Stanford | ENGINEERING
Civil & Environmental Engineering

CEE NEWSLETTER

fall 2018

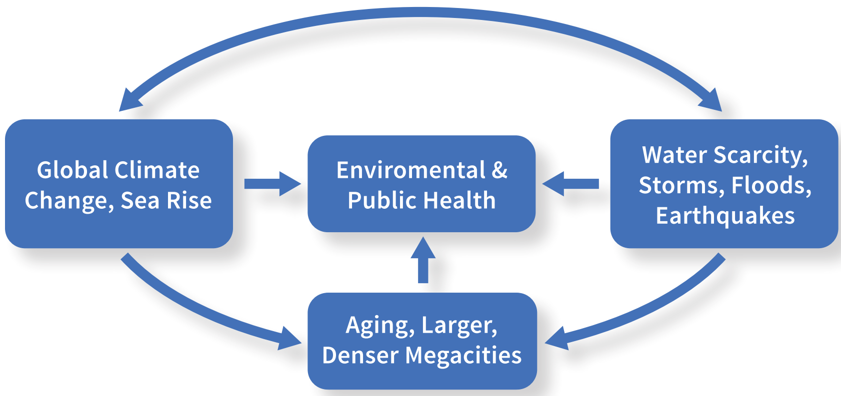
Collaborating to engineer solutions for a resilient, sustainable future

NOTE FROM CHAIR

Our Future

How can we, as Civil & Environmental Engineers, design for our future? Our aging urban infrastructure must be expanded, renewed, and made more resilient, in order to prepare for global climate change and sea level rise, the continued increase in Earth's population, and the heightened frequency of natural disasters. New strategies, materials and practices are needed to protect and sustain both our natural environment, and public health.

Lynn Hildemann, *Department Chair of Civil and Enviromental Engineering*



The flowchart above is one way of visually capturing how our department is taking a collaborative, multidisciplinary approach to addressing these research challenges. Let me briefly highlight just a few of our current noteworthy research activities:

- **Greg Deierlein** is developing modeling tools to more fully understand the economic impacts and downtime of urban-scale disruptions caused by earthquake damage.
- **Oliver Fringer** and **Stephen Monismith** are testing the use of UAVs for remote turbidity sensing, to improve water quality management in the San Francisco Bay.
- **Sarah Billington** is co-leading an interdisciplinary study on how building design can enhance human well-being, considering factors ranging from materials to design features.
- **Bill Mitch** and **Craig Criddle** are evaluating, at nearly full-scale, the effectiveness of anaerobic bacteria for generating sellable products like methane, while treating wastewater.
- **Christian Linder's** modeling of macroscopic material properties based on microscale characteristics is opening the door to the design of new materials with enhanced properties.
- **Alfred Spormann** is refining a prototype system that combines biofilms with electrochemical devices to efficiently generate methane from carbon dioxide and water.

If you would like to know what else we have been doing, please explore the newsfeed on our website, ***cee.stanford.edu***. And we would be delighted to hear from you and learn about what you've been doing since your time at Stanford — please feel free to send us an email, at ***cee-departmentchair@stanford.edu.***

In Africa, Access to Clean Water Isn't Just About Pipes and Pumps

CLEAN WATER

By Edmund Andrews for Stanford Engineering

Equally important are the often-overlooked issues in infrastructure, including information flow, governance and accountability.

When a pump fails, it may not be enough to simply install a new one.

When Jenna Davis describes her approach to water and sanitation problems in the world's poorest communities, she often talks about the puzzle of Africa's broken handpumps.

Handpumps atop wells are often the only way to get fresh water in villages that don't have a piped network. But as many as one-third of handpumps don't work. And because so many fail years before the end of their expected design lives, it isn't enough to simply install new ones.

"If you replace the broken pumps, but don't address why they were breaking down at such high rates, you may be wasting precious resources," says Davis, associate professor of civil and environmental engineering and director of the Water, Health and Development Program at the Stanford Woods Institute for the Environment.

The point is to recognize that a pump is more than just a pump. It's part of a broader system that requires resources, information and accountability.

Davis said case studies show many different reasons for failure. Sometimes there's no money for spare parts, or there is no one who knows how to fix the pump. But sometimes the problem is information flow or accountability: The person who knows how to fix the pump is sitting in the capital and doesn't know that it's broken; or the people who control the resources face no real consequences if the pump isn't repaired.

This seemingly simple idea is at the center of a new collaboration between Davis's team and the Conrad N. Hilton Foundation.

In March 2018 the Hilton Foundation awarded Davis and her team a four-year, $1.9 million grant to create a monitoring, evaluating and learning framework for the foundation's new Safe Water Strategy. The framework will help Hilton track the progress of the $55 million of water and sanitation investments that it intends to make in six African nations over the next five years. This approach will explore the entire system in which infrastructure investments occur. Those systems include often-overlooked issues such as information flows, governance and accountability.

In addition, Davis's team will carry out applied research under a second, three-year award they received from the Hilton Foundation in August. With regard to handpump sustainability, Davis plans to analyze a service model being piloted in Uganda, with villages contracting with technicians to do preventive maintenance on water systems.

Her team will assess issues such as how much the villagers value the increased reliability of supply, water quality and proximity to water sources; how the costs of preventive maintenance compare to the current approach of building and neglecting systems that fail

"If you replace the broken pumps, but don't address why they were breaking down at such high rates, you may be wasting precious resources."

and have to be rebuilt; and how increased reliability impacts community well-being. For instance, if more families had a working pump close to home, would that free children from fetching water and allow them to spend those hours attending school?

