USC Viterbi
School of Engineering
Sonny Astani Department of Civil and Environmental Engineering

FALL 2019

NEWSLETTER

Exploring Life-Enhancing Built Environments

In "The Jetsons," the future was depicted as a world full of self-driving cars and sassy, meticulous robots. People could move through space, and the shower, without having to lift a finger. Even in recent years, this future seemed unrealistic. However, recent advances in artificial intelligence have opened doors for opportunities to integrate human behavior and preferences with automation to develop personalized, dynamic work and home environments.

Recently, USC Viterbi School of Engineering's Burcin Becerik-Gerber, Stephen Schrank Early Career Chair in Civil and Environmental Engineering, and Gale Lucas, research assistant professor of computer science, launched the Center for Intelligent Environments (CENTIENTS), which will examine bidirectional interactions between humans and buildings and pave the way for smarter, more comfortable and personalized environments. The center aims to foster collaborative research focused on human-centered design and artificial intelligence integration. Its interdisciplinary team spans fields including engineering, computer and data science, social science, design and more.

"We are envisioning an unprecedented built environment, one that knows its users, their needs, desires and goals," says Becerik-Gerber. "CENTIENTS supports groundbreaking research and brings together scholars, innovators and leaders to tackle some of the most challenging questions brought about by the fast pace of technology implementation, including security and privacy challenges, how intelligent environments should support the future of work and how to build trust in automation."

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– Burcin Becerik-Gerber

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Big Impacts

Improving Energy and Water Efficiency Policies

Integrating critical resource management can reduce disruption of energy and water supplies, while simultaneously increasing the resilience of other industries that also depend on abundant energy and water resources. That's the focus of research by Kelly Sanders, assistant professor of civil and environmental engineering.

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Remarkable Research

Developing Self-Healing Structures

Hoping to develop structures that may autonomously self-repair fractures and damages, Kunhao Yu, a second-year civil engineering doctoral student, is working with Qiming Wang, to understand and design new engineering materials for resilient structures.

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Highly Accomplished

Celebrating Accomplishments of Standout Students

The Sonny Astani Department of Civil and Environmental Engineering celebrated the accomplishments and presented awards to seven standout students this past spring.

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Exploring Life-Enhancing Built Environments

CENTIENTS' directors believe future environments should be designed to support peoples' goals and preferences from the start. They think intelligent environments could increase well-being, safety and even joy at work, home and beyond.

"The world is evolving from the binary extremes of 'fully manual' and 'fully automated,'" says Lucas. "CENTIENTS helps us to take a step forward to better understand how versions of automation that seek or incorporate human feedback can pave the way for a better life when we are in buildings, which is most of the time."

Evolution of a New Field

"New fields are born out of people leaving silos and learning to speak another language outside of the jargon of their own expertise," explains Ramesh Balasubramaniam, a professor of cognitive and information sciences at the University of California, Merced, who co-organized a two-day National Science Foundation workshop at USC on human-building interaction.

"There are a lot of things that have been learned about human cognition that are useful to builders and designers," he says. "An initiative like CENTIENTS adds visibility to the emerging, collaborative research in this area."

The intersectionality of disciplines that CENTIENTS hopes to advance and optimize is embodied in its current projects – all of which are funded by the National Science Foundation. These include a smart desk, which uses wearable and workstation-mounted sensors to infer human intent, physiological condition and current tasks; a virtual reality learning environment for robot-human teams working on construction projects; and a virtual reality simulation for active shooter incidents to help better design secure buildings.

"Our goal is to reimagine our future and design for it," Becerik-Gerber says. "I do not see any reason why buildings cannot be our best allies, helping us to learn, stay safe, be healthy and be productive. Ultimately, they could free us from repetitive tasks and improve our daily lives."

Big Impacts

Improving Energy & Water Efficiency Policies

Energy and water are critical resources. Without safe and abundant access to both, public health and economic security are compromised. Energy and water are also interdependent. It takes a lot of energy to pump, treat, heat, cool and remediate contamination in water in order to meet societal needs, and it takes large quantities of water to produce primary fuels, generate electricity and process energy.

