our students with a more global experience," he said. The endowed professorship paid for sojourns in Thailand, where he used to teach, and Turkey, where he strengthened important academic relationships. "I want to develop student exchanges that will help our students understand the global opportunities. It also gets some of the top undergraduates from around the world to consider Oregon State for a graduate degree."

When those graduate students get here, he and his research teams will have plenty to share with them about designing infrastructure that can protect not only property, but lives, too. **M!**



This Disaster Preparedness Office withstood Japan's March 2011 tsunami, but the raging ocean, which rose 35 feet, washed people off the roof.

Processing mountains of tsunami debris is an important part of Japan's earthquake recovery.

WHAT'S YOUR EARTHQUAKE PLAN?

No matter how much resilience is engineered into Oregon's infrastructure, it's important to expect the unexpected in the aftermath of a quake or tsunami. While gathering data from earthquake sites around the world, Ashford heard hundreds of accounts of how people survived and rebuilt after the events, and he learned how important it is for everyone to take personal responsibility for preparation.

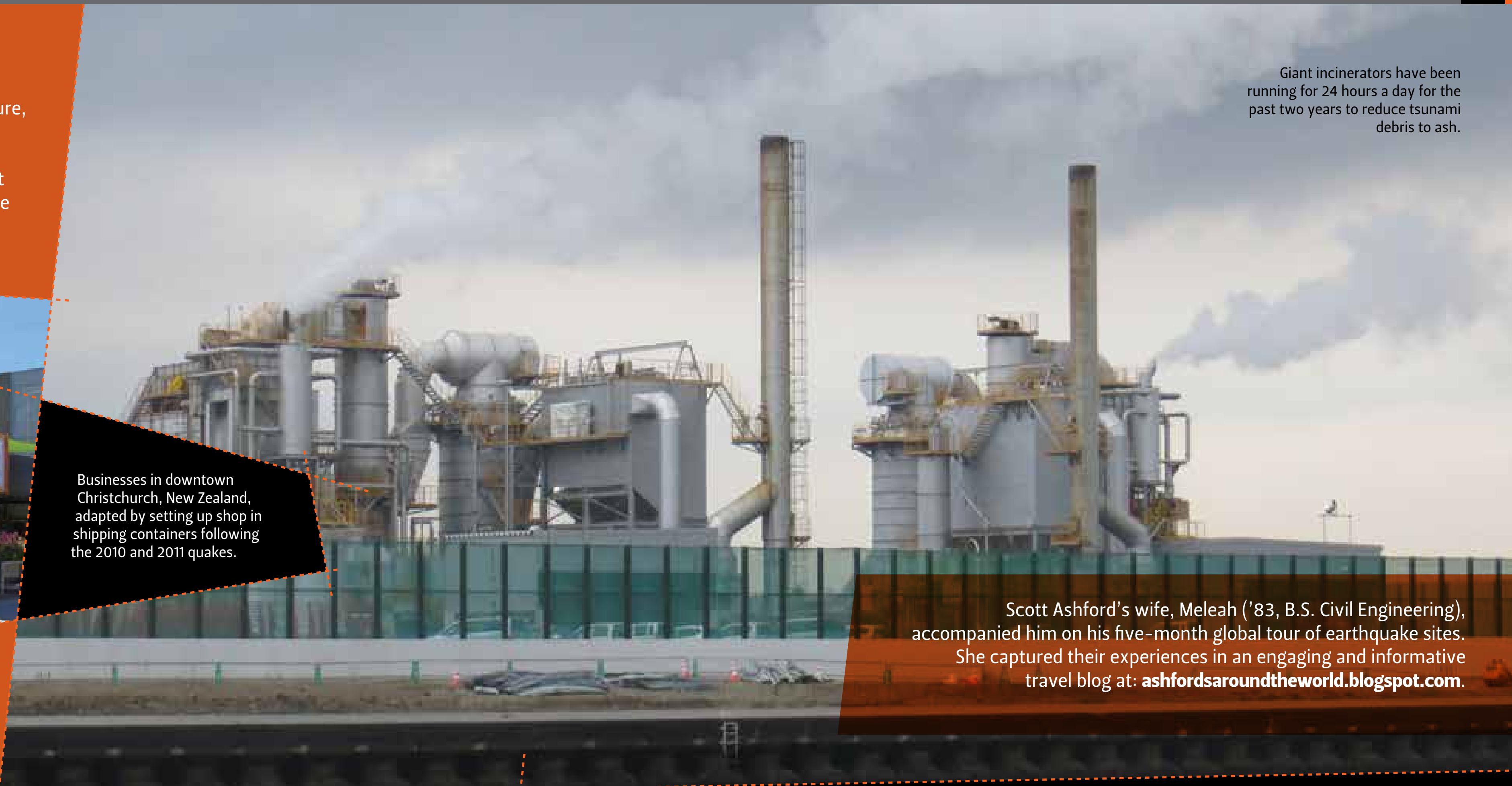
Businesses in downtown Christchurch, New Zealand, adapted by setting up shop in shipping containers following the 2010 and 2011 quakes.

