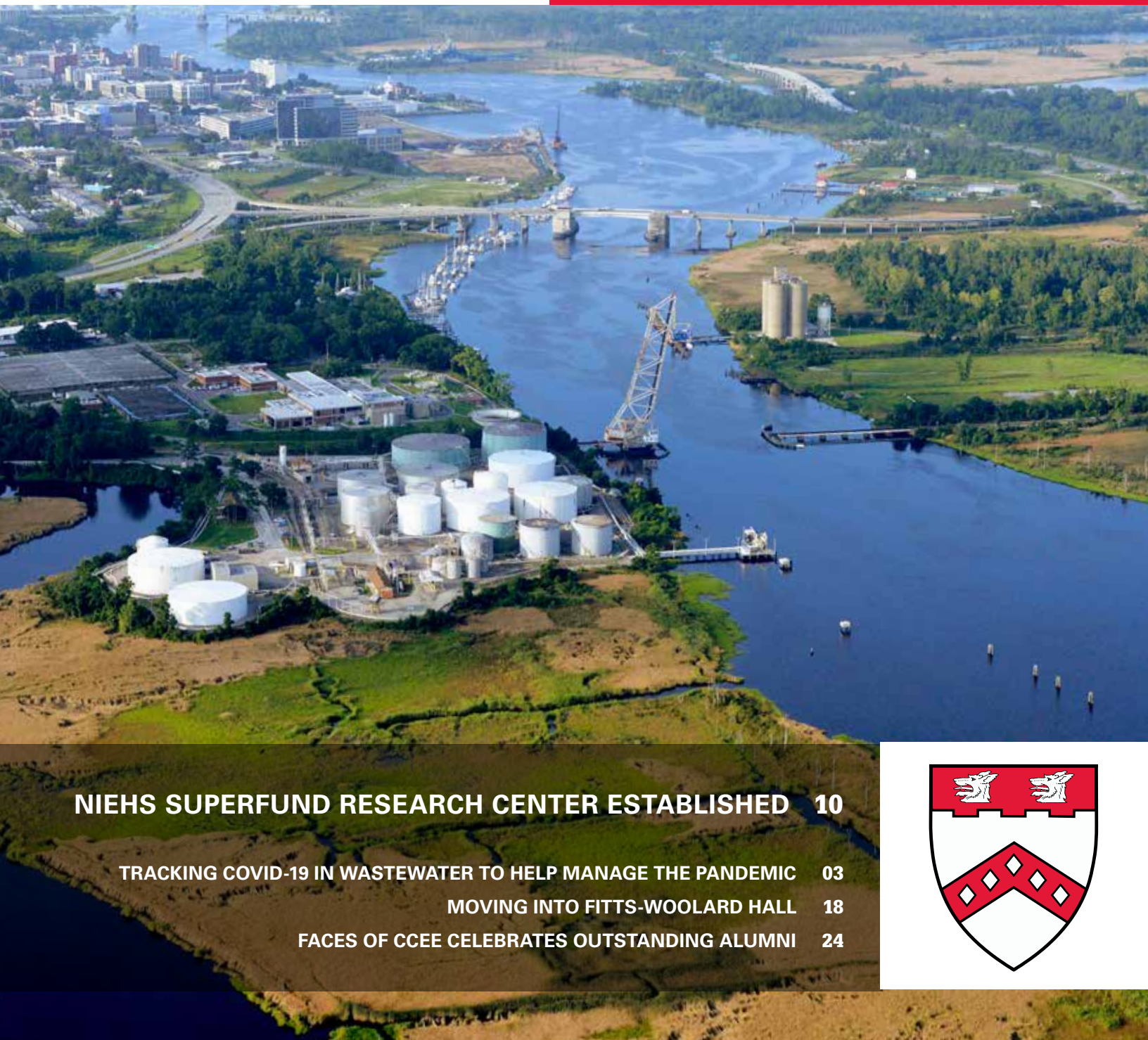


NC STATE

Engineering

CCEE NEWS

DEPARTMENT OF CIVIL, CONSTRUCTION,
AND ENVIRONMENTAL ENGINEERING
NC STATE UNIVERSITY | FALL 2020

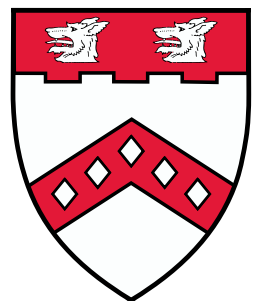


NIEHS SUPERFUND RESEARCH CENTER ESTABLISHED 10

TRACKING COVID-19 IN WASTEWATER TO HELP MANAGE THE PANDEMIC 03

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IN THIS ISSUE

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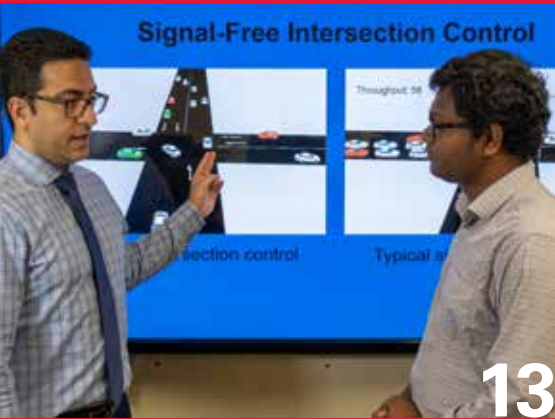
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CCEE News is published by the Department of Civil, Construction, and Environmental Engineering to share information among faculty, staff, students, alumni and friends of the department.



IN THE SPOTLIGHT

CENTER OF EXCELLENCE ON MOBILITY AND CONGESTION ESTABLISHED AT NC STATE

PAGE 13

As part of the NCDOT university-based Centers of Excellence, this new center will bring innovation to the state's transportation system by drawing on the collective strengths of collaborative, multi-university research teams.



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ABOUT THE COVER

In 2016, NC State and EPA scientists reported the presence of PFAS at high concentrations in North Carolina's Cape Fear River, and the drinking water supply of more than 200,000 North Carolinians. A new NSF SuperFund Center will study health effects and remediation strategies. See story on page 10. (Photo courtesy of Alan Cradick for Cape Fear River Watch).



Dr. Morton Barlaz

LETTER FROM THE DEPARTMENT HEAD

Dear Friends, the last newsletter was published in late February, at which time airports, hotels, and the Mann Hall classrooms and lobby were full, and the severity of COVID-19 was not dominating our daily lives. Our world has changed. We shifted to online instruction in March and completed the Spring semester successfully. We were unable to hold a formal graduation ceremony but did produce a *Celebration of Accomplishments* video to recognize our graduates. Fast forward to the Fall semester. We started with a mix of online and face-to-face instruction. Unfortunately, due to COVID-19 spread, we were forced to return to all online instruction at the undergraduate level after just two weeks. Fortunately, our faculty were prepared and the transition has been reasonably smooth. Our research labs, which were closed from the middle of March through late May, are open and functioning with multiple precautions and reduced capacity. While graduation dates for some Master's and Ph.D. students will be delayed by a semester, we are on the road to recovery for our research mission. I

feel badly for our students who cannot have the traditional college experience, but we are in uncharted waters and must adapt.