Davis is also developing research collaborations with other Hilton grantees. One such project focuses on inexpensive strategies, such as portable hand-washing stations, to improve hygiene and prevent infection in remote hospitals or clinics with limited water and sanitation infrastructure.

Here, too, Davis wants to focus on the systems issues. As sensible as portable washing stations might sound, she says, it will be important to understand why a clinic hasn't already deployed them. Is it too costly to keep them stocked with soap and water? Is no one held accountable for maintaining them? Do staff and patients consider them a lower priority than other clinic amenities?

"There is a reason that things are the way they are," Davis says. "If we don't understand why there wasn't a hand-washing station there last week, then putting one there this week may not be a sustainable solution."

ABOVE: ***When a pump fails, it may not be enough to simply install a new one.*** | *Reuters/Mike Hutchings*

The "long game," Davis says, is to get all the different participants — donors, development organizations, government agencies, local leaders to grapple together with the full organizational and social complexity of such challenges.

"I did come at this from a technical perspective initially," she adds. "But once I spent time in the field I realized that I could do impeccable engineering but ultimately have very limited impact on communities' well-being. So I began to think about planning, epidemiology and microeconomics. It's why the growing interest in systems thinking really resonates with me."

Civil engineers observe how flying insects avoid collisions, to help devise safe, self-regulated systems for drones and driverless cars.

Studying Swarms

Could studying swarm behaviors teach us how to help drones fly safely?

By Tom Abate and Glen Martin for Stanford Engineering

Anyone who's seen a flock of starlings twist and turn across the sky may have wondered: How do they maneuver in such close formation without colliding? "Many types of animals swarm or flock or otherwise move in coordinated ways," says Nicholas Ouellette, an associate professor of civil and environmental engineering at Stanford. "No individual animal knows what every other animal is doing, yet somehow they move cohesively as a group."

Understanding precisely how they do this, Ouellette says, may be a key to helping engineers design "flocks" of aerial drones and driverless cars. Emulating animal swarms is attractive because they not only operate without central control but they're also fault-tolerant, to use an engineering term, meaning they can adapt quickly and gracefully to sudden or unexpected conditions. Swarms are also resilient in that they can operate in dirty, disturbed environments.

So Ouellette and his team have embarked on a series of studies that explore how animal swarms develop the kind of self-organized and self-regulated systems that would allow devices such as drones and mobile sensors to operate safely and efficiently, without the sort of top-down controls that typify, for example, something like the air traffic control system.

Rather than examine starlings or other birds, which would be impractical to study in the lab because of the space they need to fly, Ouellette and his crew look at non-biting midges, a type of flying insect often found near water or in the shade of trees. Unlike starlings, whose graceful formations, called murmurations, make us stare up at the sky, midges buzz around in chaotic, cloud-like masses. But, says Ouellette, midge swarms still share common features with bird flocks and other animal groups, in that the swarms stay cohesive without any outside control or leadership.

“Midges are so small, they’re easy to keep in a lab,” Ouellette says. “They swarm at dusk and dawn and are easy to cue with lights.” In his lab, the midges live in a roughly 5-foot plastic cube, surrounded by high-speed cameras that he uses to reconstruct 3D trajectories for each insect — direction, acceleration — all the essential kinematic information needed to characterize swarm movements.

Working in the lab allows Ouellette’s team to run experiments to test different models. The team starts with observed data taken from the camera images. Then they use this data to test hypotheses about what sorts of rules might govern midge movements. But because natural swarm behavior does not provide enough information to distinguish between many hypotheses, the researchers also disrupt the swarm using light and sound to observe whether the real swarm is affected as their proposed rules had predicted.

Ouellette says it’s too early to design artificial systems that behave the same way as animal groups. But his team is developing the sort of experimental environment that other researchers may one day use to build and test high-tech systems based on the bottom-up wisdom of the swarms rather than the top-down rules that typify many technological undertakings.

“As engineers we like to control things,” Ouellette says. “But we have a lot to learn from insects and other animals that operate just fine without human command and control frameworks.”

LEFT: *A starling roost in the United Kingdom. credit: Unsplash/James Wainscoat*

At the Wind Engineering Lab, a team is working to harness a building's natural ventilation to allow it to stay cool or warm up at just the right times.

A Modeling Technique Could Help Buildings and Cities Breathe Easier

By Edmund Andrews for Stanford Engineering

For many people, the price of modern life is being sealed off from fresh air. Even in fairly blissful climates, we spend a good part of our lives in airtight buildings that are kept comfortable by recycling air through lumbering forced-air ventilation systems.

What's more, residential and commercial buildings account for 40 percent of U.S. energy consumption, and a significant share of that is tied to heating and cooling.

Catherine Gorlé, founder of the Wind Engineering Lab at Stanford Engineering, thinks buildings of the future could harness natural ventilation to stay cool or warm up at just the right times, saving energy and money while improving indoor air quality and comfort at the same time.

Over the past three years she has been working with a variety of collaborators to, quite literally, turn the modeling techniques of computational fluid dynamics inside out. Historically, engineers developed computational fluid dynamics to simulate airflows on the outside of airplane wings. Gorlé wants to use these techniques to simulate how to regulate the internal temperatures of buildings by pulling in cool air and pushing out hot air at night. By lowering the temperature of the entire building at night, the structure can serve as a heat sink during the day, avoiding uncomfortable increases in air temperature.

And while this inside-out shift may seem conceptually simple, most engineers are reluctant to trust the simulation models unless they've been validated in wind-tunnel experiments. Even then, Gorlé says, these validated predictive models are fraught with uncertainty.

"A wind tunnel is also a simplification of reality," she says. "Even if your model can predict what happens in the wind tunnel, it doesn't mean you've captured reality."

