THE BRIDGE

W

Engineering an engaging online experience

CEE faculty member Julian Yamaura gets creative when moving hands-on labs online.

SPRING 2020

CIVIL & ENVIRONMENTAL ENGINEERING
UNIVERSITY *of* WASHINGTON

A landslide victory

CEE researchers develop a map that quantifies landslide risk in Seattle.

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MESSAGE FROM THE CHAIR

I start my message this spring the same way that I am starting many messages these days, with my sincerest hope that you, your family and your loved ones are doing well during this challenging time. In March, CEE faculty, staff and students made the transition to remote operations due to COVID-19.

Employing various software and technologies, we moved to online lectures, quiz sections, office hours, exams, advising, research activities and more. Faculty have adopted a range of approaches to online teaching, a few of which are highlighted in this edition of *The Bridge*, including lecturer Julian Yamaura's creative approach to transitioning the hands-on junior-level construction materials course online.

All but a few critical research activities have also moved online, requiring some researchers to shift their focus from field work to computer modeling and data analysis. This newsletter highlights several research projects that aim to make notable advances in the field, such as developing the first landslide risk map for the city of Seattle and advancing the post-earthquake assessment of reinforced concrete buildings through the application of new technologies, such as lidar.

While our department enjoys participating in various events throughout the year, such as Engineering Discovery Days, and was planning to host the American Society of Civil Engineers (ASCE) Regional Competition on campus, these events have been postponed until next year. Our students, who have been involved in planning the ASCE competition, have done an admirable job in not only adapting to the changing circumstances, but in figuring out how to apply their hard work to next year's events.

We will also be unable to gather together to celebrate a longtime faculty member's retirement. After spring quarter, professor Steve Kramer, who was elected to the National Academy of Engineering this winter, will be retiring. An article in this newsletter highlights not only his many accomplishments, but his commitment to creating a geotechnical engineering graduate degree program that now has a strong national reputation around the country.

Through all the changes these past few months, I have been profoundly impressed with the CEE community's willingness to embrace challenges and support one other to achieve a successful transition to this new operational mode. I have no doubt that we will emerge with new knowledge and skills that will enable us to better achieve our mission moving forward.

Laura Lowes
Chair & William M. and Marilyn M. Conner Professor

Faculty honors

Congratulations to CEE faculty for receiving the following awards:

STEVE KRAMER

Professor Steve Kramer has been elected to the National Academy of Engineering, one of the highest professional distinctions in engineering, for contributions to geotechnical earthquake engineering, including liquefaction, seismic stability and seismic site response. Kramer was also one of eight newly announced American Society of Civil Engineers (ASCE) Distinguished Members, an honor reserved for only 223 ASCE members overall.

LAURA LOWES

Chair and professor Laura Lowes has received the 2020 Puget Sound Engineering Council Academic Engineer of the Year Award in recognition of her contributions to the state of earthquake engineering practice. Lowes has advanced the seismic design of structures through research that employs computational modeling to investigate the behavior and design of reinforced concrete structures for earthquake loading.

YINHAI WANG

Professor Yinhai Wang has been elected a fellow of the ASCE, an honor reserved for a small percentage of members based on professional accomplishments. Wang is the founding director of UW's Smart Transportation Applications and Research (STAR) Lab and serves as director of the Pacific Northwest Transportation Consortium (PacTrans), a Regional University Transportation Center.

DEPARTMENT NEWS

Professor Steve Kramer

RETIRES AFTER 36 YEARS AT UW

It's one thing to leave on a high note. It's quite another to leave after being elected to the National Academy of Engineering.

"That's kind of a cherry on top of the cake," says professor Steve Kramer, about receiving one of the highest professional distinctions in engineering in February 2020.

Having reached the pinnacle of his career, Kramer retires after spring quarter. During his 36-year tenure at the UW, he helped establish and grow CEE's geotechnical graduate degree program, made notable research advancements, assumed leadership roles with research centers and even authored a book.

"I have always loved learning, that has been my motivation," Kramer says. "Having a job where you can satisfy your curiosity and learn new things has been fantastic for me."

Building up UW's geotechnical program

After earning all three of his degrees at the University of California, Berkeley, Kramer accepted a faculty position at the UW in 1984, joining the geotechnical group.

"When I arrived, there really wasn't a geotechnical graduate program. There were only three practicing geotechnical engineers in the Puget Sound region with graduate degrees from the UW," Kramer says. "There were only two faculty, my first class had three students in it and the lab was used as a storage room."

Over the years, Kramer worked to establish a graduate program with professor emeritus Robert Holtz and, later, professor Pedro Arduino.

"I came in on the weekends and built lab benches, I wanted to get things going," Kramer says. "I also met with local firms. Many supported the idea of building up a geotechnical program, though a few said 'it's never going to happen.'"

Now boasting five faculty, 25 graduate students, and hundreds of alumni, the program has a strong reputation across the country.

Research accomplishments

Over the years, Kramer has been involved with many national and international research efforts and has made notable research advancements in the areas of liquefaction, seismic slope stability and dynamic soil behavior.

Together with a graduate student, he pioneered an innovative method for producing more complete, rational and consistent estimates of the hazards of liquefaction, which causes soil to behave like a liquid in different earthquake-prone environments.

"That's had some impact," Kramer says. "We're in the process now to get it into the building codes."

Locally, Kramer led a study with professor Marc Eberhard that documented the seismic vulnerability of the Alaskan Way Viaduct and Seattle seawall about 25 years ago. He has also worked on various independent consulting projects over the years, from the Tacoma Narrows Bridge and high-rise buildings in downtown Seattle to dams and landslides around the world. He plans to continue consulting during retirement.