Let's transition to news that will impact NC State and CCEE for the next 50 years. The university assumed beneficial occupancy of Fitts-Woolard Hall (FWH) in late July and we started moving in early August. We are moving gradually over the fall semester and plan to fully occupy the building by December. I want to express my deep gratitude to Edward I. Weisiger Distinguished Professor Emeritus **Dr. David Johnston** for his dedication and attention to detail during the design phase and for managing our complex move into FWH. Please see the story and pictures on **page 18**.

I am pleased to share that three of our junior faculty, **Alex Albert** (Construction), **Doug Call** (Environmental) and **Dan Obenour** (Water Resources) were promoted to associate professor with tenure. In addition, **Joe DeCarolus** (Energy Systems) was promoted to professor. The opportunity to serve in a department with so many talented faculty members is the best part of my position as department head.

I hope you share my pride in the Department's teaching, research, and extension activities. This newsletter features research briefs to highlight the Department's contributions to the well-being of society. **Dr. Shane Underwood** is using data on COVID-19-associated changes in traffic to understand how human hazards affect traffic patterns. **Drs. Kevin Han** and **Abhinav Gupta** are developing a virtual system to improve the management of construction at nuclear power plants. **Drs. Francis de los Reyes, III**, and **Angela Harris** are tracking the spread of COVID-19 by sampling wastewater and looking more broadly at relationships between community health and indicators in wastewater. **Dr. Detlef Knappe**, S. James Ellen Distinguished Professor, is co-leading NC State's first NIEHS Superfund Research Program and will study the environmental and health effects of per- and polyfluoroalkyl substances (PFAS).

In closing, COVID-19 is presenting perhaps the biggest challenges that universities have faced. We are designed, built and operated for human interaction. We thrive on those interactions in the classroom, in research meetings, in student group activities and in interacting with peers at conferences and workshops. While virtual meetings have been a lifesaver, they are not a complete substitute. We all look forward to resuming in-person interactions as soon as it is safe to do so.

I always enjoy meeting people interested in the department. Please let me know if you are in the area and would like to tour our Fitts-Woolard Hall. I hope that you and your families are staying safe and healthy and I look forward to in-person gatherings in 2021. Thank you as always for your support.