For example, New Zealand is still struggling to repair the damage in Christchurch after the 2010 and 2011 quakes. The ground there essentially turned to liquid and tilted the foundation of tens of thousands of houses and buildings. The downtown building district remains closed down, and businesses have adapted by setting up shop in shipping containers.

Oregon's situation may not be a whole lot different. "The Oregon coast is likely to be cut off for weeks," said Ashford. "You need to plan on being on your own for much longer than the 72 hours recommended for storm preparation. With events like these, the gasoline you have in your car is likely to be all you have for weeks."

Ashford recommends that all Oregonians develop a personal preparedness plan for serious emergencies. "How will you contact your family after an earthquake or a big storm, when the land lines and cell phone towers are down? Who will you call in your family to let them know you are okay?" he said.

He also recommends that businesses have a meeting once a year to talk about what to do in the aftermath. "How will you reach your employees? Your customers? How will you run your business without water or electricity?" he asks. In Chile, a lot of the utility companies provided food and family assistance to entice employees back to work, he said.



Giant incinerators have been running for 24 hours a day for the past two years to reduce tsunami debris to ash.

Scott Ashford's wife, Meleah ('83, B.S. Civil Engineering), accompanied him on his five-month global tour of earthquake sites. She captured their experiences in an engaging and informative travel blog at: **ashfordsaroundtheworld.blogspot.com**.