Kramer has also assumed leadership roles with several research centers, including the Pacific Earthquake Engineering Research Center, which is developing performance-based earthquake engineering, and Next Generation Liquefaction project, an international effort to build an openly accessible database of liquefaction case histories that will be used to develop new predictive models.

In 1996, Kramer published the first book ever on the topic of geotechnical earthquake engineering. *Geotechnical Earthquake Engineering* remains widely used and is recognized as having raised the practice of earthquake engineering around the world. The second edition of the book is "almost done," he says.

A favorite memory

As he looks back on his time at the UW, Kramer says there is one memory that stands out. About 15 years ago, when he was recruited by another university, Kramer decided to use the offer as leverage to fund a remodel of the geotechnical group's space, which was spread across several locations in two buildings and in need of upgrades.

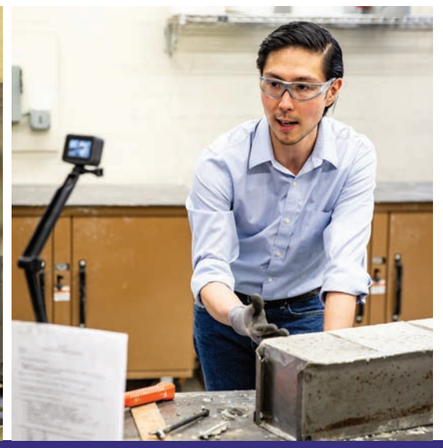
Although the department chair at the time, professor emeritus Scott Rutherford, was able to secure some remodeling funds, he fell about $70,000 short. To raise the remaining funding, Rutherford made an appeal to the local geotechnical professional community. In just two days, the funding was secured.

"The way that people stepped up in the local community and the way that Scott worked so hard were significant factors in my deciding to stay here," Kramer says. "It has been nice to think back on how that all came together and resulted in a better space for our students and faculty."

ENGINEERING AN ENGAGING online experience

Instructor gets creative when moving hands-on labs online

This spring, lecturer Julian Yamaura was presented with a new type of engineering challenge — moving hands-on labs online due to COVID-19. He knew he'd have to get especially creative, as mixing concrete is about as hands-on as it gets.



FEATURE STORY

"A lot of our students are the ones who might not be actually mixing concrete, but supervising the process [in their future careers], so I figured this might be a great opportunity for the students to supervise me and tell me how to do it right," says Julian Yamaura, who is the Tom and Marilyn Draeger/The Beavers Charitable Trust Lecturer.

During the 10-week construction materials course, undergraduates must complete seven major labs to learn about the properties and behavior of common construction materials, from concrete to steel to wood.

Prior to weekly online lab sessions, Yamaura creates videos of himself completing lab exercises. He films each exercise twice — the first time he shows the students the correct method and the second time he does something a little different.

"I sprinkle in some errors here and there," says Yamaura.

This allows the more than 70 students enrolled in the course to discuss mistakes they've noticed in the videos — and how to correct them — during the online lab sessions. The lab videos also provide the students with a tangible takeaway — data, which they analyze for lab reports.

"The fact that our instructor intentionally adds mistakes is very helpful for us students to identify how we might have done some parts wrong in lab had we been there in-person, and how to watch out for those mistakes in the future," says CEE junior Kyla Pritzl.

Student perspective

When she learned that spring quarter courses were being moved online, CEE junior Alexandra Schadler was disappointed. The construction materials course would be her first hands-on lab in the department and she had heard "how fun it was to make concrete in a wheelbarrow."

"I felt like I was going to miss out on a really important experience," Schadler says. "When I first heard labs were going to be held online, I had no idea how they were going to work. But online learning has actually been better than I thought."

Although it's hard for the UW track and cross country team athlete to sit in front of a computer all day, Schadler says her instructors have managed to keep classes engaging. The Zoom meeting platform also helps, she says, as seeing her instructor and classmates online makes her feel like she is part of a class setting.

"I originally thought I was going to be easily distracted, but this has not been the case," Schadler says. "The material I am learning is also really fun, so that has kept me engaged and interested."

Despite not being able to make concrete herself, Schadler says she was able to gain a good understanding from the videos and online class discussion.

Photos by Dennis Wise / University of Washington

Faculty viewpoint

When Yamaura first learned that he would need to transition the construction materials course to an online format, he wasn't worried about the twice-weekly lectures— but he was concerned about the quality of instruction for lab sessions.

"I worried how I could make a lab meaningful in the way that it would be in an in-person lab session," Yamaura says.

In addition to engaging the students with entertaining lab videos, Yamaura also asks them to participate in online discussions.

"To be honest, I feel like they've been more interactive in the online setting rather than in-person," Yamaura says. "The amount of thought they are putting into it is great."

Together with his teaching team, Yamaura plans to continue to fine-tune the online course throughout the quarter, to make it even more engaging for students. Having taught the course on campus for several years, he is embracing the opportunity to try out some new online teaching strategies.

"This quarter has definitely been dynamic; we are constantly thinking of better ways to interact with students, and we are learning from them, too," Yamaura says.

A rite of passage...eventually

One question that Yamaura often fields from students is if they can make concrete when they return to campus — this time with their own hands.

"Making concrete cylinder samples is a rite-of-passage as a civil engineering student," says Pritzl. "Once classes are back on campus, I hope to make it into the lab. I have a very strong desire to make concrete!"

As soon as students are allowed to meet again on campus, Yamaura says he will invite them into the lab and guide them through the concrete-making process.