So it is with a caution born of experience that Gorlé and her colleagues are seeking to apply these modeling techniques to predicting how a building might "breathe" on a cool versus hot day — independent of wind conditions, what people are doing inside the building, or how its design and construction materials affect internal air flows.

As a result, most designers consider natural ventilation too risky and expensive. For one thing, natural ventilation usually requires open-air atriums that claim large amounts of usable space. But even when buildings feature big atriums, along with automated windows and vents to shuffle air in and out at the right moments, building owners generally prefer mechanical systems they can control with certainty.

To test their strategy for predicting natural ventilation indoors, the researchers ran detailed simulations on Stanford's Yang and Yamasaki Environment and Energy building, essentially turning it into their equivalent of a wind tunnel to validate their software models.

Y2E2, as the building is known on campus, was designed with what are currently considered state-of-the-art natural ventilation techniques. It features a four-story atrium fitted with computer-controlled windows on each floor, which open and close in response to the com-

Most designers consider natural ventilation too risky and expensive.
credit: iStock / paulwongkwan

bination of outdoor and indoor temperatures. This design enables the building to breathe by doing what are called "night flushes," pulling cool air in while pushing out hot air out after sunset.

The question Gorlé posed was whether their computational models could accurately predict the building's temperature changes over the course of the night. As a starting point, they modeled four separate nights with different indoor and outdoor conditions.

They actually ran two separate computer simulations of building temperatures. The first was a fairly simple program, which crunched data on a handful of major variables and took only about a second to run on a laptop. The second simulation, a complex simulation using computational fluid dynamics, modeled the intricate interaction between scores of factors, presumably making it far more accurate, but also more costly and difficult to run because it required several hours on very high powered hardware.

What Gorlé and her team found was that a smart combination of the two approaches could be both accurate and affordable. The simple version predicted temperatures with a confidence level of about 5 degrees Fahrenheit — good, but not good enough. The researchers then ran far more complex simulations with the second model, and used the results from that to update the simpler program with more refinements. That updated simple model, the researchers found, had a tighter confidence level of 3 degrees Fahrenheit. The predicted temperatures also compare well to temperature measurements in the building.

With a little more work, Gorlé believes it should be possible to create computerized models that are both affordable and accurate enough to design robust natural ventilation systems in the real world.

"This has important practical implications," Gorlé says. "People who build buildings want them to be comfortable and functional. That is a tall order given the variety of operating conditions a building might experience over its lifetime. By quantifying the effect of this variability during the design, we can be confident that the building will perform as intended."

In addition to their natural ventilation work, Wind Engineering Lab researchers are also trying to model the airflow for entire cities with the ultimate goal of affecting urban design in a way that would make metropolitan areas healthier, more comfortable, more resilient and energy-efficient. Along these lines, they are studying whether data from wind sensors could be used to improve their models. Another thrust of research delves into air conditions in the developing world, trying to model the health benefits of better ventilation of homes in the slums of Bangladesh, where children living in small single-room units with their families are highly susceptible to infectious diseases.

"All this is about trying to represent reality better," Gorlé says. "Weather conditions change. The way buildings are used changes. The sources of pollution change. We cannot predict these things exactly, but we can get a much better understanding of their impacts."

FACULTY SPOTLIGHT

Raymond Levitt

I never planned to become a professor. I left South Africa in 1972 after graduating with a BS in Civil Engineering and working in marine construction in Cape Town. I did not see any hope of a peaceful transition from the hateful apartheid system to something better at that time. So I came to Stanford for a MS degree with the intention of emigrating to the US or Canada afterwards.

After graduating from Stanford with a Master's degree in construction engineering and management, I went to work in Toronto just as President Nixon instigated a price control program to curb high inflation following the end of the Vietnam War. This program caused a shortage of steel in the US that spread all the way up into Southern Canada. As my project was running out of steel, I called Prof. Oglesby at Stanford to ask if he had ideas about where I might find another job in Canada if our project closed — and he invited me back to pursue a PhD instead. I had very much enjoyed my time as a MS student at Stanford, so I happily returned.

When I graduated with a PhD in 1975, a number of universities were launching graduate civil engineering programs in construction management and I received three job offers: MIT, University of British Columbia and University of Southern California. I chose MIT. The rest is history! I started my academic career as an assistant professor in the newly created construction management program at MIT and was promoted to Associate Professor, then had the good fortune to be selected for a position that had opened up at Stanford. I now look back on almost 39 wonderful years as a faculty member in CEE.

During my career, I have used sabbatical leaves to learn about new disciplines, tools and methods and to redirect my research. I spent one sabbatical leave with a start-up called IntelliCorp in Mountain View to learn about Artificial Intelligence. I then carried out research and teaching in this area. I used some of the ideas I learned about object-oriented programming methods through this sabbatical to develop an agent-based simulation model of information flow through project teams on fast-track projects, where design and construction tasks are radically overlapped, cuasing large, unanticipated amounts of additional coordination, supervision and rework. This was developed into a commercial software tool that has been used on multiple megaprojects and in teaching students worldwide about organization design.

In thinking about the work of which I'm most proud, I look back on my PhD research, funded by OSHA, on how managers of construction companies could enhance the safety of their workers, as well as a subsequent study I led, funded by the Business Roundtable, which focused on how construction clients could impact the safety of construction work carried out by contractors for them. I believe that the findings from this research — carried out by a team of Professors Clark Oglesby and Hank Parker, Psychologist Dr. Nancy Samuelson and students Jimmy Hinze, Michael Robinson and me — has contributed to avoiding thousands of injuries and hundreds of fatalities in the construction industry since the mid-1970s.