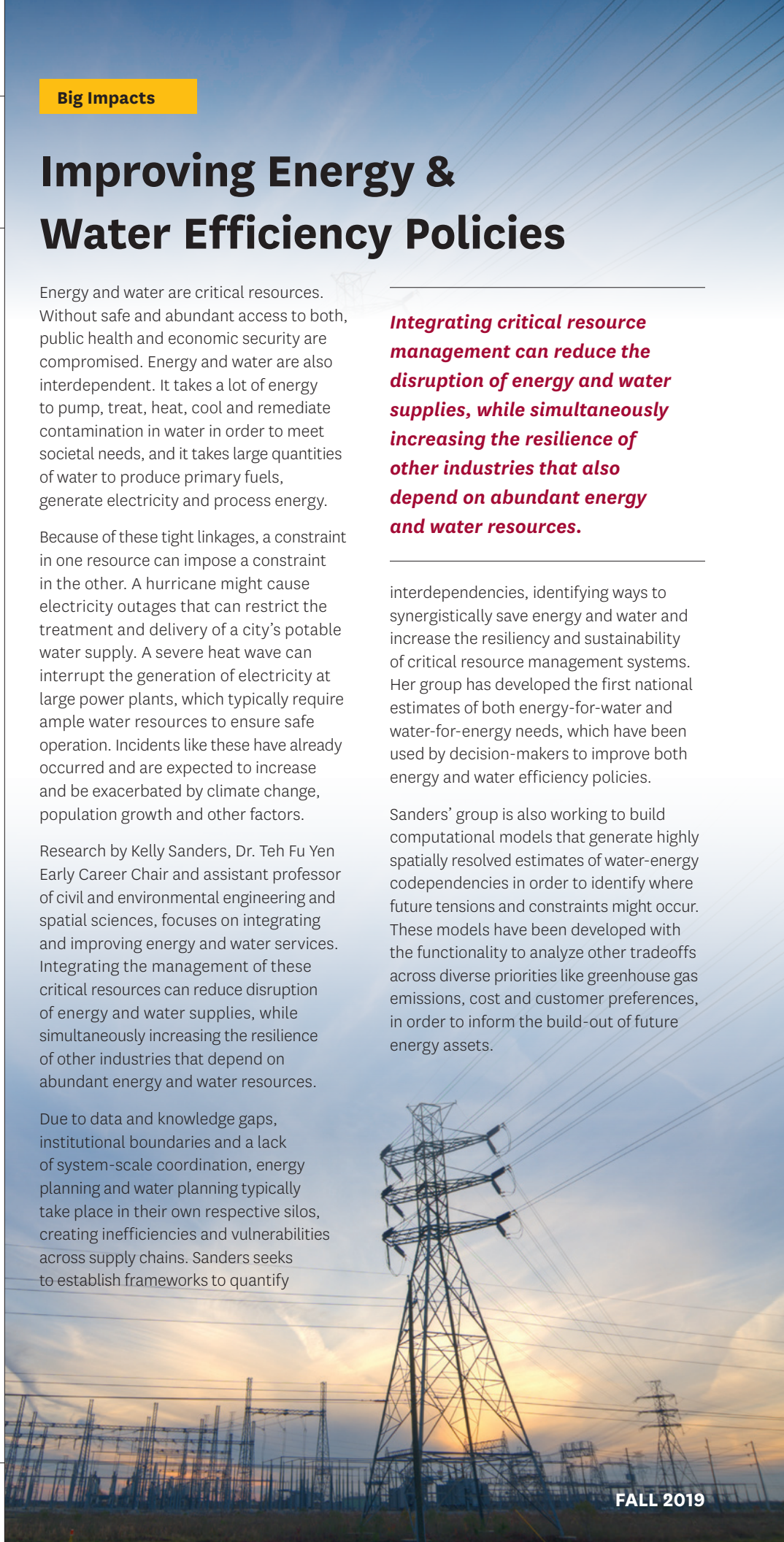
Because of these tight linkages, a constraint in one resource can impose a constraint in the other. A hurricane might cause electricity outages that can restrict the treatment and delivery of a city's potable water supply. A severe heat wave can interrupt the generation of electricity at large power plants, which typically require ample water resources to ensure safe operation. Incidents like these have already occurred and are expected to increase and be exacerbated by climate change, population growth and other factors.