"I gave them an analogy for teaching music," Yamaura says. "It's one thing to teach someone how to read music and where to put their hands on the guitar, but unless they actually do it, it can be tricky to master."

SPRING QUARTER GOES ONLINE

In the Department of Civil & Environmental Engineering, the following number of courses and students transitioned online for spring quarter:

- **Courses**: 25 undergraduate and 20 graduate courses were held online.
- **Students**: 422 undergraduate and 362 graduate students were enrolled in online courses.

A LANDSLIDE VICTORY

CEE RESEARCHERS DEVELOP FIRST-EVER MAP THAT QUANTIFIES LANDSLIDE RISK IN SEATTLE

When it comes to safeguarding Seattle from landslide hazards, CEE Ph.D. student William Pollock has a plan mapped out – quite literally. He will soon be releasing a first-of-its-kind map that predicts landslide risk throughout the city.

"As far as I know, this is the first map in the nation to quantify landslide risk on a regional scale – to put a number on it rather than just rating it high, low or medium," says Pollock. "This will help city planners know how to prioritize resources when mitigating landslide risk."

Throughout the United States, jurisdictions are responsible for monitoring landslide activity, as the U.S. Geological Survey doesn't track or inventory slide areas on a local scale. Since existing landslide maps for the city of Seattle only identify the location of landslide-prone areas, the risk map that Pollock is developing with CEE professor Joe Wartman will be more meaningful to stakeholders and communities.

"One of the big outcomes we are hoping to present to the city and public is being able to look at different areas of the city and estimate, on average, the number of dollars per year of damage we would expect and the potential for loss of life," says Pollock, who has been working on the project for the past four years.

Funded by a National Science Foundation EArly-concept Grant for Exploratory Research (EAGER), the researchers are collaborating with geoscientists at the Institute of Geological and Nuclear Sciences in New Zealand. In coming months, they plan to share their work with the city of Seattle and the public to help guide and inform landslide mitigation throughout the city.

"Traditional landslide maps do not explicitly consider risk, but it is essential to do so since this is the best way to assess the likely consequences of landslides, not just their occurrence," Wartman says.

Photo above: Graduate student William Pollock estimates the volume of a freshly fallen block of glacial soil, which provides a valuable baseline for evaluating the landslide hazard map. Photo by Mark Stone / University of Washington

Seattle's susceptibility

In recent years, there has been heightened awareness about regional landslide risk, especially in the aftermath of the deadly landslide in Oso, Washington, in 2014. And a research collaboration across several UW departments, the M9 Project explored how shaking from a Cascadia Subduction Zone earthquake may trigger landslides throughout the area.

"The Oso landslide and the M9 Project both highlighted the urgency of understanding the landslide hazards and – especially – risks in the Pacific Northwest," Pollock says.

With its hilly terrain and rainy climate, the geology of Seattle is prone to landslides, which tend to recur in the same areas. More than 8% of the city's surface area is considered to be landslide prone, according to the city's Environmentally Critical Areas Ordinance. The majority of these areas are zoned for single-family residential and open space, such as parks.

In Seattle, the majority of landslides fall into two categories: large and slow moving, or small and rapid. Many landslides are activated during the rainy season and come to a relative halt during the summer. It's not uncommon for landslides to travel long distances and reach areas that are not generally considered landslide prone.

"The interaction between landslides and places of development often happens in the runout zone, which is how far a landslide travels," Pollock says. "That is where we start to see a lot of risk."

Although the city has undertaken a number of strategies to help mitigate risk, from slope stabilization projects to revising the zoning density near hillsides, pinpointing future risk can help identify where to allocate resources.

"We are doing this on a relatively fine scale, so we can evaluate neighborhoods and buildings to assess their risk to different types of landslides," Pollock says.

Risk management

Early in his graduate studies, Pollock traveled to Lebanon to help quantify landslide hazards and associated risk on a comprehensive scale. At the time, Lebanon's population was swelling due to the mass resettlement of more than one million refugees. Although the refugees were settling in less hazardous areas than where the existing population resided, they were actually more at-risk due to makeshift shelters.

"If we just looked at landslide hazard, we would never have seen this," Pollock says. "This is why looking at risk matters."

The resulting methodology worked so well that Pollock is now applying it to Seattle, inputting Seattle-specific details about elevation, geologic features and soil quality, as well as building inventory and census population data.

Since the researchers are predicting events that haven't occurred yet, they tested the methodology using an unprecedented dataset that was developed after the 7.8 magnitude Kaikoura earthquake in New Zealand in 2016, thanks to a partnership with the Institute of Geological and Nuclear Sciences.

The landslide risk map will be part of a suite of maps that will provide comprehensive information about landslides — from estimated recurrence to how they are triggered.

"A unique part of this work is that we are not looking at just one type of landslide, but different types," Pollock says. "They have different effects on human infrastructure and that in itself is a novel part of this work."

> "We want the risk map to be understandable, open and accessible to all people, so they can make informed decisions,"
>
> **PROFESSOR JOE WARTMAN**

Practical applications

As Pollock refines the risk map, which entails visiting landslide hotspots such as West Seattle and Magnolia to verify data, he and Wartman plan to publish their findings in coming months. They will also present their results to city officials and discuss community engagement opportunities. During the process, they hope to develop some practical applications based on their findings.

"In the past, most zoning policies related to landslides and development have been based on susceptibility — the areas likely to have a landslide in the future, without consideration of their timing, runout or consequences," Pollock says. "Ultimately, we really should be making our zoning policies based on risk."