I have also greatly enjoyed developing and leading the Stanford Advanced Project Management executive program, with more than 10,000 graduates, and which brought about a terrific synthesis of ideas and methods for managing projects from such disparate fields as construction, aerospace, software development, medical devices, pharmaceuticals, finance, government — including the EU parliament—and nonprofits.

CEE has historically been based on natural sciences — first physics, then chemistry and, most recently, biology. I feel that a major impact of my career has been to introduce and legitimize the rigorous application of applied social and management science by CEE researchers and practitioners to optimize the design of work processes and organizations that develop CEE facilities. My PhD alumni and their students, along with scholars from Scandinavia, the UK and elsewhere, have launched the field of "Engineering Project Organization Studies" that now has its own journal and annual conferences.

Looking forward, I believe we are in the early stages of digitalization of the construction industry and of buildings, infrastructure and vehicles in new "Digital Cities" that integrate re-time data from multiple new sources to enhance and expand city services. Our Center for Integrated Facility Engineering was instrumental in developing the object-oriented data structures that powered digital building information models in lieu of paper drawings. This has provided powerful new capabilities for enhanced management of facilities throughout their lifecycle. My colleagues and I in the Global Projects Center have shown that the nature and sources of financing for CEE projects set the terms, and thereby limit the options, for their governance and organization, with significant impacts on their economic, environmental and social outcomes. The GPC is focused on developing alternative financing, organization and governance approaches for projects, harnessing information technology, to make the complex supply chains that make up our big construction projects and cities more sustainable.

Both basic and applied research needs to be done in integrating and analyzing data in cities to gain actionable insights while safeguarding the privacy of individuals and the security of our buildings, infrastructure and personal data. I see this as a huge opportunity for Stanford, with its world-leading strengths in both design and construction of sustainable buildings and next generation infrastructure, and computer science. Leveraging digitalization and AI analytics, with new project financing an delivery approaches to address the stresses on infrastructure and buildings caused by population growth, urbanization and climate change make this a very exciting time to be a civil engineer — especially, for those prepared for the challenges ahead.

STUDENT WORK

STANFORD WINS 1ST PLACE AT THE 2018 REGIONS 6 & 7 ASC STUDENT COMPETITION

Stanford University triumphs again by winning 1st Place in the Integrated Project Delivery category at the ASC competition in Sparks, Nevada this year! Faced with stiff competition, Stanford edged out teams from 10 other schools across the country. Clemson University placed 2nd place in their first time ever competing in the event and 3rd place went to the always-high-performing team from Berkeley. Thanks to the top-notched training from Faculty and Industry coaches Darryl Goodson and Disney Construction's Peter Worhunsky (along with a colorful cast of recent alumni of former Stanford ASC teams that were willing to lend a hand), as well as the support from Faculty Sponsor, Brian Sedar.

Stanford's teams 1 and 2 responded very well to the eclectically challenging prompt, and showed seamless team dynamics even under the stress of the antagonistic interview.

And though our Team 2 officially brought home the well-deserved 1st place designation, it is definitely a collective victory for both teams. Their time spent eagerly training side by side in the month leading up to the competition served to challenge both teams and improve their performance and commitment immensely. The smiles on display in the photo above, taken moments after the award was announced, are evidence of this collective effort and shared joy.

The ASCE team:

BACK ROW (*Left to right*):
Brian Sedar, Wilfrido Martinez, Eithan Sonnino, Someshwar Gowda, Nicholas Burton, Pranjal Patil, Jue Wang, Pepe Alcalde, Darryl Goodson

FRONT ROW (*Left to right*):
Sushant Gupta, Isabella Douglas, Rebecca Green, Basma Altaf, Raman Voorhis, Maria Vilatela, Eduardo Hanon

STUDENT WORK

Mentoring High School Students in Construction Management

A group of students enrolled in shop class at an East San Jose high school participated in a year-long pilot program where they earned community college credit. Working with Stanford Civil Engineering graduate students and professionals, they learned how to apply virtual design tools to construction projects. On May 18th, 2018 they presented their final project, a sidewalk replacement, to a group of mentors from industry, academia and community groups.

This program is creating a pathway of stackable credentials that will enable these students to move from blue collar construction work into high-tech construction management. The long-term goal of this program is to equip students to be admitted to Stanford to earn a M.S. in Sustainable Design and Construction.

LEFT TO RIGHT:
East Side Union High students Royce Wong, Samuel Canales Jr., Andrew Nguyen, and Jack Allen Laser, with their Construction Technology teacher, Jonathan Montoya.

Seismic Design Competition 2018

The Seismic Design Team represented Stanford CEE at the 15th Annual Undergraduate Seismic Design Competition held in Los Angeles from June 25-29 as part of the 11th National Conference on Earthquake Engineering. The main focus of the SDC is the shake-testing of balsa wood model towers and the measurement of their seismic performance; the competition also incorporates tower efficiency, architectural appeal, performance predictions, and presentation quality in the ranking of teams.

Preparing for competition is a year-long process. The Stanford team, which consists of about 10 undergraduates drawing from the civil engineering, architecture, and mechanical engineering departments, began developing designs in the fall, aided by the new graduate student-led course CEE83. Two designs were chosen and built as prototype towers throughout the winter. Both designs incorporated research on topology or shape and size optimization in order to allocate material efficiently. After testing these prototypes on the shake table in the Blume Center lab, a final tower was selected and built for the competition. To develop performance predictions for the tower's performance in competition, the team relied on both empirical testing (tensile tests to determine material properties and a pullback test of the tower to determine fundamental period and damping ratio) as well as structural analysis software (ETABS).