Morton A. Barlaz

Distinguished University Professor and CCEE Department Head



One car drives through what is normally a packed traffic circle in front of NC State's Bell Tower in late March 2020. (Photo courtesy of Julia Wall, *News & Observer*)

RESEARCH UPDATES

Traffic on the clover leaf interchange at U.S. Route 1 and Interstate 40, pictured here in late March, dwindled when COVID-19 restrictions were put in place. (Photo courtesy of Julia Wall, *News & Observer*).

What can we learn from how traffic patterns changed during the pandemic?

The COVID-19 pandemic has affected every aspect of peoples' lives including their mobility. As Americans shifted to working from home and engaged in fewer social activities, many family cars sat idle. Reduction in mobility following COVID-19 restrictions was evident, but just how much did traffic decrease, and how quickly did it return to normal?

Graduate students **BORIS GOENAGA**, **NARGES MATINI**, and **DEEPIKA KARANAM**, under the supervision of **DR. SHANE UNDERWOOD**, examined how this pandemic affected traffic patterns in North Carolina and Virginia using data from over 300 Department of Transportation traffic stations throughout the adjoining states. "The students and I began this work to quantify how human hazards affect traffic patterns in the hopes that we might find parallels to understand how natural hazards, like hurricanes, can do the same. Many times these natural hazards cause the stations to fail and so valuable data is lost," Underwood explains.

Over the last three weeks in March, the total traffic system in North Carolina and Virginia showed 40 percent fewer vehicles on the roads. Between March 16 and May 15, the overall average reduction was approximately 26 percent. "We were not surprised to see the large reductions, but the really interesting thing was how quickly the traffic volumes reacted to initial closures and how they recovered," said Goenaga. "We saw a pattern very similar to how traffic is disrupted during catastrophic natural events with the traffic reducing very rapidly at about 20 percent per week, but recovering more slowly at about 2.4 to 4 percent

per week," added Matini. The researchers also observed different patterns for different types of vehicles. "We were able to see clearly that trucking was substantially less impacted, about a 15 percent overall reduction compared to more than 40 percent for passenger vehicles," Karanam said.

"This study has shown how intimately interconnected our built-environment is with social and human services, how human-related hazards can have unforeseen cascading effects to our roadways and other civil infrastructure, and how complicated it is to capture and quantify these impacts."

DR. SHANE UNDERWOOD

Disruptions to the traffic patterns have had direct impacts, both positive and negative. Reduced traffic loads give pavements more time to recover between heavy loads, and may mean fewer accidents, yet it can mean less gas tax revenue for state highway agencies. "Our findings are most beneficial to roadway and pavement managers because they provide insight on what the roadways have experienced during the spring and early summer of 2020 and also provide them with data that can be used for resilience-based decision making in the future," Underwood concludes. ■

Can tracking COVID-19 in wastewater help public health officials manage the pandemic?

Wastewater based epidemiology (WBE) is not new. It's been used for decades to study infectious diseases such as polio, as well as to track the opioid epidemic. The current pandemic has again highlighted the potential value of monitoring municipal wastewater in the U.S. and globally. Researchers from around the globe have created networks to collaborate and the Centers for Disease Control is developing guidelines for WBE methodology.

In mid-March CCEE's **DRS. FRANCIS DE LOS REYES** and **ANGELA HARRIS**, with post-doctoral researcher **DR. NADINE KOTLARZ**, hurriedly assembled a multi-university team and began sampling Raleigh, NC, wastewater to track the spread of COVID-19. With initial funding from the National Science Foundation's RAPID program, the team has been sampling wastewater influent from treatment plants in Raleigh, NC, Washington, DC, Houston, TX, and Los Angeles, CA. "Initially our goals were to verify that the molecular signature of SARS-CoV-2 in wastewater would allow for tracking the spread of COVID-19 in a community and determine whether wastewater system specific features, such as system size, would impact the utility of wastewater surveillance," de los Reyes explained.

In May, their efforts were expanded when the North Carolina Policy Collaboratory awarded \$1.8 million to the NC Wastewater Pathogens Research Network, based on a proposal led by de

los Reyes and Harris, as well as researchers from UNC-Chapel Hill. The network brought together researchers from universities throughout NC along with officials from the NC Department of Health and Human Services and the Department of Environmental Quality, including wastewater specialists, engineers, epidemiologists, and modelers. Samples have been collected at least twice a week at several plants throughout the state.

"The initial results show promise in relating our findings to COVID-19 infection data," Harris said, "but there is more work needed both to refine our testing methodologies and to process and analyze the human health data."

The work has just begun.

Going forward the researchers will explore relationships between community health data and wastewater results. "If wastewater surveillance is to become a tool used to monitor the spread of SARS-CoV-2, then setting expectations for how the data can be used and supporting stakeholders in the data interpretation will be critical in making that happen" Kotlarz said.