Professor Joe Wartman compares the modeled landslide hazard to an old landslide deposit. Photo by Mark Stone / University of Washington

CAPSTONE COURSE MOVES ONLINE

Students embrace twice the problem-solving

For a highly collaborative capstone project that entailed developing a remote-controlled sensing vehicle, moving the course online due to COVID-19 meant twice the opportunity to utilize problem-solving skills.

"The pandemic is a great opportunity to do things differently – challenge conventional approaches, use technology more and be more connected even during an era of physical distancing," says professor Faisal Hossain, who taught CEE 444 Environmental Engineering this spring.

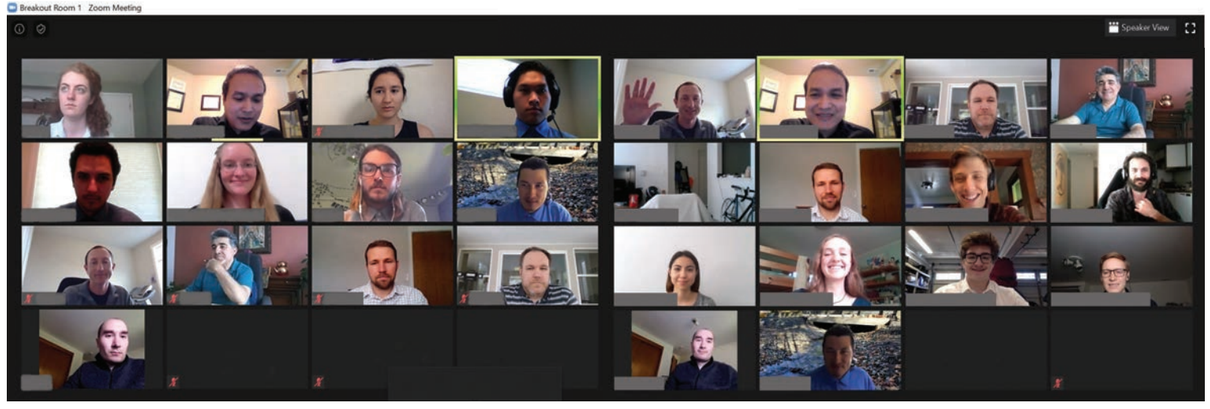
In addition to navigating an online classroom setting, students in civil and environmental engineering worked with electrical and computer engineering (ECE) students to complete a capstone design project in partnership with the Washington State Department of Transportation (WSDOT).

The project entailed prototyping a remote-controlled sensing vehicle that will be used to monitor confined spaces, such as culverts, bridges and sewers, which are difficult for humans to access for inspection. The prototype may eventually replace the current sensing vehicle employed by WSDOT, which suffers from issues such as unstable Internet connectivity, limited camera range and lack of speed control.

"Basically, ECE students are building this and CEE students are providing some high-level feedback on what it takes to make it relevant for real-world field conditions for a client working in civil engineering," says Hossain. "It's a great marriage of two branches of engineering."

Prior to the start of spring quarter, Hossain outlined a contingency plan for the course, to create an online learning environment. The students, who were in separate online classes in each department, met online to exchange ideas and feedback about the prototype. Students from both departments also attended online meetings with WSDOT officials, who helped to mentor the students.

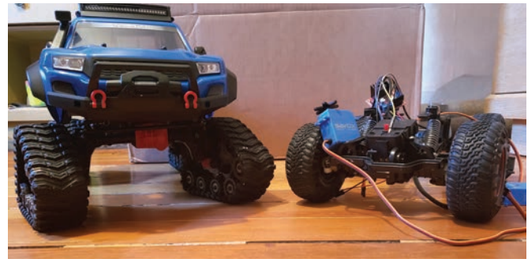
Rather than complete several prototypes by the end of the quarter, as originally planned, the students worked to finalize a smaller number of designs for their "Hydro-CUB (Compact Utility Bot)." Despite shipping delays for necessary parts, such as precision cameras and Arduino boards, the students completed



Students deliver an online mid-term presentation to WSDOT officials.

the design of the first prototype, which continued to evolve throughout the quarter.

"They worked to make Hydro-CUB as relevant for real-world conditions as possible," Hossain says. "With the pandemic, we weren't sure if we would get all the way to the finish line as students were working from home and ordering parts took time, but we got very close."



Built by ECE students Sherman White and Jina Yoo, the team's first prototype (right) and more recent prototype (left), which features a track mounted design for better traction in wet soil.

RECORD ATTENDANCE: 14th annual CEE Career Fair

Resumes at the ready, more than 300 CEE students attended the 14th annual CEE Career Fair on January 23. This year's event saw record attendance from industry members.

Representatives from more than 92 companies were on hand to discuss career opportunities and internships with CEE undergraduate and graduate students. Employer participation increased from the previous year by 15%. Several companies, many of which were new to the fair this year, were from outside the Seattle area.

Founded in 2007, the CEE Career Fair connects employers with students who are seeking internships and full-time positions. Industry focuses range from general civil engineering to specialty areas such as construction, transportation, geotechnical, structural, hydrology and environmental engineering. This year, construction saw the biggest sector of employers in attendance.

Industry representatives, many of whom are CEE alumni, enjoyed a post-fair reception with the department chair and other faculty. Thank you to the many companies and organizations that participated in this year's CEE Career Fair.

