

# CIVIL AND ENVIRONMENTAL ENGINEERING



UNIVERSITY OF WISCONSIN-MADISON



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LEADING SOLUTIONS  
IN AIR, EARTH AND WATER

# CHAIR'S MESSAGE



## Greetings from Madison!

I am very pleased and honored to introduce myself as the 15<sup>th</sup> chair of the Department of Civil and Environmental Engineering. I have been a faculty member in our department since 2012 and have served as director of the

Geological Engineering Program for the past four years. My background is in geotechnical engineering, with an emphasis in geohazards and geoenvironmental engineering. You can learn a bit more about me in the box on the right, and I'm looking forward to getting to know more about all of you.

It is an exceptionally exciting time for our department. We have energetic faculty, state-of-the-art new facilities, engaged alumni and outstanding students who continue to make us proud. We are innovating and excelling in our educational mission, most notably in our award-winning senior capstone experience, which remains a model program nationwide.

Our research enterprise is as strong as ever and is having a direct and real impact on emerging challenges in mobility, water, construction, energy, infrastructure and the environment. Our long-awaited new structures lab is now a prominent jewel on the corner of Engineering Hall. The energy and enthusiasm of our many new faculty members is simply contagious.

My aim as chair is to continue to lead our department by growing our number of students and faculty, promoting excellence in our education, research and service missions, engaging our alumni, and fostering a safe, diverse and fun working environment. I'm very excited for our future.

On behalf of the department, I would like to thank David Noyce for his outstanding service and leadership as chair for the past four years. David has led our department through a remarkable period of growth and excellence. David has taken a new role as executive associate dean of the College of Engineering.

My door is always open, so stop by if you are in Madison or give me a call. I'd love to tell you about all the great things we are up to here.

## ON, WISCONSIN!



**William J. Likos**

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## Meet our new chair

- Joined UW-Madison's faculty in 2012 and has served as director the Geological Engineering Program
- Research background in geotechnical engineering
- Graduate of Colorado School of Mines (PhD '00) and Tulane University (BS '94, MS '96)
- Teaches undergraduate courses in soil mechanics and seepage and slopes, and graduate courses in clay behavior

## Noyce moves up to college post



From the early days of David Noyce's career in government and with private engineering firms, he's sought out leadership roles. That drive has not changed in his 25 years in academia and prompted him to take over as CEE department chair

in 2015. Now it's elevated him to a position near the top of the College of Engineering.

Noyce has taken over as executive associate dean, a post that's essentially the college's "vice dean." In his new role, Noyce will work with associate and assistant deans in all aspects of the college and lead short- and long-range initiatives. It's a position that influences all parts of the college's mission.

"The executive associate dean position touches a lot of different areas, and I will hopefully contribute to making positive impacts in each one of those," he says. "Everybody in leadership, if they're doing a good job, is making an impact."

As Noyce surveys his more than four years leading CEE, he sees tangible examples of that positive influence, such as growth in undergraduate enrollment and the number of tenure-track faculty, increased financial support from alumni, and improved research infrastructure.

"A lot of our young faculty and staff in CEE are having tremendous success, winning awards, getting major grants and growing in their careers," he says. "To know I had a little part in that is very rewarding."

Noyce used to visit campus as a kid growing up in nearby Sun Prairie and earned his bachelor's and master's degrees in civil engineering from the university. Now, he's thrilled to help shape the big-picture direction of his alma mater.

"This university and this college have always been much more than a job to me," he says. "To have the opportunity to help lead it, I have to pinch myself from time to time, just to realize this is actually happening. Truly a dream come true!"

# ANCHOR POINT:

## New structures lab will enhance structural testing prowess

The new Jun and Sandra Lee Wisconsin Structures and Materials Testing Laboratory—a 2,500-square-foot addition to the structures lab in Engineering Hall—will help the College of Engineering push forward with larger, more intense testing than has been possible in the existing laboratory. The lab will serve the structural engineering program, which is part of the CEE department.

Lab director and professor Gustavo Parra-Montesinos, the C.K. Wang Professor of Structural Engineering and director of the lab, says the program's goals for testing have outgrown the existing structures facility, which was smaller and lacked a reaction wall.

"In order for us to do experimental research on large-scale structural components or smaller-scale structural systems, we needed a new laboratory," he says. "That's why, several years ago, we started the fund-raising, and now it's built. This will allow us to conduct experimental research that we have not been able to do."