Research by Kelly Sanders, Dr. Teh Fu Yen Early Career Chair and assistant professor of civil and environmental engineering and spatial sciences, focuses on integrating and improving energy and water services. Integrating the management of these critical resources can reduce disruption of energy and water supplies, while simultaneously increasing the resilience of other industries that depend on abundant energy and water resources.

Due to data and knowledge gaps, institutional boundaries and a lack of system-scale coordination, energy planning and water planning typically take place in their own respective silos, creating inefficiencies and vulnerabilities across supply chains. Sanders seeks to establish frameworks to quantify interdependencies, identifying ways to synergistically save energy and water and increase the resiliency and sustainability of critical resource management systems. Her group has developed the first national estimates of both energy-for-water and water-for-energy needs, which have been used by decision-makers to improve both energy and water efficiency policies.

Integrating critical resource management can reduce the disruption of energy and water supplies, while simultaneously increasing the resilience of other industries that also depend on abundant energy and water resources.

Sanders' group is also working to build computational models that generate highly spatially resolved estimates of water-energy codependencies in order to identify where future tensions and constraints might occur. These models have been developed with the functionality to analyze other tradeoffs across diverse priorities like greenhouse gas emissions, cost and customer preferences, in order to inform the build-out of future energy assets.



Remarkable Research

Developing Self-Healing Structures

Hoping to develop structures that may autonomously self-repair fractures and damages, Kunhao Yu, a second-year civil engineering doctoral student, is working with Qiming Wang, assistant professor of civil and environmental engineering, to understand and design new engineering materials for resilient structures.

The researchers are currently focused on additive manufacturing and the mechanics of self-healing structures. They hope to harness these new technology and design principles to help improve next-generation civil infrastructure, aircraft components, automobile panels and unconventional electronics.

They've had papers detailing their work published in prestigious journals, including *NPG Asia Materials*, *Advanced Materials* and the *Journal of the Mechanics and Physics of Solids*. Their research has also been featured in reports by *The Washington Post*, *NASA Tech Briefs*, *Materials Today* and *NSF News*.

Kunhao was born and raised in Taiwan. He received his master's degree from USC and his bachelor's degree from the National Central University in Taiwan. He has been awarded the Viterbi School Merit Research Award and the Taiwan-USC Fellowship, one of the most prestigious fellowships offered jointly by the University of Southern California and the Taiwan Ministry of Education.

Self-healing rubber could have a variety of applications, including shoes, toys and even tires.

– Kunhao Yu

FUNDRAISING UPDATE: David M. Wilson Early Career Chair

As of July 18, the total cash and pledges is at $990,876, close to the $1 million goal needed to fund the endowed chair. To contribute, contact Gregg E. Brandow, professor of civil and environmental engineering practice, at brandow@usc.edu.

SPOTLIGHT ON...

Our New Environmental Chemistry Laboratory is Now Open

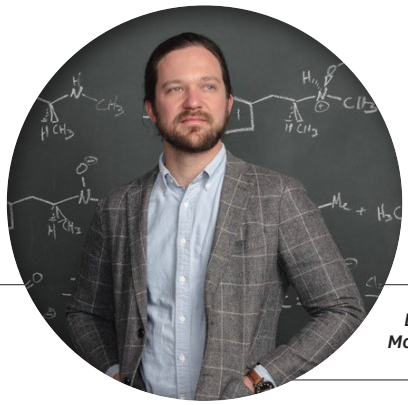
Equipped with a suite of advanced analytical equipment for identifying and quantifying regulated and unregulated chemicals in water, the Sonny Astani Department of Civil and Environmental Engineering's new Environmental Chemistry Laboratory is now open.

Located on the second floor of Biegler Hall, the lab is overseen by Daniel McCurry, assistant professor of civil and environmental engineering. It will serve as a complement to the Water and Environmental Technologies Lab, which hosts research groups led by McCurry and fellow faculty members Amy Childress, Felipe de Barros, Adam Smith and Qiming Wang.

The Environmental Chemistry Laboratory supports ongoing research in Biegler Hall, including McCurry's studies on improving wastewater recycling processes by minimizing the formation of byproducts of the disinfection process and developing new ways to treat water using catalysts, and Smith's research on characterizing the development of antibiotic resistance during wastewater treatment.