The final tower, named Solare in homage to the sunny Los Angeles weather, performed well at competition, surviving the shake testing with no damage. The team also placed in the top 10 for the design proposal, presentation, poster, and architecture categories, resulting in an overall ranking of fourth place among 40 teams.

FACULTY SPOTLIGHT

Although there are hypotheses about buildings' effects on occupant well-being, few of these have been tested at scale over time.

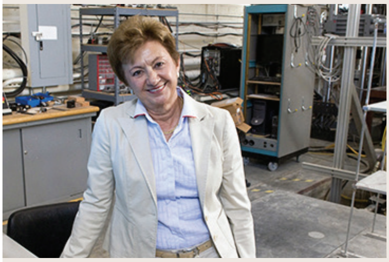
Sarah Billington

"I clearly remember the distinct moment I decided to pursue a new area of research. I had just finished meeting with a group of colleagues. The meeting itself was great and the company was engaging. However, the space was oppressive, stuffy and cramped. Cinder block walls closed in on us and the artificial light induced a dreary feeling. As I walked outside and back onto the sunny Stanford campus, I felt keenly aware of the difference in my sense of physical and mental wellness.

Together with partners in civil engineering, computer science and psychology, I'm now working to examine the impact of buildings and materials on human well-being. There is a fair amount known about how physical health is impacted by toxic materials in a building, but less around how mental health and overall well-being—things like a sense of belonging, stress, creativity, mood and physical activity—are impacted by buildings. Although there are hypotheses about buildings' effects on occupant well-being, few of these have been tested at scale over time. Today, building occupants, operators, designers and builders work in silos. We don't have the science to clearly identify building priorities around well-being that would bring these groups together early on in a building project. Given that it's 2018, it's time to start getting this right! Our goal is to fill in the gaps of understanding what works in the long term by taking an integrative, scientific approach to answering the question of how our buildings support well-being.

One of my favorite aspects of our research is what we're doing to look at how spaces can contribute to a sense of belonging. More and more organizations are trying to foster a sense of belonging through inclusion and supportive cultures, but we can't remove physical space from the equation. It's exciting to think about how our work could potentially alleviate any lack of belonging, allowing people to really thrive and grow in the spaces where we spend so much of our time."

FACULTY SPOTLIGHT



Anne Kiremidjian

Professor Kiremidjian was awarded the John Fritz Medal by the American Association of Engineering Societies in 2018

Receiving the Fritz Medal has been the high point of my career and I am truly honored to be recognized by my peers. That career has been quite an adventure so far!

My studies began at Queens College, which gave be a broad background in humanities and sciences but also an in-depth understanding in my major of physics. The subsequent two years at Columbia University were my first exposure to civil engineering and research in general. I was initially skeptical about coming to Stanford as I was offered the very prestigious Freudenthal Fellowship at Columbia to continue my studies there. However, the opportunities at Stanford quickly showed I could grow with a promising program in earthquake engineering that had just started by Professor Haresh Shah. Perhaps it is worth noting that I was the first woman to receive a PhD in Structural Engineering at Stanford. After completing my doctoral degree, I had the honor and the privilege to work for Dr. John A. Blume, who is considered as one of the godfathers of earthquake engineering. My next opportunity came in 1978 when I joined the faculty in the Civil Engineering Department at Stanford within the Structural Engineering group. I should probably mention that I was also the first woman to become tenured in the Stanford School of Engineering and only the second female faculty member of the school.

Over the years I have taught classes at all levels and have worked with many bright and wonderful students. The two main areas of my research have been in earthquake hazard and risk modeling utilizing probabilistic methods and the development of wireless structural monitoring systems with advanced damage diagnostic algorithms. More broadly, I have remained interested in regional earthquake hazard and risk modeling. Currently, the critical question is how to quantify the resilience of an urban area. It is not sufficient to estimate the risk which had been the focus of much of my previous research. We need to understand our exposure to extreme events and provide guidance on how to rebuild and how quickly to rebuild a region that has been affected. Understanding the factors that influence resilience is the first key step in this process. Modeling the interaction of the various components of resilience is the next step. We are working toward developing quantitative metrics for resilience and investigating approaches that enable urban regions to increase their ability to respond to such events, thus increasing their resilience.

Yet, there are many fundamental questions that we still cannot answer. I have seen the field of earthquake engineering grow at an exponential rate, but we still have much work to do. We are seeing the creation of databases that we have been lacking previously. For example, ground motion recordings are now in the thousands while they use to be in the tens when I first started my work in the field. Similarly, we are able to generate physical infrastructure databases using advanced technological tools that we did not have available to us previously. At the same time our physical models are becoming more and more sophisticated providing a deeper understanding of the behavior of structures and infrastructure systems. The success and expansion of these models is also due to the vastly increased computational capabilities. The availability of richer databases is informing our models reducing some of the large uncertainties that were present with previous models. In another dimension, there is a greater recognition of the importance of the social, economic, financial and political components of risk and resilience. Thus, I see a great emphasis on the interaction of all of these components.

I encourage my students to try to identify a unique but practical way to solve a problem. A complex solution that is not practical is likely to sit on a shelf. Don't be afraid to try things that may look radical. Try them before you dismiss them. In a way, my advice is similar for future engineers: be open to adopting new technologies. Do not dismiss them before you have actually understood what they are and what are their benefits. Try to see how you can best utilize a new technology in your work and you may find that it greatly enhances your ability to solve unusual problems.