The hope is that WBE is recognized as not just an approach for helping to track SARS-CoV-2 in communities, but can also be used for other infectious agents, such as influenza. The researchers believe that WBE can support local and state health departments and policy makers as we all deal with this and future pandemics. ■

Kevin Heavner, Pretreatment Specialist at NRRRF (Neuse River Resource Recovery Facility) collects samples, which are immediately transported to the laboratory on ice, then processed for storage at -80 degrees C or for immediate RNA extraction.

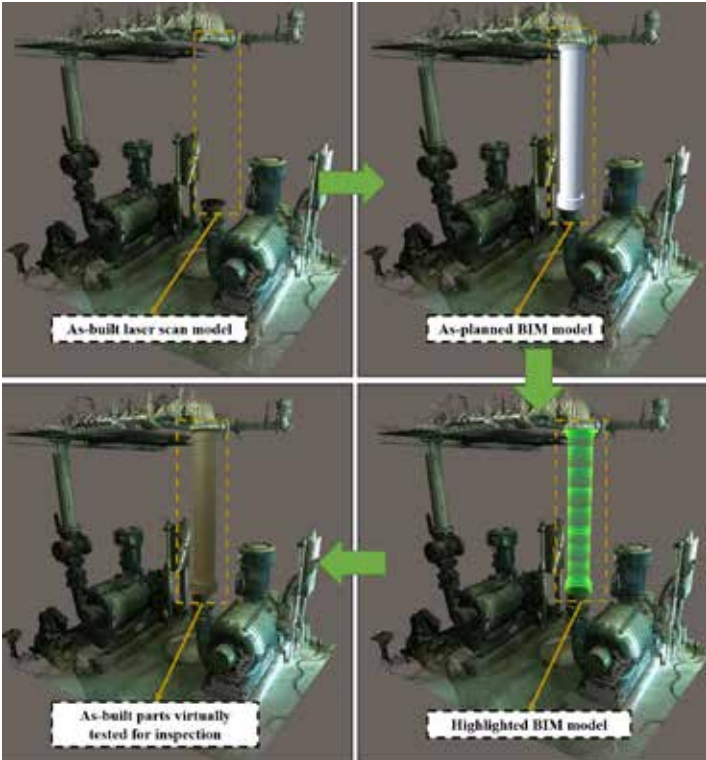


Can virtual reality gaming platforms be used to better manage the construction of nuclear power facilities?

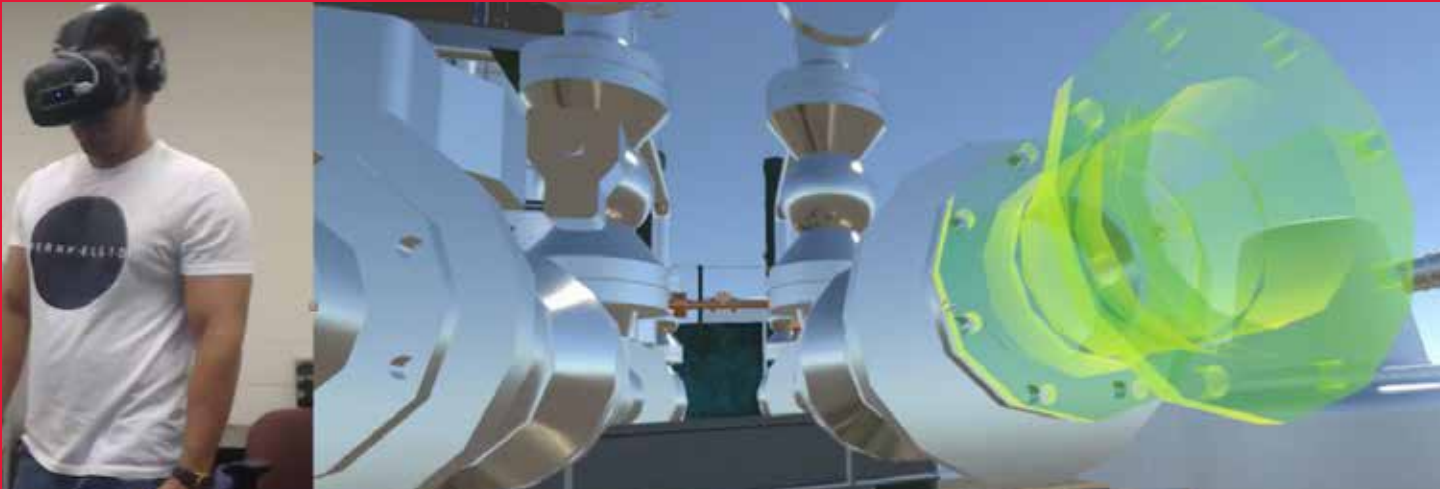
Can gaming engines originally designed for entertainment be useful in the construction of nuclear power plants? **DRS. ABHINAV GUPTA** and **KEVIN HAN** think so. Gupta brings experience in structural engineering, while Han’s expertise lies in construction engineering management. They have a common interest in computational modeling and the desire to diminish risk and avoid unneeded costs and delays on construction projects. The virtual performance management system they’re developing is targeted to the nuclear energy industry, but is applicable to any industry.