The new lab cost roughly \$3.2 million, Parra-Montesinos says, and came to fruition thanks to a \$1 million lead donation from Jun (BSCE '68, MSCE '69, PhDCE '73) and Sandy Lee (BA '69) and support from other CEE friends and alumni.

The facility includes an L-shaped concrete post-tensioned reaction wall that is 26 feet tall with buttresses that are 10 feet deep. It has a post-tensioned strong floor that is 6 1/2 feet thick. The wall and floor are lined with gridded high-strength anchor points, which are used to connect test specimens and fixtures such as hydraulic actuators for application of a wide variety of forces and displacements. The lab also has a 20-ton overhead crane and opens up to allow access to the outside and the existing laboratory.

"When you apply a force, everything is action-reaction," Parra-Montesinos says. "If I need to apply a lot of force or a lot of displacement to simulate the effect of an earthquake or wind load, I have to be able to apply a lot of lateral force. To apply that force, you need something to react against, which is why we have the strong wall and the strong floor."

Hannah Blum, an assistant professor who specializes in structural engineering, said the new lab's larger floor allows for full-size model testing, while its height will let engineers test multi-story structures.

"You can create and run models, but how do you know if the model results are correct if you don't have some initial test results to compare

them against?" Blum says. "To really understand what's happening in a structure and how all the elements interact together, you need to do a large-scale test."

The L-shaped reaction wall, Parra-Montesinos says, will allow the testing of large-scale frames and structural walls under a wide variety of loading scenarios, including simulated earthquake-type loading. The floor dimensions and capacity will also allow the testing to failure of specimens as long as 40 ft, such as precast prestressed concrete bridge girders.

"It's been very exciting to witness the entire process, from the design all the way to completion," he says. "Now we have the opportunity to expand our horizons in terms of large-scale experimentation to support the development of new structural systems or evaluation of existing ones."

**"Now we have the opportunity to expand our horizons in terms of large-scale experimentation to support the development of new structural systems."**

— Gustavo Parra-Montesinos



Hannah Blum



A canoe filled with wild rice—along with the knockers used to harvest it—after a ricing trip on the Lac du Flambeau Reservation. Photo courtesy of Sarah Dance.

## WILD RICE PROJECT SOWS SEEDS FOR COLLABORATION



The Ojibwe people tell of a prophecy that spurred their journey from the East Coast of the United States to the Great Lakes region more than 1,000 years ago, revelations that told them to travel west to a land where food grew on the water.

That food? Wild rice, or “manoomin” to the Native American nations that, like the Ojibwe, comprise the broader group of Anishinaabe tribes in the Upper Midwest and Canada.

But manoomin, which translates to “the good berry” in Ojibwe, is much more than just a crop to these tribes and others. It represents their connection to nature and holds profound spiritual significance as a gift from their creator.

“It permeates all aspects of their cultures,” says PhD student Sarah Dance, who’s working to protect and restore wild rice while building connections between the university and Native American tribes through a Baldwin Wisconsin Idea Grant project.

A 2011 study by researchers at UW-Madison’s Nelson Institute for Environmental Studies showed the number of watersheds with wild rice in Wisconsin and neighboring Minnesota had declined 32 percent since 1900. Southern Wisconsin, in particular, has become barren of the grain, which also provides food and habitat for wildlife.

Research from the University of Minnesota in Duluth and the Twin Cities has illustrated the harmful role of sulfide in the soil beneath wild rice waterways—a key consideration given the prospect of several potential mines in Wisconsin and Michigan’s Upper Peninsula and state legislation in 2017 that eased Wisconsin’s sulfide mining restrictions.

By testing water quality, studying sediment and conducting bucket experiments that will simulate a range of environmental conditions, Dance hopes to develop site-specific recommendations in partnership with her tribal collaborators from the Lac du Flambeau and Lac Courte Oreilles Tribes.

“We found that there are all of these diverse efforts out there to protect and restore manoomin across the region and they’re not well connected to one another,” says Dance, a member of the Lumbee Tribe of North Carolina. “Our hope is that the research we’re doing can push the needle forward on creating some best practices and sharing those.”

**MORE:** [go.wisc.edu/engrnews-071619](http://go.wisc.edu/engrnews-071619)

## TREADING WATER:

**Wright finds increasing storms pose infrastructure challenge**



As the climate warms, more and more communities across the United States are facing an increase in 100-year storm events.