The John Fritz Medal in many ways confirms for me that the many sleepless nights working on papers, projects, proposals, class notes or administrative duties were well worth it. I have been fortunate to work on many exciting and innovative projects over the years and have had wonderful, bright and intelligent students. This medal is as much for them as it is for me.

FACULTY SPOTLIGHT

Jack Baker

Professor Baker leads the recently-launched Stanford Urban Resilience Initiative (SURI)

My education is in mathematics, statistics and engineering, and most of my research has been in supporting decision-making with regard to natural disasters. The field has historically focused on designing buildings and infrastructure that keep people safe but in the past few decades, financial impacts became more important: setting catastrophe insurance pricing, and limiting building repair costs. Currently, there is great interest in helping communities bounce back from disasters more quickly — that is the idea of resilience. This aspiration requires designing a safe built environment, building social and institutional capital that can be deployed for recovery, and developing policies that encourage greater resilience. This breadth of issues means that no one scholar can solve this problem. Fortunately, there is great interest in the topic and many students, faculty, and external partners who want to be involved. Launching a disaster resilience initiative at Stanford was really a grass-roots idea from students and others in CEE, and I agreed to help lead the effort.

Ultimately, I hope that our work will help communities reduce the impact of future disasters. Many groups will have a hand in making that happen. Technical groups that set design standards want guidance in calibrating these standards. City and county governments want help with assessing their risks and developing policies to address their vulnerabilities. And individual citizens can benefit from better understanding the challenges they may face, and how they can prepare to manage in future disasters.

One interesting area we are focusing on is how to use nontraditional data sources to assess resilience. The deluge of data about the built environment — via satellite imagery, traffic monitoring, Internet-of-Things sensors, or even social media posts after disasters — all offer insights about the state of our built environment and how people utilize it before and after disasters. There is still untapped potential to use these data to assess and build resilience. Because disasters are — fortunately — somewhat rare, this will never be a purely Big Data field of inquiry. But in five or ten years I believe that engineers in this field will be much more adept at utilizing data sources which are not in the mainstream today.

For students interested in this field, I'd encourage gaining technical depth in a specific area, even if you are passionate about big problems. Disaster resilience, for example, is a tremendously complex problem that requires understanding of natural phenomena, physical impacts to the built environment, and economic and social dynamics of the impacts and recovery. But students who want a career in a complex field like this should know that they will be part of a team, rather than a single person who needs to know everything. In my career, my biggest opportunities have come when I could bring a specific and unique skill to bear on a larger problem.

FACULTY AWARDS

Associate Professor **Jack Baker** received the 2018 Walter Huber Civil Engineering Research Prize. This national award from the American Society of Civil Engineers recognizes early-career faculty for significant research accomplishments in civil engineering. Baker was recognized "for research to characterize the damaging effects of earthquake ground motion spectral shape, duration, near fault directivity and other features for seismic hazard analysis and performance-based engineering of buildings, bridges and geographically distributed infrastructure."

Professor **Ronald Borja** was awarded the 2016 Maurice A. Biot Medal by the ASCE for his outstanding research contributions to the mechanics of porous materials. Prof. Borja's medal citation notes "his significant contributions to the development of a theoretical and computational framework for saturated and unsaturated porous media, and for bringing to light the role of finite deformation and heterogeneity on the localization of deformation of porous materials."

Professor **Sarah Billington** was reappointed the Milligan Family University Fellow in Undergraduate Education. The Bass University Fellows in Undergraduate Education Program recognizes faculty, including faculty from the graduate and professional schools, for their exceptional contributions to undergraduate education.

Professor **Greg Deierlein** was honored with the 2018 Hardesty Award by the American Society of Civil Engineers. The ASCE Shortridge Hardesty Award recognizes an individual "who has contributed substantially in applying fundamental results of research to the solution of practical engineering problems in the field of structural stability."

Professor **Martin Fischer** has been elected as a 2018 member of the National Academy of Construction. This "is a high professional honor for engineering and constructors, conferred with care on those few, most qualified." The National Academy of Construction is an organization of industry leaders — construction users, engineers, designers, constructors, consultants, attorneys, sureties, editors, researchers and academics — who have made outstanding contributions over a career to the design, construction and engineering industries.

Assistant Professor **Catherine Gorlé** received a 2018 National Science Foundation (NSF) CAREER Award. The award recognizes early career faculty who show equal dedication to research and education within their departments and institutions. Gorlé leads Stanford's Wind Engineering Lab, where she and her team research and assess complex environmental issues in urban environments. She was recognized for her proposal, *Quantifying Wind Hazards on Buildings in Urban Environments*, which centers on the use of computational fluid dynamics to design resilient buildings and cities. Gorlé's research seeks to quantify the uncertainties facing designers and policymakers in their efforts to grow sustainable cities by developing predictive frameworks that model or solve wind flow and transport problems. She and her team work to apply these findings to breathable cities, improved ventilation systems and energy optimization around the world.

Professor **Mark Jacobson** received the 2018 Judi Friedman Lifetime Achievement Award from People's Action for Clean Energy (PACE) "for a distinguished career dedicated to finding solutions to large-scale air pollution and climate problems. Professor Jacobson has carried out original and important research on the feasibility of wind, water and solar energy to meet the needs of buildings, cities, states and countries around the world. In so doing, he has given scientific rigor to a public discussion that is central to the survival of humanity."

Professor **Anne Kiremidjian** was selected to receive the 2018 John Fritz Medal. The award, presented by the American Association of Engineering Societies (AAES), recognizes one individual each year for their scientific or industrial achievements in the pure or applied sciences. Kiremidjian received the award for her research in the field of probabilistic seismic risk assessment and for her leadership in the classroom, educating the next generation of earthquake engineers. Established in 1902, the John Fritz Medal is among the highest honors awarded an engineer. Kiremidjian joins a highly respected cadre of recipients, including Alexander Graham Bell and David Packard.