ADMIRABLE ATTENDANCE

The following companies attended this year and have participated in more than half of all CEE career fairs since 2007:

DCI Engineers
Degenkolb Engineers
Fehr & Peers
Gray & Osborne
Harriott Valentine Engineers
Hart Crowser, Inc.
HDR, Inc.
HNTB Corporation
Jacobs
Kiewit
KPFF
Magnusson Klemencic Associates
Manson Construction
PACE Engineers
Parsons
Perteet, Inc.
Reid Middleton
Tacoma Water
Transpo Group

STELLAR SUPPORT

The following companies attended this year and have had near-perfect attendance since their first year:

AECOM
AHBL
American Bridge
Associated Earth Sciences
Blueline
Carollo Engineers
Coffman Engineers
Cornerstone General Contractors
Coughlin Porter Lundeen
Davido Consulting
DOWL
Granite Construction
Kimley-Horn
Landau Associates
Morrison Hershfield
Murraysmith
Otak, Inc.
Shimmick Construction
Skanska
Sound Transit
The Walsh Group
Thornton Tomasetti
WSDOT
WSP

Gathering concrete details

IMPROVING THE SEISMIC ASSESSMENT OF REINFORCED CONCRETE BUILDINGS

Looks can be misleading, especially after an earthquake. Many buildings still stand tall, but this doesn't mean they are structurally safe or can be quickly and inexpensively repaired.

"Even if a building is standing, we want to know if it's safe to go inside and operate in the vicinity of the building, or if it's economical to fix," says principal investigator and assistant professor Paolo Calvi. "We need better tools that can help us decide what to do."

In the aftermath of earthquakes, assessing the structural integrity of reinforced concrete buildings, which make up as much as 70% of the built environment, persists as a significant problem in the United States and around the world. Except for single-family homes, the majority of buildings are constructed from reinforced concrete, including high-rise office and residential buildings as well as critical structures such as hospitals and schools.

Newer data collection and analysis methods that promise to enhance both precision and speed of damage assessment require validation and fine-tuning before they can be employed in the field. To help advance these methods, UW CEE researchers joined forces with researchers from the University of Nevada, Reno (UNR) and multiple Japanese universities led by the University of Tokyo to work on the "Japan-U.S. Collaboration on the Seismic Performance of Reinforced Concrete Structures" project.

Funded by the National Science Foundation (NSF), the CEE research team comprising Calvi, professor Jeffrey Berman, professor and chair Laura Lowes and graduate student Tatsu Sweet, traveled to Japan in winter 2019 to participate in tests using the E-Defense shake table — the largest indoor shake table in the world.

By working to advance the post-earthquake assessment of reinforced concrete buildings, the researchers hope to make a significant contribution toward improving damage assessment for concrete buildings throughout the world. In addition to reduced risk and downtime posed by damaged buildings, policymakers will be able to better determine if buildings are economical to repair.

"Eventually, our work will enable engineers to rapidly assess the damage state of concrete buildings following an earthquake to help speed community recovery," says Lowes.

Evaluating new analysis methods

In addition to introducing more efficient data collection methods through the use of technology, the researchers are also working to improve data interpretation by moving toward analysis based in mechanics, rather than observation-based methods. Up until now, it has been difficult to evaluate newer analysis methods due to a lack of reliable baseline information about the performance of reinforced concrete buildings.

To address this challenge, the researchers gathered precise baseline data in a controlled environment while subjecting a full-scale three-story reinforced concrete frame building to three levels of increasing ground shaking intensity at the E-Defense shake table facility in Japan. While researchers from Japan conducted tests using traditional instrumentation, UW and UNR researchers collected redundant data using newer technologies, which they will compare to the baseline data.

"This project provides an opportunity to compare the accuracy and efficiency with which these methods can be used to detect, quantify and document damage," says Lowes.

Testing new technology

State-of-the-art data collection tools, including lidar, were available to the researchers during the shake table testing, thanks to a partnership with CEE's Natural Hazards Reconnaissance Facility (known as "RAPID"), which houses equipment to support the collection of perishable data following natural disasters.

"One thing that is unique about this project is that for the first time we used lidar to detect damaged features in a concrete building after a simulated earthquake," Calvi says.

Known for precision, lidar data was used to generate 3D point cloud images of the building specimen before and after each shake table test, enabling the researchers to calculate building displacements and deformations.

"The measurements are more objective and obtained more quickly and efficiently," Calvi says. "One person operates both scanners, as opposed to having experts running around the building taking measurements manually."

Another new method that the researchers tested is under development by UNR and involves using high-resolution digital image correlation (DIC) monitoring equipment, which measures structural deformations by comparing images taken at various intervals throughout specimen testing.

"DIC, like lidar, is a relatively new technology and it is still under development," Calvi says. "The goal is to use it in the field, in conjunction with lidar, once we develop it to the point that it can be accurate and efficient."

Through the partnership with the RAPID center, the researchers will archive and share their data with the larger research community.

Applying findings to real buildings

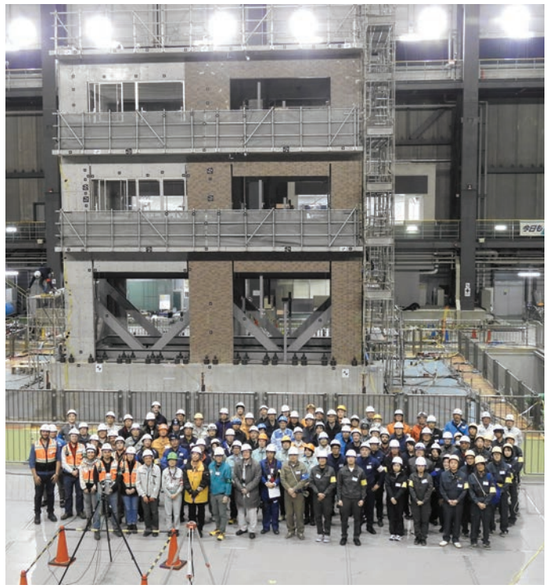
As they analyze data from the shake table testing, the researchers are planning for the next phase of the project. Once NSF-funded travel is reinstated after being suspended due to COVID-19, the researchers hope to test the new analysis methods and technology on structures damaged after the 6.4 earthquake in Puerto Rico in January 2019. This would be a first step toward one day implementing newer assessment methods in the field.