With the use of 3-D Building Information Modeling (BIM), engineers and contractors now have the ability to compare ‘as-planned’ models with ‘as-built’ models. The technology that Gupta and Han are developing takes it one step further by capturing the progress and quality of fabricated components that are manufactured at **off-site** facilities. “There is no current technology that incorporates manufacturing progress as part of construction progress,” Han says. “By capturing performance of the supply chain, there is opportunity for digital record generation and management.” This is especially relevant to nuclear energy facilities where there is a heavy burden on documentation of progress and quality. This requirement for documentation has been an ongoing challenge and burden for smaller companies.

“Imagine that you are having a very large steam turbine manufactured in Japan for a nuclear plant being built in the U.S. It is massive, weighs many tons, and will be expensive to ship to the construction site. We can use virtual reality to bring it to the site and confirm it fits properly,” Gupta explains. ■



Above: Building components are scanned off-site, and then their construction fit can be examined virtually, long before they arrive on-site. Below: Drs. Kevin Han and Abhinav Gupta have been researching and developing this technology since 2018 with funding from the Department of Energy’s ARPA-E program and Idaho National Labs where they work in partnership with a Versatile Test Reactor team. In mid-2020, Han and Gupta applied for and received a disclosure for patent for their virtual performance management system.



NEW RESEARCH PROJECTS



Since January 2020, CCEE has launched numerous new research projects with funding from federal and state agencies, foundations, and industry sponsors. This support will enable CCEE faculty members, their research teams, and their collaborators to address problems facing infrastructure and the environment in North Carolina and around the world.

FEDERAL GRANTS

With funding from the National Academy of Sciences and in collaboration with Auburn University, **DRS. RICHARD KIM** and **SHANE UNDERWOOD** will investigate quality assurance aspects of performance related specifications (PRS) for asphalt pavement. This project will advance the use of PRS in highway quality assurance programs. PRS will provide a bridge between design, construction quality, and long-term performance and thus a direct linkage between design expectations and construction quality.

DRS. MORTON BARLAZ, JIM LEVIS and **DETLEF KNAPPE** received support from the U.S. Environmental Protection Agency (EPA) to develop a computer tool to estimate the release of per- and polyfluoroalkyl substances (PFAS) from a number of systems that receive PFAS-contaminated wastes. Initial work will focus on composting, land application, landfills and thermal treatment. Over time, the tool will be extended to emerging technologies. Wastes to be considered include wastewater treatment plant residuals, contaminated soil, construction and demolition wastes, and spent activated carbon.

DRS. KEVIN HAN and **JASON PATRICK**, in collaboration with **DR. TAMECIA JONES** of STEM Education at NC State and Dr. Youngjib Ham of Construction Science at Texas A&M, received funding from the National Science Foundation (NSF) to develop educational tools that consist of visual sensors and mobile devices. These tools will capture student movement on a virtual bridge, simulating and visualizing in real-time the structural behavior of the bridge, helping students learn structural engineering concepts.

DR. FRANCIS L. DE LOS REYES, III, along with Dr. Nadine Kotlarz (Center for Human Health and the Environment) and **DR. ANGELA HARRIS**, are using methods targeting molecular biomarkers to detect and quantify SARS-CoV-2 in wastewater samples. Funded by the NSF, the project involves collecting wastewater and solids samples from the Neuse River Water Resources Recovery Facility (City of Raleigh) through Spring 2021. They are working with colleagues from the University of Southern California, Rice University, and Howard University to compare results from Los Angeles, CA, Houston, TX, and Washington, DC.

DR. ALI HAJBABAIE is collaborating with **DR. LEILA HAJIBABAI** (Industrial and Systems Engineering), Dr. Wei Fan from UNC Charlotte, and Mr. Henry Knipe from the Kercher Group, Inc., to formulate “long-range” plans for replacement of highway operations equipment with support from the National Academy of Sciences. State highway agencies own large fleets of operations equipment that are critical for the delivery of their programs, projects, and services. While a variety of practices have been used for making investment decisions for the operations equipment, there is no widely accepted process for determining the needs and budgets over a period of 20 to 25 years.

DRS. DOUG CALL and **DETLEF KNAPPE** received funding from the EPA People, Prosperity and the Planet (P3) Student Design Competition. The funding will allow a team of undergraduate and graduate students to design, build, and test an electroactive point-of-use filtration system that can improve drinking water quality. The goal is to use a small input of electricity in the filter to enhance the removal of per- and polyfluoroalkyl substances, which are contaminants present in drinking water across the country.