Amy Larimer, Assistant Director of the Architectural Design program and one of its long-time lecturers, received a 2018 Lloyd W. Dinkelspiel Award recognizing distinctive contributions to undergraduate education. Larimer was honored "for being an outstanding teacher, listener, mentor and supporter" and "for navigating the complexities of teaching architecture and ensuring an invaluable and meaningful experience for each student." She was commended "for her deep commitment to expanding students' intellectual and interpersonal capacities" and "for being a kind, generous and open individual who does everything she can to help students."

Associate Professor **Christian Linder** received the National Science Foundation (NSF) CAREER Award from the Mechanics of Materials and Structures Program for his research on *Stretchability by Design - Understanding Mechanical Phenomena in Microarchitectured Soft Material Systems* in 2016. This Faculty Early Career Development (CAREER) program will investigate mechanical phenomena in microarchitectured soft materials such as conjugated polymers to achieve stretchability by design and thereby stable device performance under large stresses.

Professor **Eduardo Miranda** was honored with the 2018 President's Award from the Tall Buildings Structural Design Council. He was recognized "for commitment to excellence and long-lasting significant contributions to the advancement of performance-based earthquake engineering of building structures."

STUDENT AWARDS

Evelyn Li (Civil Engineering major), **Erica Slavin** (Architectural Design major) and **Brandon Whiteley** (Civil Engineering '18) received Terman Awards. The Terman Award is one of Stanford's most selective academic awards in Engineering. It is presented to the top five percent of each year's School of Engineering seniors. Dr. Terman, for whom the award is named, was a distinguished Dean of Stanford's School of Engineering, Provost of the University, and a Professor and Chairman of the Department of Electrical Engineering.

STUDENT AWARDS / CONTINUED

PhD student **Hesam Hamledari** won the 2017 buildingSMART Student Project Award for his project on “IFC-Enabled Site-to-BIM Automation: An Interoperable Approach toward the Integration of Unmanned Aerial Vehicle (UAV)-Captured Reality into BIMs.” BuildingSMART is the global organization for open information exchange in the construction industry and created this award program to recognize exemplary projects using buildingSMART solutions.

Joshua Lappen (BS ’18), who studied classics and atmosphere/energy engineering in the Civil & Environmental Engineering department, was one of two Stanford students heading to the University of Oxford as 2018 Marshall Scholars during Fall 2018. They are among the 43 students from across the United States chosen to receive Marshall Scholarships, which provide recipients the opportunity for graduate study in any field for up to three years at a university of their choice in the United Kingdom.

The scholarship was established to strengthen the enduring relationship between the British and American peoples, their governments and their institutions, and to enhance the intellectual and personal growth of scholars. The scholarship is named for former U.S. Secretary of State and Army Gen. George Marshall, who formulated the Marshall Plan to aid economic development in Western Europe after World War II.

STUDENT SPOTLIGHT

ANJA MALAWI BRANDON, PHD CANDIDATE, CIVIL AND ENVIRONMENTAL ENGINEERING

I’m a third-year PhD student in civil and environmental engineering. I study plastic degradation in the lab of Professor Craig Criddle. Plastic pollution and marine debris are topics I’ve been passionate about since I was in fifth grade. There is a perception that graduate school is supposed to be difficult, and that you have to get through it alone. That is just not the case. Whether you’re struggling with a fellowship, qualifying exams or the first draft of a paper, there are people who can help.

I have always been a writer, but I am new to technical writing in the world of science and engineering. I was first exposed to the Technical Communication Program (TCP) in the midst of the fellowship application process. Not only was the TCP program helpful in making my application stronger, it also helped keep me on schedule. TCP’s service goes beyond what you’d experience with a writing tutor. The tutoring is not just about grammar. The TCP tutors taught me the general rules for communication. While TCP does help edit your writing line by line, the tutors also help you understand what needs to be changed, and why, so you don’t make the same mistakes over and over again. I believe that the guidance I received through TCP helped me become a National Science Foundation Graduate Research Fellow.

There is an increasing need for scientists and engineers to disseminate their work in a way that’s more accessible to the public. If we want science to be valued by society as a whole, we have a responsibility to communicate our science effectively. As scientists and engineers, we like to use technical terms and jargon because we’re immersed in it through our work; it’s our language. But you can’t impact or engage someone in conversation if they don’t understand you.

ALUMNI SPOTLIGHTS

SUBHAN ALI, MS ’09, PHD ’15, CIVIL AND ENVIRONMENTAL ENGINEERING

I am an engineer. To me, engineering is about people. We all think it’s about an analytical model, but at the end of the day, if you aren’t able to make that person-to-person connection, you can’t design a solution that’s going to have an impact on people’s lives. You have to have the ability to relate and put yourself in someone else’s shoes.

I came to Stanford to be a civil engineer. My dad was a civil engineer; it was very familiar to me. I got my PhD in Civil and Environmental Engineering but ended up going into data analytics. When I got to Stanford, I found myself in this place where all kinds of new and exciting things were happening — there’s just something very different in the air here that you don’t find anywhere else. I really began to see the impact technology would have on the world. Once I started seeing that, I started looking at my skill set and trying to figure out where I wanted to go. A lot of my friends got their PhDs and diverted a little bit from the field they had been in. After I graduated I did a postdoctoral fellowship/boot camp for people who have PhDs and wanted to go into data science. After I finished this I began to look for jobs. Ultimately, it was through this and my associations with the Stanford Alumni Association’s Career Connect program that I found my current job doing business analytics for Symantec. Stanford taught me that it’s all about people and community, and I think my story and career trajectory so far is a testament to that.