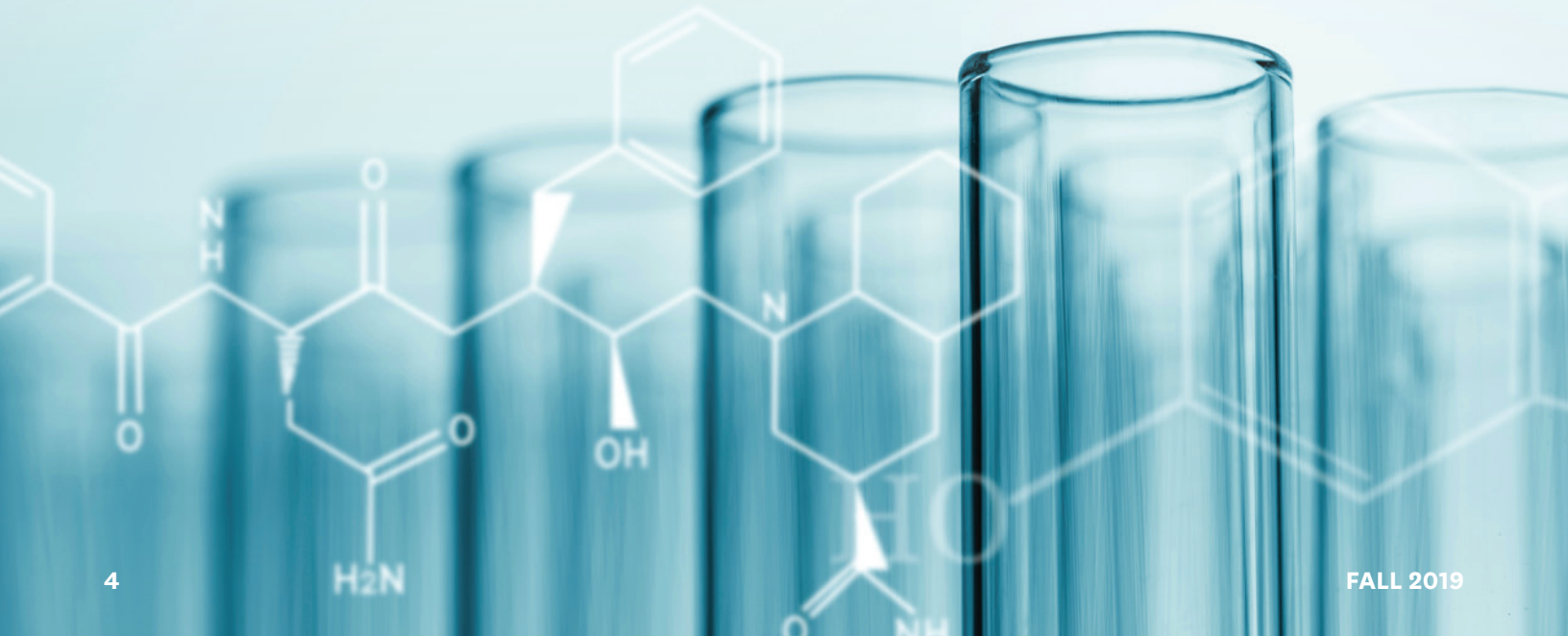
The lab's instrumentation includes a gas chromatograph/triple quadrupole mass spectrometer (GC/MS), inductively coupled plasma mass spectrometer (ICP-MS) and an ion mobility quadrupole time-of-flight mass spectrometer (IM-QTOF), all recently purchased from Agilent Technologies.

The GC/MS is capable of detecting the concentration of certain highly toxic chemicals such as N-nitrosodimethylamine (NDMA), a probable human carcinogen, down to levels of 0.5 parts per trillion. That is equivalent to approximately one drop in an Olympic-size swimming pool. The IM-QTOF is the first instrument of its kind in any academic environmental lab in the world. It allows for identification and quantification of trace organic pollutants, such as pharmaceuticals, in complicated samples like wastewater. The IM-QTOF purchase was made possible by a gift from Walter H. Singer (BS CE, '82).



Daniel McCurry

The Environmental Chemistry Laboratory is among the best academic environmental mass spectrometry labs in the nation and helps support USC's expanding environmental engineering programs and faculty. Its instrumentation has already been used to support projects by local engineering firms and water utilities, such as Carollo Engineers and Orange County Water District.