DR. BRINA MONTOYA, with support from the NSF, will study the role of microbes in mineral precipitation that results in exceptional fossil preservation, including preserving soft tissues. By better understanding the process of exceptional fossil preservation and the effect of elevated atmospheric carbon dioxide, the interdisciplinary research team will explore the development of robust, scalable carbon-capture systems. The research team includes collaborators from the Departments of Biological Sciences; Plant and Microbial Biology; and Marine, Earth, and Atmospheric Sciences; as well as the Museum of the Rockies.

DR. ABHINAV GUPTA received funding from Idaho National Lab (INL) to assist with development of probabilistic risk assessment tools in INL’s MASTODON toolkit. The project will help develop capabilities for quantification of component and system level risks through fault and event tree analysis. Quantification algorithms will be considered for risk assessment and for identification of various sequences in the progression of an accident at a nuclear power plant.

DR. ANGELA HARRIS, in collaboration with Dr. Cassandra Workman at UNC Greensboro and Mr. Kenneth Mapunda at Sokoine University

NEW RESEARCH PROJECTS

continued

of Agriculture in Tanzania, received funding from the NSF to conduct research on the relationship between water insecurity, food insecurity and human health. This project combines theory and methods from anthropology, geography, public health and engineering to develop multi-pronged and interdisciplinary approaches to global health challenges. This research will be conducted in Morogoro, Tanzania.

DR. JEREMIAH JOHNSON received funding through the U.S. Department of State and the University of Nebraska at Omaha's Partnership 2020 program to study the impacts of solar water pumping for agriculture in Chhattisgarh, India. In collaboration with the National Institute of Technology - Raipur, the researchers will engage with local farmers and test a prototype solar-powered pump to identify potential operational improvements.

FOUNDATIONS

In collaboration with researchers at the University of Michigan and Ohio State University, **DR. JEREMIAH JOHNSON** received funding from the Sloan Foundation to improve methods to compress and inject carbon dioxide into deep saline aquifers, enabling geothermal energy production and bulk energy storage. These technologies offer the potential for energy systems to achieve net negative greenhouse gas emissions while providing valuable energy services.

DRS. ANDY GRIESHOP and **EMILY BERGLUND**, with a team of five other CCEE faculty, were awarded a planning grant from VentureWell to support development of a new innovation- and entrepreneurship-based academic track for CCEE undergraduates. The initiative, Training for Innovation in Smart and Sustainable Infrastructure (TISSI), builds from ongoing 'smart city' research activities and enhances links to NC State's existing entrepreneurship ecosystem to develop a course in which students develop marketable ideas for sustainable infrastructure.

DR. MOHAMMAD POUR-GHAZ received funding from the Environmental Research and Education Foundation (EREF) to develop guidelines for repair strategies and repair material selection that can be used for the repair of waste transfer stations without the need for specialized equipment and labor. The premature deterioration of concrete overlays in waste transfer stations is a major operational problem.

Targeting effective interventions to reduce air pollution health risk requires quantifying when and where people are exposed. Sponsored by the HSBC 150th Anniversary Charity Programme via the Hong Kong University of Science and Technology (HKUST), **DR. H. CHRISTOPHER FREY** is developing models of human exposure to multiple air pollutants in Hong Kong. This is part of a larger project led by Professor Alexis Lau at HKUST, where Frey is an adjunct professor, that combines sensors, big data, air quality, and exposure to inform decision-makers.

INDUSTRY AWARDS

With funding from Applied Research Associates, **DRS. SHANE UNDERWOOD**, **CASSIE CASTORENA**, and **RICHARD KIM** will evaluate a test method that has been identified as critical to asphalt pavement performance and design. The method is used to measure the temperature and speed dependent modulus of asphalt concrete, which is used in structural analysis and design of pavement structures and other material modeling. The researchers will statistically refine the procedure to facilitate widespread adoption and implementation.

NC State's Center for Nuclear Energy Facilities and Structures (CNEFS), led by **DR. ABHINAV GUPTA**, received support from the Korean Atomic Energy Research Institute, who joined the Center to support research to better understand the seismic behavior of electrical systems and substations. Continued functionality of digital control equipment in nuclear plants is vulnerable to high frequency vibrations. Records from recent earthquakes in South Korea and in the eastern U.S. have contained high frequency ground motions which is unlike earthquakes in the western U.S.