Beyond my engineering work, I helped start the Stanford Muslim Alumni Association. We have about 300 to 400 active people in our group. We have a Reunion Homecoming event every year, and we will again this year. It’s another great way for me and others in this community to stay connected to The Farm.

ALUMNI SPOTLIGHTS / CONTINUED

SHOSHANA COHEN, BS ’85, INDUSTRIAL ENGINEERING

Shortly before his death, CEE Professor Boyd Paulson was asked by a group of us how he would like us to best recognize his work during his time at Stanford. Professor Boyd was very active in involving students in his classes in working on Habitat for Humanity projects in which they could both perform service learning activities and contribute to underserved communities. So he told us that he would like to be remembered by having someone designated to support service learning in the CEE Department and the School of Engineering more broadly. Thanks to the generosity of a number of alumni donors, a fund was created and supplemented by Dean Persis Drell of the School of Engineering. Shoshana Cohen, a Stanford Engineering alumna, was appointed the first Director of Community Engaged Learning for the School of Engineering. She has significantly increased involvement by our faculty and students in service learning activities that both teach our students valuable technical and interpersonal skills and contribute to our broader community. She started her career working in manufacturing and spent more than 20 years in the field of global operations before moving to academia. Shoshanah was formerly a senior partner with PRTM Management Consultants, where she led PRTM’s global Supply Chain Innovation practice. She has written two books and numerous articles focused on supply chain strategy. Most recently, she served as the Director of the Stanford Global Supply Chain Management Forum, an industry-academic partnership housed at the Graduate School of Business. She currently serves as Lecturer in the Management Science and Engineering department, where she teaches project-based experiential learning courses. She is actively engaged in local community organizations focused on public education and services for underserved students. She is a passionate advocate for girls in STEM and coaches an all-girl high school robotics team.

NIKIYA CRISOSTOMO, BS ’12, MS ’14, CIVIL AND ENVIRONMENTAL ENGINEERING

I was born in the Philippines and lived there until I was 10 years old. One of my most prominent memories is driving to school with my dad and sisters. The traffic was always bad, and as I sat in the car for hours, I remember looking out the window at the ‘squatter areas,’ where the poor and homeless lived. I remember thinking that improving their quality of life would be as easy as giving them decent housing, and that I would do that for them when I grow up. When my family moved to the U.S., I experienced culture shock in seeing the discrepancy between life in an underdeveloped country and life in one of the richest countries. I was deeply grateful to come here, but it always bothered me that there are people back home who will never have the opportunity to get out of their dire situations. From then, I told myself, ‘I’m going to use whatever opportunities I can get in the U.S. to figure out a way to help Filipinos back home.’ And that’s what I’m still striving to do to this day.

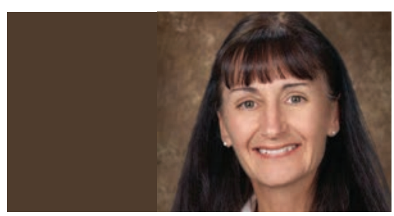
Right now, I’m working in construction/project management at San Francisco International Airport. My current project is doing work throughout the International Terminal to revitalize the space for improved passenger experience that could lead to revenue enhancement. I’m still trying to learn as much as I can about the building industry, and mainly focusing on the management and user-centered processes, so I can eventually translate that knowledge and experience once I start focusing on housing for the poor in the Philippines. My current company is big on strong engineering through strong personal relationships, and I’ve seen firsthand how excellent collaboration pushes projects to succeed. Because of this, even though my work is in engineering, social interactions and interpersonal relationships end up defining the strength of our projects.

These days, the term ‘triple bottom line’ is thrown around a lot in construction. But while the triple bottom line is supposed to equally value people, planet, and profit in order to carry out a successful sustainable project, I have found that, in the real world, profit is always at the top. In our world, money is the driver of everything. I want to change that. I want to challenge the building industry to flip the triangle of the triple bottom line and have people and planet be at the top, above profit. I think that if we could do this, we could create systems that provide poor communities with a way of life worthy of human dignity, and help address the long urgent need to bridge the extreme gap that currently exists in the world’s social order.

MARIA DOERR, BS ’17, ENVIRONMENTAL SYSTEMS ENGINEERING

I served as a Water & Cities Fellow with Conservation International in Mexico City, collaborating with the Mexican government, NGOs, private corporations, indigenous communities and urban stakeholders on local watershed issues. Following the yearlong fellowship, I joined the Redstone Strategy Group.

LAURIE LAPAT-POLASKO, MS ’80, ENGINEER ’83, CIVIL AND ENVIRONMENTAL ENGINEERING



I as one of 28 honorees selected as Outstanding Women in Business for 2018 by the Phoenix Business Journal. Dr. LaPat-Polasko is Vice President and National Director of Remediation for Matrix New World Engineering. Laurie said “I learned so much about how to perform research, work as a team and leadership” during her graduate studies in CEE. She is being recognized for her “community leadership, professional accomplishments and personal achievements”.

STAY CONNECTED

Please visit our website at ***cee.stanford.edu*** for updated information about the department, including faculty, students, research programs, and teaching initiatives.

We welcome your suggestions regarding the department's directions and activities and encourage you to visit us on campus to learn more about our facilities and programs firsthand.

We hope that you will remain an active member of the department's alumni community by keeping us apprised of your activities and whereabouts. You can log on to the School of Engineering Alumni Update page to update your contact information or send a note to ***cee-departmentchair@stanford.edu***.

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