"Our current work was simulated, but we plan to do the same thing with real buildings after a real earthquake," Calvi says. "We care about life safety and the financial aspect of earthquakes — we want to make sure buildings are functional and there isn't too much downtime after an earthquake."

Opposite left: During the shake table testing, the researchers tested new technology, including lidar, which was used to generate 3D point cloud images of the building.

Opposite right: UW CEE faculty Paolo Calvi and Jeffrey Berman, from left, set-up lidar equipment to collect high resolution scans of the concrete building, particularly cracks.

Right: On the last day of the shake table testing, researchers from the United States and Japan gather for a group photo.



RESEARCH HIGHLIGHTS

WARMER TEMPERATURES INCREASE ARSENIC LEVELS IN RICE

People around the world consume rice in their daily diets. But in addition to its nutrient and caloric content, rice can contain small amounts of arsenic, which in large doses is a toxin linked to multiple health conditions. UW researchers including faculty Rebecca Neumann and Stuart Strand have found that warmer temperatures, at levels expected under most climate change projections, can lead to higher concentrations of arsenic in rice grains. Arsenic occurs naturally in the soil, though its concentration is higher in areas that have historically used arsenic-based herbicides or where irrigation water contains arsenic. When farmers grow crops such as rice under flooded conditions, arsenic is drawn out of the soil and into the water.

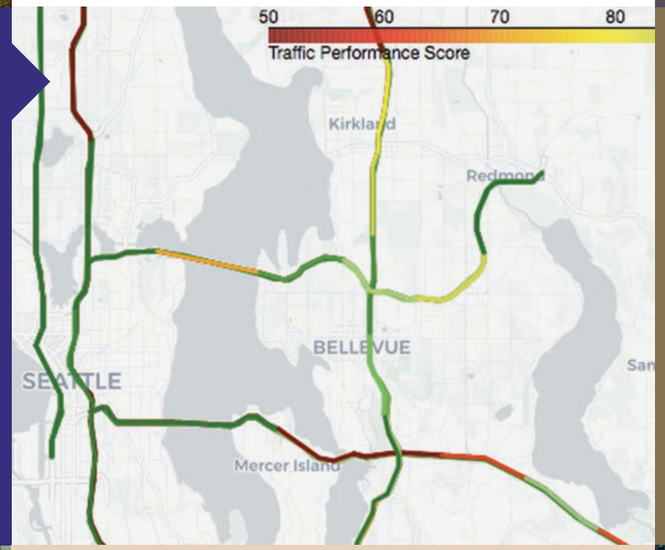
RESEARCHERS EXPLORE THE ARCTIC TO IMPROVE CLIMATE MODELS

Information about the role that waves play in the changing Arctic is rolling in, so to speak, after UW researchers spent a month at sea collecting data. The critical connection between melting sea ice, increasingly powerful waves and eroding coastlines has been missing from existing research in the Arctic. To help fill this knowledge gap, a team of researchers including faculty member and Applied Physics Laboratory oceanographer Jim Thomson and assistant professor Nirnimesh Kumar set sail aboard the Sikuliaq last November. By investigating the interactions between waves and sea ice and how they contribute to coastal erosion and flooding, the researchers hope to improve the accuracy of climate models, which can be used to inform more strategic climate policy decisions.

MEASURING TRAFFIC PERFORMANCE DURING COVID-19

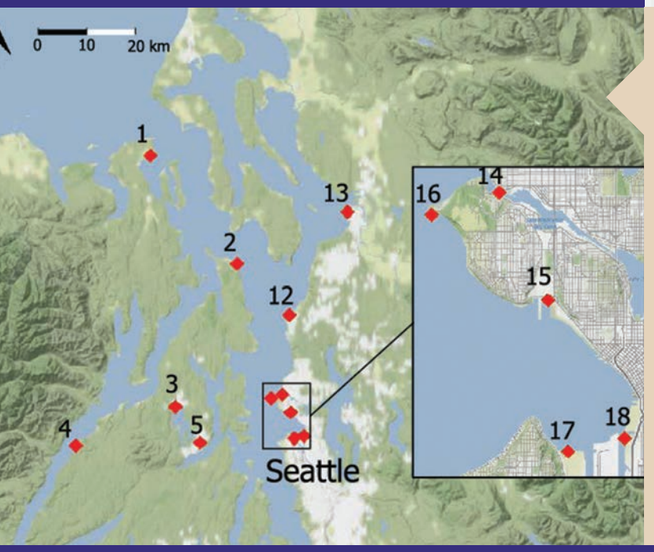
It's not a surprise that traffic, like many things, has been impacted by COVID-19. But by how much? Researchers in UW CEE's STAR Lab now have an answer to that question after employing a new scoring algorithm they developed to measure fluctuations in traffic. The researchers devised a metric called the Traffic Performance Score, which they applied to the greater Seattle area freeway network. A perfect score of 100% means that roadway users can travel at free-flow speed without encountering any traffic slowing or congestion. According to this assessment, traffic in Seattle during peak travel times has been drastically impacted by COVID-19, with congestion improving more than 70% in some instances.

Learn more: tps.uwstarlab.org.