Lee and Connie Kearney

LEE AND CONNIE KEARNEY: FUNDING ENGINEERING, SUPPORTING OREGON

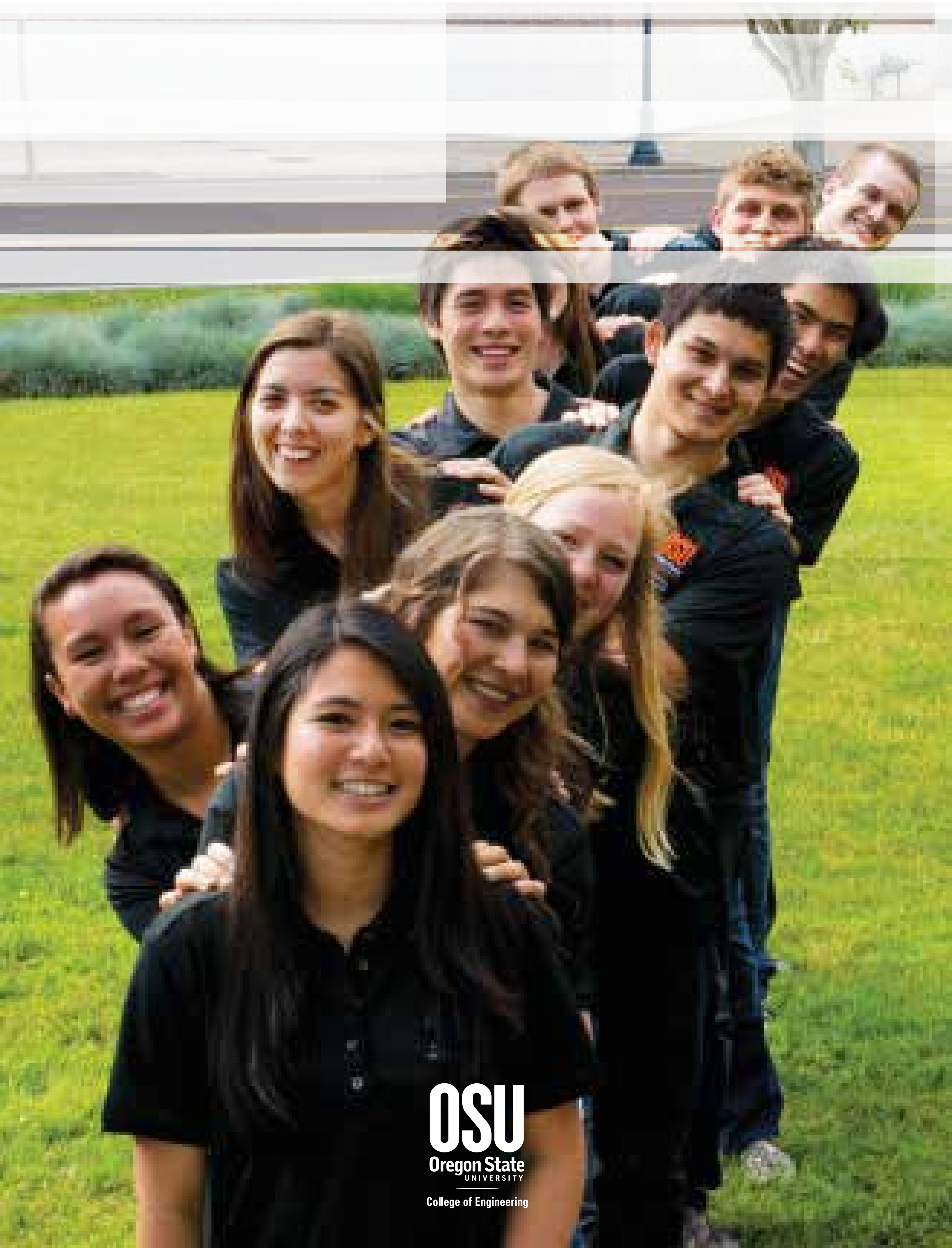
In 2010, Lee and Connie Kearney of Vancouver, Wash., committed $2.5 million to create two faculty endowments at the Oregon State University School of Civil and Construction Engineering. It was their most recent transformative gift in a long history of support for the College of Engineering. The couple previously donated $4 million to help restore Apperson Hall, which now bears the Kearney name.

Lee earned his degree in civil engineering from Oregon State in 1963. He worked for 32 years for Kiewit, one of the largest construction and mining organizations in North America, where he held several executive positions and served on the board of directors. He was inducted into the College of Engineering Hall of Fame in 2001.

Connie started her studies at Oregon State in 1961 and finished at the University of Washington. She became Clark County's first female commissioner, serving from 1976 to 1980, then earned a law degree from Creighton University in Omaha.

Today, Lee serves on the College of Engineering advisory board and the OSU Foundation Campaign Steering Committee; Connie, an OSU Foundation Honorary Trustee, serves on the board of trustees of the Oregon 4-H Foundation. In 2008, the OSU Alumni Association awarded them the E.B. Lemon Distinguished Alumni Award.

Reflecting on Scott Ashford's travels, Lee said, "It's a pleasure to a donor to see how the money is being used in such a positive way, for the benefit of not only Oregonians, but many others. The fact that the Northwest is anticipating a future big event makes Scott's work all the more important. We were glad to help him carry forward his research."



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