And that’s a fact, according to Assistant Professor Daniel Wright. Wright published results of his latest study in July 2019 in the American Geophysical Union’s *Geophysical Research Letters*.

In part of the study, Wright focused on two categories of storm events: 10-year storms and 100-year storms.

Both categories have become more common in recent years. There was an average of 45 10-year storms and eight 100-year storms each year across the U.S. during the 1950s. Nowadays there are, on average, 62 10-year storms and 12 100-year storms per year.

In other words, more rain falls more frequently. The growing trend could pose serious challenges to the country’s hydrologic infrastructure. Wright’s study could help inform future decisions about how to shore up existing structures and plan for new, sturdier ones.

In many instances, Wright says, infrastructure has been designed to Weather Bureau storm standards laid out in 1961. However, while the National Oceanic and Atmospheric Administration has updated its standards over the last 15 years, in many locations, those newer metrics are already out of date.

“We wanted to quantify the extent to how these storms are changing, and that translates to how often infrastructure design standards are being exceeded,” Wright says. “If the rainfall is changing, a piece of infrastructure designed to meet those standards might not be performing to the rate that it needs to.”

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# BATTLING BLUE-GREEN BLOOMS

## Block earns NSF CAREER award for long-range cyanobacteria forecasts

Summers in Madison mean paddleboarding, kayaking, boating and, of course, lounging at the Memorial Union Terrace along Lake Mendota.

Lakes are an elemental part of life in the Madison area.

"If you see more than two pictures of Madison, I guarantee there will be a lake featured in at least one of them," says Associate Professor Paul Block.

Unfortunately, those summertime images also sometimes include unsightly blooms of toxic blue-green algae, the result of heavy rains carrying phosphorus from surrounding farm fields into the Yahara Watershed. Those smelly cyanobacteria formations can—and regularly do—force beach closures and deter all activities on the lakes.

Block hopes to enable agencies and stakeholders to plan further ahead for cyanobacteria blooms through a National

Science Foundation CAREER Award. He's using the five-year grant of more than \$450,000 to develop modeling tools to predict seasonal cyanobacteria levels, allowing natural resource and public health decision-makers to shape budgets and allocate resources before the start of each summer.

"If we expect the water quality conditions to be worse this summer, that means there's just going to have to be that much more water quality testing, maybe additional lifeguard training, definitely lifeguard awareness, maybe more signage," says Block, who solicited input from the Wisconsin Department of Natural Resources, Public Health Madison & Dane County, and



other entities while writing his grant application. "These are very practical, pragmatic things, but they take time, they take budget." Block will examine the number of intense rainstorms and streamflow levels, along with global climate conditions that can influence seasonal temperatures and precipitation. With the help of citizen scientists who are part of the Madison nonprofit Clean Lakes Alliance, he and his student researchers will also collect water samples to explore how that data might enhance predictive models.

**MORE:** [go.wisc.edu/engrnews-052419](http://go.wisc.edu/engrnews-052419)

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# PRESERVING A BASIC HUMAN RIGHT

## Ginder-Vogel lands NSF CAREER award to study arsenic in groundwater

Most people don't think about arsenic from day to day, but Associate Professor Matt Ginder-Vogel says it's more common than you'd think.

Ginder-Vogel has received a \$560,000 CAREER award from the National Science Foundation to ponder that very topic. This prestigious grant for young faculty members funds a five-year study in which he will research how arsenic becomes "mobile" and ends up in water sources that could pose threats to humans.

The study will consist of lab work, with the goal of learning how surface chemistry and the presence of manganese oxides impacts arsenic transformations, which in turn affects



how "mobile" it is and how easily it can move around in the environment.

"Arsenic is everywhere," Ginder-Vogel says. "You don't think of it, but it really is everywhere in the environment.

Having a little bit in the soil—that's not bad as long as you don't eat a lot of soil.

To humans, a lot of the threat is when it's in water."

Given that the World Health Organization views access to safe drinking water as a basic human right, this research could have global health implications. Ginder-Vogel says this is especially true in Asia, where scientists have been encouraging communities to drink groundwater, rather than surface water, in an effort to avoid surface contamination.

In countries in Southeast Asia, Ginder-Vogel says groundwater arsenic levels have been found to be much higher than in areas along the Mississippi River delta, despite similar surface concentrations.

Arsenic can get into the ground in a number of ways—it can often be found near sulfide mineral mines—and can linger for decades once it's there.