HIGHLY ACCOMPLISHED

Celebrating Accomplishments of Standout Students

Last year more than 20 members of the USC student chapter of the Construction Management Association of America received internships or full-time offers through CMAA.

At the Associated Schools of Construction Sparks Competition

- The Mixed-Use Team placed second.
- Andrew Chang won the Rudolph & Sletten Alternates competition.
- Julia Lind was named PCL's Most Valuable Player.

Koffman Receives CMAA Award

At the CMAA Southern California Annual Gala in May, our chapter's academic advisor Professor Henry Koffman was awarded the Academic Leadership Award. This award highlights academic figures shaping the next generation of construction managers.

American Society of Civil Engineers

The ASCE student chapter ended last semester with a great showing at the Pacific Southwest Conference. Many USC ASCE teams placed, most notably winning first in the Technical Paper competition.

HIGHLY ACCOMPLISHED

PhD Students Receive Recognition

The 2019 USC Viterbi School of Engineering Awards Ceremony took place Thursday, May 9, in Bovard Auditorium. During the ceremony:

- **Mohammad Sowlat** was acknowledged for receiving the Jenny Wang Excellence in Teaching Award.
- **Mahsa Moslehi** was the recipient of the Best Dissertation in the Civil Engineering Department. Working under Professor Felipe de Barros, Moslehi's research is on smart stochastic hydrogeological modeling.
- **Mo Chen** was the recipient of the Theodore and Wen-Hui Chen Fellowship.
- **Rebecca Peer** was recognized as Best Research Assistant in the Sonny Astani Department of Civil and Environmental Engineering.

Vice Provost Sally Pratt, Dr. Kelly Sanders and Rebecca Peer at the PhD Achievement Awards in May.

2019 Viterbi Master's Student Award Recipients

Students were recognized for excellence and service at the annual Viterbi Master's Awards in April.

- The Excellence in Service Award was presented to **Drew Poulter**
- The Excellence in Research Award was presented to **Kyungekeun Jo** and **Nathan Bissonette**

Welcome, David Juarez

David E. Juarez recently joined the Astani Department of CEE as the department business manager. He has been working at USC since 2005 in the transportation and hospitality departments and has exceptional experience in financial leadership. He received his bachelor of arts degree in business administration with a concentration in accounting from California State University, Fullerton and his MBA from the USC Marshall School of Business.

Congrats, Grads!

At USC Viterbi School of Engineering's 2019 Commencement in May, the Astani Department of CEE awarded

20	116	29
doctoral degrees	master's degrees	bachelor's degrees

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3620 S. Vermont Avenue, KAP 210
Los Angeles, California 90089-2531

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Visit our website, **cee.usc.edu**, for in-depth CEE Trojan family highlights.

We're eager to hear about the great things our alumni are doing. Please share your successes with the Trojan community by emailing your updates to **salinapa@usc.edu**.

CHAIR'S MESSAGE

Welcome Back, USC!

As we make our way through this school year together, I am grateful to resume my role as department chair, leading an outstanding, driven and talented group of faculty, staff and students.

The fields of civil and environmental engineering continue to flourish at USC and around the globe. Our program includes 165 undergraduates, 216 master's students and 68 doctoral students. Earlier this year, 165 students received their well-deserved degrees from the Astani Department of CEE, and many earned formal recognitions for their excellent work at annual award ceremonies.

Our faculty and staff continue to excel in their research with projects that revolutionize the way we think. Our outstanding faculty, many in the early stages of their career, have become some of the brightest stars in the civil and environmental fields nationwide. Just this spring, Felipe de Barros and Bora Gencturk were promoted to associate professor with tenure, and Burcin Becerik-Gerber was promoted to professor. Congratulations to all three!

One of our biggest successes last year was the introduction of a new class, "Innovation in Engineering Design for Global Challenges." Professors Burcin Becerik-Gerber and David Gerber and their students have been making real-world impacts, improving the standards of living in refugee camps. They've partnered with universities in Greece and visited refugee camps there with student-led projects to address problems that refugees face.

I hope you share my pride in what we are accomplishing as we continue to attract ambitious and accomplished faculty and students dedicated to making real changes in the world.

Lucio Soibelman, PhD
Chair of the Sonny Astani Department of Civil and Environmental Engineering