DRS. GREGORY LUCIER, **GIORGIO PROESTOS**, and **RUDOLF SERACINO**, in collaboration with Mr. Gary Klein of Wiss, Janney, Elstner Associates, Inc., received funding from the Precast / Prestressed Concrete Institute (PCI) to study dapped ends in deep prestressed beams and in beams using lightweight concrete. Daps are the notches sometimes created at the ends of precast concrete beams to enable a better fit between the beams and their supporting members. Daps are an important tool for minimizing the floor-to-floor height of a building, and thus, they facilitate the efficient use of construction materials.

DR. BRINA MONTOYA received funding from NewFields to develop a bio-mediated soil stabilization technique to improve the mechanical response of mine tailings. Failure of mine tailing dams can be catastrophic for the nearby communities and the environment. Microbial processes can be harnessed to induce cementation within the mine tailings, thus stabilizing the material and preventing dam instabilities.

STATE AGENCY AWARDS

DR. CASEY DIETRICH received funding from NC Sea Grant to study how North Carolina estuaries respond to hurricanes. He will develop numerical models to understand how storm surge moves up the estuaries, how quickly the fresh river and saline ocean waters are mixed, and how long it takes for the estuary to re-stratify. This research will improve predictions of estuary response during future storms.

The state of North Carolina has funded COVID-19 projects across different UNC-system universities. At NC State, **DRS. FRANCIS L. DE LOS REYES, III**, **ANGELA HARRIS**, **JANE HOPPIN** (Biological

Sciences) and **HELENA MITASOVA** (Marine, Earth, and Atmospheric Sciences) received funding from the NC Policy Collaboratory to quantify SARS-CoV-2 in Cary and Durham wastewater. The research group is relating health indicators and COVID-19 infection data to results of wastewater surveillance for SARS-CoV-2 using molecular methods such as digital droplet PCR.

DRS. SHANE UNDERWOOD and **CASSIE CASTORENA** received funding from the Virginia Transportation Research Council to evaluate recycling agents in pavements. The majority of asphalt mixtures produced today contain a blend of new materials and recycled asphalt materials. There is currently a limit to the amount of recycled material that can be reliably included in new pavements because recycled asphalt can be more prone to cracking than new asphalt. Recycling agents are additives that can be added to asphalt mixtures to restore the properties of the recycled asphalt and thus allow the use of higher amounts of recycled materials without compromised performance. However, the long-term benefits of these recycling agents are not fully known. In this study, they will address these unknowns and develop performance-based specifications for the use of recycling agents.

DRS. MERVYN KOWALSKY and **GIORGIO PROESTOS** received funding from the State of Alaska Department of Transportation (AKDOT) to conduct research on the development of a new reinforced concrete bridge system type that utilizes 'external sockets' to connect components of the bridge. This project will employ computational modelling and large-scale tests to develop an understanding of the connection behavior and to develop recommendations for the design of the bridge system, which must also be robust against earthquakes given the high seismic demands typical of Alaska.

With funding from the AKDOT, **DRS. MERVYN KOWALSKY** and **JAMES NAU** will study the Anchorage Port Access Bypass, which is a major bridge in Alaska's largest city and is located in a very high seismic zone. Using a combination of large-scale seismic tests on half scale models and computational modelling, techniques for enhancement of the bridge's capacity will be explored.

The AKDOT is funding research to optimize the design of pre-stressed concrete bridge girders for enabling longer girder spans. **DRS. RANJI RANJITHAN**, **MERVYN KOWALSKY** and **GIORGIO PROESTOS** are working to develop and apply meta-heuristic search algorithms coupled with structural analysis to identify efficient girder cross-section shapes and tendon configurations. This three-year investigation aims to identify cost-effective and practical girder design alternatives for AKDOT to adopt in field implementations of bridges of different spans over rough Alaska terrains.

DR. ALI HAJBABAIE has received a grant from the Washington State Department of Transportation to develop methodologies for efficient traffic light operations in a connected and automated vehicle environment. The use of connected and automated technologies offers great potential to reduce congestion and its associated costs. This research will enable traffic engineers to determine why, when, and where a connected arterial should be implemented and improve predictions of connectivity and automation.

DRS. DAN OBENOUR and **SANKAR ARUMUGAM** are collaborating with **HELENA MITASOVA** (Geospatial Analytics) on a watershed

modeling project sponsored by the NC Water Resources Research Institute (NC WRRRI). This project will leverage new geospatial datasets on land use, stormwater controls, and other landscape features to better understand drivers of nutrient loading. The research focuses on the watersheds of Falls and Jordan Lakes, which are critical water supplies. The models will be used to assess how future development and management strategies will influence nitrogen and phosphorus loading to these reservoirs.

DRS. TAREK AZIZ and **FRANCIS L. DE LOS REYES, III**, in collaboration with Hazen and Sawyer and the City of Durham, have received support from the NC WRRRI to study a novel method for the removal of nitrogen from wastewater using existing filter infrastructure. The research team will use pilot-scale filters housed at the South Durham Water Reclamation Facility to investigate the technical and economic feasibility of a process called partial denitrification – anammox to remove nitrogen from wastewater with fewer chemical and energy requirements.