"I think you know about it if it's an issue in your area," he says. "But it's not necessarily something you think of when you're drilling your well. I believe it should be."

Ginder-Vogel is also the principal investigator on a UW2020 grant from the Wisconsin Alumni Research Foundation for establishing the Core Facility for Advanced Water Analysis on campus.

**MORE:** [go.wisc.edu/engrnews-080919](http://go.wisc.edu/engrnews-080919)

## FOCUS ON NEW FACULTY

# ZHU COMBINES COMPUTING WITH CONSTRUCTION



An excavator plunges its bucket into a hole, scooping dirt and piling it nearby. A short while later, a bulldozer pushes the dirt away.

Neither has a human in its driver's seat. Instead, the operators are sitting in an office miles away, working alongside project managers and other team members. The group monitors video feeds and data pouring in from on-site sensors, making sure the job proceeds smoothly and safely.

Zhenhua Zhu hopes his research will help make that kind of automation possible in the construction industry in the future—"smart construction," if you will.

Zhu, an assistant professor and Mortenson Fellow who joined CEE in spring 2019, uses video and other visual sensor technology to assess productivity, monitor project progress, detect damage and improve safety in the construction field.

"If there is more automation in the construction field, it could help us to increase productivity, reduce the waste, improve safety and have more skilled workers," says Zhu, who spent the previous eight years at Concordia University in Montreal. "All these problems need to be solved, and if they can be solved with new technology, I believe it will bring a lot of benefits."

By using computing technology to analyze videos from the field, Zhu can mine information on equipment usage, worker behavior, structural integrity and more. Construction firms could use data measuring productivity to create benchmarks for future projects and to improve cost estimates.

Zhu can also use video feeds to create real-time safety warnings or ensure workers are wearing protective gear such as helmets.

Zhu cites CEE's strong relationships with industry partners as a major draw in coming to UW-Madison.

"I think there will be a lot of opportunities to work with the companies in the field," he says.

**MORE:** [go.wisc.edu/engrnews-042319](https://go.wisc.edu/engrnews-042319)

## FOCUS ON NEW FACULTY

# HAMPTON DIGGING DEEP TO HARNESS EARTH'S ENERGY



Before coming to UW-Madison, Jesse Hampton worked in geomechanics research, particularly in the oil and gas industry. Though he has been away from academia for seven years, he always knew he'd come back.

Hampton joined the university in June 2019 as an assistant professor and will work in CEE's geological engineering program.

Hampton says he's particularly excited to research enhanced geothermal systems and the geomechanics associated with rock characterization and behavior in deep environments. He's also interested in damage and microcracking, particularly the evolution of damage at multiple scales and its influence on apparent physical properties.

That work, along with underground structure research, also could have uses and implications beyond Earth.

"In order to have manned missions and structures on the moon and Mars, you need to understand the stability and physical properties of the soil and rocks that you're interacting and building with," he says.

Hampton went to Old Dominion University (BS '10) and the Colorado School of Mines (MS '12, PhD '15).

He researched enhanced geothermal systems as a graduate student, which introduced him to experimental geophysics, a field where his research carries on through today. After finishing school, Hampton worked at Halliburton's Technology Center in the Applied Sciences and New England Research.

As a faculty member, he's translating his expertise in experimental geophysics to his work as a researcher and educator—and UW-Madison's collaborative nature is one of the things that most attracted him.

"It's really amazing to be in a place that gives you access to a huge number of labs all over the university that can do a diverse number of things," he says, "and also gives other people access to what you're working on so that you can do more cross-disciplinary work."

**MORE:** [go.wisc.edu/engrnews-072619](https://go.wisc.edu/engrnews-072619)

# TINJUM NAMED NEW LEADER FOR GLE PROGRAM

James Tinjum has high expectations for the Geological Engineering Program.

Tinjum has been named the new director of the program, which is housed within CEE. Now in his 12<sup>th</sup> year as a professor at UW-Madison, Tinjum brings experience not only from his years of work in academia, but from more than a decade of consulting work across the country. He focuses on environmental and energy geotechnics.

Tinjum's environmental work has included contaminated site remediation and landfill design, development and operation. His energy research has included geothermal exchange and wind plant design.



He aims to increase the program's connections with companies in the energy sector to provide expanded opportunities for growth and innovation across a breadth of disciplines—from sustainable energy to working with more traditional energy sources.

Tinjum also wants to push the program to be one of the nation's best.