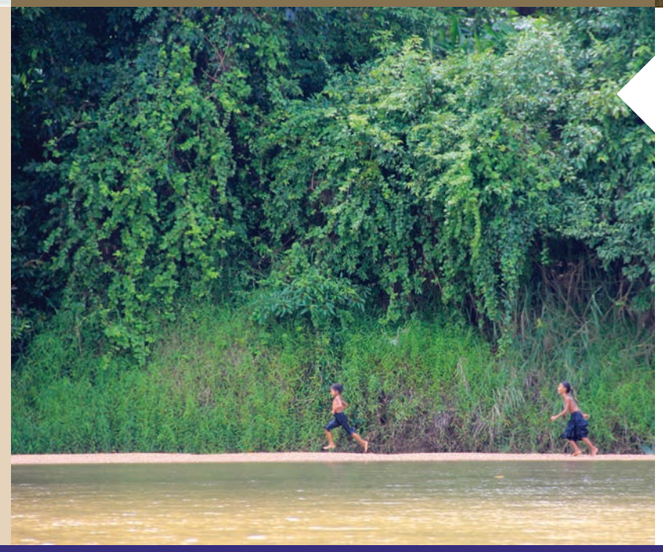
SEATAC AIRPORT AIR POLLUTION PATH IDENTIFIED

The community surrounding Seattle-Tacoma International Airport, which is the eighth busiest airport in the U.S., has long wondered if air pollution caused by aircraft is reaching nearby residential areas. For the first time at SeaTac Airport, UW researchers including professor Tim Larson have identified a distinct type of ultrafine particle pollution associated with aircraft. Ultrafine particles, which are less than 0.1 micron in diameter, are readily inhaled and can penetrate across traditional membrane barriers in the body, according to separate health-related studies. Because ultrafine particle pollution can be produced from various sources — for example, traffic on freeways near airports as well as jets overhead — it can be difficult to distinguish its exact origin.



NEW TECHNIQUE CASTS A NET FOR CONCERNING CHEMICALS IN PUGET SOUND

The waters of Puget Sound support many species, including mussels, salmon and killer whales, which are vulnerable to runoff from land that may contain chemicals. Although chemicals of known concern are already tracked, until recently there was no way to find out if other potentially harmful compounds are also present in the water. UW researchers including associate professor Edward Kolodziej screened samples from multiple regions of Puget Sound to look for additional concerning chemicals. They were able to confirm the identity of 75 chemicals, of which 64 were reported for the first time. The chemicals included pesticides, herbicides, food additives, pharmaceuticals and compounds related to vehicles, such as tire rubber chemicals.



HYDROPOWER DAMS COOL RIVERS IN THE MEKONG RIVER BASIN

Hydropower dams, which use flowing water to turn a series of turbines to generate electricity, provide a source of energy that doesn't rely on fossil fuels. UW researchers including professor Faisal Hossain, alumnus Matthew Bonnema and research professor Bart Nijssen studied how several hydropower dams affected the temperature of three major rivers in Southeast Asia's Mekong River Basin. Using 30 years of satellite data, the team discovered that within one year of the opening of a major dam, downstream river temperatures during the dry season dropped by up to 3.6 degrees F (2 degrees C). The cooler water may have an effect on fish that live downstream, according to the researchers.

UW ASCE to host regional competition in 2021

Donations were secured, a banquet was organized and a tentative competition schedule was outlined. The UW American Society of Civil Engineers (ASCE) student chapter officers had prepared for just about everything leading up to the ASCE Pacific Northwest Regional Student Competition — except COVID-19.

About six weeks before the competition, which was to be hosted at the UW in April, student officers learned that the competition would be moved to an online format. Shortly after, they learned it would be canceled. But their hard work will pay off — eventually.

"UW will be hosting next year instead, assuming it will be possible to hold a conference by then," says Emma Van Orden, president of the UW ASCE student chapter.

The annual competition is typically attended by more than 300 engineering students from Washington, Oregon, Idaho, Montana, Alaska and British Columbia. In addition to the concrete canoe competition, the event includes surveying and sustainable solutions challenges.

From securing venues to coordinating parking and discounted lodging, about 20 students collaborated with CEE staff and faculty to organize conference details.

The UW ASCE student officers sought sponsorships from companies in the greater Seattle area and beyond, as well as individual donations. Estimating that they would need to fundraise about $40,000 to cover competition costs, the team ended up raising about $50,000. The funds will be transferred to the 2021 competition.

Since this year's UW ASCE student officers are graduating, they will meet with incoming officers to get them up to speed on the planning process— which will hopefully be easier the second time around.

Dedicated donors

UW ASCE student officers would like to extend a special thank-you to generous support from a total of 19 donors, including the following "diamond-tier" sponsors who donated a minimum of $5,000: HDR, HNTB, Kennedy Jenks and the UW CEE Department.

UW ASCE student chapter officers.

Steel Bridge Team competition canceled

Like many situations, there's good and bad news. Although the 2020 Pacific Northwest Student Steel Bridge Competition Regional Event was canceled due to COVID-19, next year's team may be able to utilize and improve upon this year's design, rather than starting from scratch.

"Some of the rules staying the same for next year does mean that the team will be able to reuse the efforts of this year's team, as a change of rules often means that an entirely new bridge must be designed," says the team's faculty adviser, assistant professor Richard Wiebe.

Every year, the competition is organized around a scenario, inspired by real-world problems, and a set of associated requirements. When the American Institute of Steel Construction officials announced in mid-March that the competition was canceled, they stipulated that in order to minimize losses, some of the requirements for the following year would remain the same. Teams from up to 16 universities typically participate in the regional competition, which was scheduled for April 17-18 in Seattle.

The UW's 15-member team, comprised of CEE students as well as students from other engineering disciplines, started working on the bridge design in the fall. They were planning to implement several new design features, including compression connections that would allow for more rapid construction, which is one of three areas that teams are evaluated on during the competition.

"Compression connections are self-binding and thereby do not require a bolt," Wiebe says. "The students took advantage of this, other concepts they learned in their structural analysis and design classes, creative thinking and CAD to develop a bridge that snaps into place quickly."

During the competition, teams are evaluated on three areas: how long it takes to assemble the multi-part bridges; lateral testing that determines how much the bridge will sway; and vertical load testing that evaluates the bridge's strength.

A rendering of the team's bridge.

Lifelong dream inspires book about clean water in developing countries

It's never too late to live out a post-college dream. For alumnus John Dracup (BSCE '56), that entails working in developing countries to provide clean water, coupled with a more recent undertaking: authoring a book on the topic.

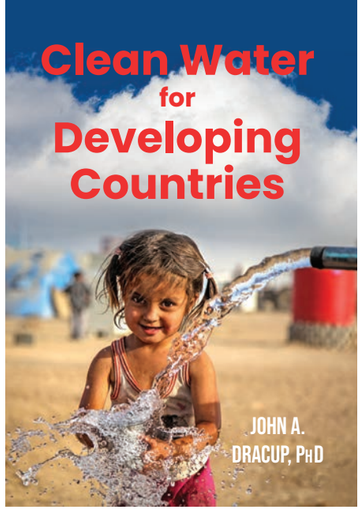
"I would have joined the Peace Corps if it had been an agency in 1956 when I graduated from UW CEE," says Dracup, professor emeritus at the University of California, Berkeley. "I have always wanted to provide clean water to those with limited or no access to clean water."

During the past decade, Dracup's involvement in Rotary International finally allowed him to gain hands-on experience working in developing countries and inspired him to author *Clean Water for Developing Countries*. Intended to assist non-governmental organizations (NGOs) with selecting the best method for providing clean and safe water, the book draws upon Dracup's experience working on clean water projects in Kenya, Peru, Guatemala and Honduras, and more than 50 years of teaching and research expertise in water resources engineering and hydrology.

Utilizing case studies, Dracup emphasizes the importance of matching the need for water, such as for an orphanage or entire village, with the appropriate method of delivery.

"It is a unique book," Dracup says. "There are no other books on the market that are like it."

Dracup became involved with Rotary International in 2009. He recalls the satisfaction he experienced working on his first clean water project in Kenya, where he helped construct a water system on a small island with a population of 8,000 people comprised of fishermen and their families.



"On the day the clean water system began operation, hundreds of islanders came to the kiosks and filled their 20-liter jerry cans with water. They left with smiles on their faces," Dracup says.

All profits from the sale of the book will support the Rotary Foundation or other NGOs that are working to provide clean water to developing countries. Learn more: www.cleanwaterbook.com.

Tom Gibbs posthumously honored with inaugural Distinguished Alumnus Award

Many people dream of helping to preserve and protect the environment. Alumnus Tom Gibbs (BSCE '54, MS '66) turned his dreams into a reality.

"Dad loved the outdoors, especially the forests and the abundant waters of the Pacific Northwest," says Todd Gibbs about his father, who passed away in June 2019. "He really wanted to help preserve the scenery and beauty of the region he loved and called home."

Gibbs is known for leading the clean-up of Lake Washington in the 1960s. In recognition of his life's work, the CEE department has posthumously honored him with its first annual Distinguished Alumnus Award. CEE chair Laura Lowes founded the annual award to recognize the achievements of alumni in industry and show students how civil and environmental engineering degrees help create meaningful impact.

An advocate for environmental issues, Gibbs's efforts to clean up Lake Washington and the Puget Sound while working at the Municipality of Metropolitan Seattle helped to reverse the damage incurred during the 1950s when untreated wastewater flowed into many waterways. In recognition of his efforts, Gibbs was honored by the White House in 1971. He also earned national awards from the American Society of Civil Engineers and American Public Works Association for the development of innovative approaches to environmental challenges.

Gibbs later joined the engineering firm CH2M Hill, where he helped transform Milwaukee, Wisconsin's polluted waterfront into a dynamic urban destination. He also founded the National Association of Clean Water Agencies and assisted in the development of the original Clean Water Act.

In honor of Gibbs's accomplishments, he was awarded a UW College of Engineering Diamond Award for Distinguished Service to Industry in 2009.

"Dad would have been proud to be recognized," says Todd Gibbs about the award. "But he also would have immediately identified a number of people who helped him achieve his successes."

THE BRIDGE SPRING / 2020

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PacTrans awards COVID-19 research grants

As the central transportation research engine in the Pacific Northwest, PacTrans has awarded three $10,000 matching grants to support research investigating how social distancing measures are changing almost every aspect of transportation.

"PacTrans leadership believes we can learn from the pandemic and is committed to supporting the best efforts to draw lessons from these trying times," says PacTrans' associate director for research, professor Jeff Ban.

A call for proposals was issued by PacTrans in mid-March, which was open to all faculty at consortium partner universities in the Pacific Northwest, including Alaska, Idaho, Oregon and Washington. The three institutions selected to receive grants are the UW, University of Idaho and Oregon State University.

From the UW, associate professor Don MacKenzie will analyze the long-term impacts of COVID-19 disruption on travel patterns; researchers from Oregon State University will study freight network resiliency, specifically analysis of truck drivers and support services in the Pacific Northwest under pandemic distress; and University of Idaho researchers will track, map and model mobility changes and business recovery amid COVID-19 in the Pacific Northwest. The selected projects are set to begin in June and deliverables are due within a year.