"I'd like us to be recognized in the top tier—without question, the top-five geological engineering programs in the nation," he says.

"Pushing us as far as that top one or two would definitely be my goal as far as reputation and respect for our students and our graduate program."

## Building bridges

The UW-Madison steel bridge team finished 14<sup>th</sup> at the 2019 Student Steel Bridge Competition National Finals in June in Carbondale, Illinois. But the CEE students made a strong impression on one judge and a local resident after the competition wrapped up.



## DEPARTMENT NEWS

For the second straight year, CEE won two \$10,000 Engineering Education Awards from the National Council of Examiners for Engineering and Surveying for projects from its senior capstone design course.

The American Society for Composites named Assistant Professor **Pavana Prabhakar**, the Charles G. Salmon Fellow of Structural Engineering, a 2019 ASC/DESTech Young Researcher Award winner. Prabhakar also received a Defense University Research Instrumentation Program grant from the U.S. Department of Defense to develop a system for studying how materials degrade under extreme heat.

Associate Professor **Christy Remucal** earned a spot among 24 rising environmental researchers in a special early career scientists virtual issue from the journals *Environmental Science & Technology* and *Environmental Science & Technology Letters*.

Dr. Arthur F. Hawn Professor **David Noyce** won election to the board of governors of the Transportation & Development Institute, part of the American Society of Civil Engineers.

Alumnus **Joe Naughton** (BS '16) is among the finalists in the National Sea Grant College Program's 2020 class of the John A. Knauss Marine Policy Fellowship program.

Alumna **Hala Nassereddine** (MS '16, PhD '19) earned recognition from the Construction Industry Institute for her doctoral research project using the Microsoft HoloLens to design, implement and validate an augmented reality-enabled production strategy process prototype.

Undergraduate **Cara Stanker** landed a Wisconsin Idea Fellowship to refine an affordable solar-powered air filtration prototype to reduce household air pollution from combustible fuel in Uganda.

UW-Madison will host the 2020 American Society of Civil Engineers National Concrete Canoe Competition June 13-15. The team placed seventh at the 2019 national finals in Melbourne, Florida.

## Distinguished leaders



Rod Hassett

After long, successful careers in industry, Rod Hassett (BS '62) and Duane Radtke (BS '71) are CEE's 2019 Distinguished Achievement Award recipients as part of the College of Engineering's annual Engineers' Day celebration.

Hassett taught CEE's capstone design course for 13 years after retiring from the Madison engineering firm Strand Associates. He also created the Hassett Scholars Program.

Radtke, a mining engineering graduate, has worked in the energy industry for nearly five decades. He is chairman of the board at Devon



Duane Radtke

Energy and president and CEO of Valiant Exploration.



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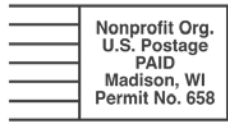
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## GREEN MEANS SAFE TO SWIM



Thanks to work by Professor Chin Wu and PhD student Yuli Liu, visitors to North Beach in Port Washington, Wisconsin, now have an extra layer of safety: real-time “traffic lights” that brightly indicate the presence, or absence, of dangerous waves and rip currents on Lake Michigan.

The lights sit atop an informational kiosk that's connected to the integrated nowcast-forecast operational system, which provides the most current temperature, wind and water conditions, fed with data from a camera at the

beach, an underwater sensor and National Weather Service (NWS) reports.

According to the NWS, rip currents kill an average of 12 people on the Great Lakes each year, while another 25 people require rescue. The traffic lights, dubbed beach lights and notifying kiosk—or BLINK—can serve as an alternative to the existing rip current flag warning system, which requires a person to hoist and lower flags.

“Sometimes people, when they go to the beach, they don't have internet access,” says Liu. “BLINK puts it outside so people can get the most updated information on current conditions to tell if they are safe.”



Rip currents occur when a strong offshore, narrow current forms along sandy beaches as well as around obstructions such as sandbars, piers or jetties. Water in these areas may sometimes be

just knee-high, but it can be strong enough to pull a strong swimmer into deeper and more dangerous water.

Earlier in 2019, Wu, former student Alvaro Linares (PhD '18) and collaborators published the first verified findings of a meteotsunami-generated rip current—or meteo-rip, for short—in the journal *Scientific Reports*.

“No one in the world has ever documented this before,” says Wu, noting rip currents formed by the one-time wave of a meteotsunami can last for hours afterward.