DR. FRANCIS L. DE LOS REYES, III, received funding from the NC WRRRI to investigate the effects of anaerobically digesting grease waste with thermally hydrolyzed biosolids. The goal is to increase energy recovery via methane production by understanding the microbial community shifts associated with this unique co-digestion blend. The work is in collaboration with the City of Raleigh and Hazen and Sawyer.

DRS. JOEL DUCOSTE and **MOHAMMAD POUR-GHAZ** received funding from the NC WRRRI to study the adhesion of Fat, Oil, and Grease (FOG) deposits on different sewer line surfaces. These deposits lead to the clogging of sewer lines and wastewater releases to surface waste. Successful completion of this project will provide new strategies to change the sewer lines' surface characteristics, eventually reducing FOG deposit accumulation in sewer collection systems.

INTERNAL AWARDS

DRS. ABHINAV GUPTA and **GIORGIO PROESTOS** received funding from the Center for Nuclear Energy Facilities and Structures to develop advanced simulation models to describe the response of concrete structures to earthquakes. Simulations will account for uncertainties in modeling material behavior of concrete. The research will be based on observations from tests on a three-story concrete structure and will utilize modern statistical tools to assess the risk of failure in concrete structures at a nuclear energy facility.

DRS. DOUG CALL and **JORDAN KERN**, in collaboration with several researchers across the NC State campus, received funding from NC State's Game-Changing Research Incentive Program for Plant Sciences Initiative (GRIP4PSI) to study and develop new electrochemical technologies that can generate on-site nitrogen-based fertilizers for farms. Call will engineer optimized microorganisms to capture nitrogen gas from the air and secrete ammonium in response to electricity. Kern will assess the economics and environmental impact of the technologies. ■



Dr. Douglas Call

DR. DOUGLAS CALL RECEIVES NSF CAREER AWARD

Associate Professor **DR. DOUGLAS CALL** was awarded a Faculty Early Career Development award, also known as the CAREER Award, from the National Science Foundation (NSF). The award is one of the highest honors given by NSF to young faculty members in science and engineering.

NSF will provide \$500,000 in funding over five years to support his project, “Leveraging the multifunctional redox properties of pyrogenic materials to enable biological transformations of aqueous organic contaminants.”

The overall goal of Call’s CAREER research is to protect human and environmental health by developing treatment technologies that more completely degrade toxic organic pollutants in a cost-effective manner. Call’s primary focus will be on degrading chlorinated solvents, a broad class of chemicals used in everyday products such as paints, pesticides, and cleaning solutions. Conventional microbial methods of degrading these and other organic pollutants involve searching for the right kind of microbe with the right kind of machinery (i.e. enzymes) that can act on the pollutant. This sometimes-lengthy process

does not always work in practice, so this research explores a completely different approach.

Call will leverage a unique group of bacteria that are highly abundant in the environments where the pollutants are found including water, wastewater and soils. These bacteria, from the genus *Geobacter*, can “breathe” by transferring electrons into pyrogenic materials such as biochar and activated carbon. Organic pollutants that attach to the surface of these materials can pick up those electrons, react, and transform into less harmful compounds. In essence, these pyrogenic materials provide a specialized conduit between *Geobacter* and pollutants, enabling targeted destruction of pollutants by customizing the material properties, rather than searching for new microorganisms with new enzymes.

Call obtained a B.S. in environmental sciences from the University of Virginia in 2003 and a second B.S. in civil engineering from Virginia Tech in 2005. He received both his M.S. and Ph.D. in environmental engineering from Penn State University in 2008 and 2011, respectively. ■

Funding from the National Science Foundation, which was established in 1950 to keep the United States at the leading edge of discovery, is highly selective and potentially career-changing. This brings our departmental total of CAREER Award winners to 15.

CCEE DEPARTMENT HEAD DR. MORTON BARLAZ HONORED WITH AEESP FOUNDERS’ AWARD

“Professor Barlaz has demonstrated excellence and has been a leader in environmental engineering research, education, and practice throughout his career. He arguably has been the leading solid waste management educator and researcher in North America for the past thirty years.”

Dr. David A. Dzombak
Dept. Head, Civil and Environmental Engineering
Carnegie Mellon University

Early in 2020, **DR. MORTON BARLAZ**, Distinguished University Professor and CCEE Department Head, received the Perry L. McCarty AEESP Founders’ Award. It is given annually by the Association of Environmental Engineering and Science Professors (AEESP) to recognize the significant contributions of Professor McCarty to environmental engineering education, research, and practice. Recipients are considered leaders in their field and honored for their accomplishments in integrating research and education and impacting engineering practice.

“Perry McCarty was a superstar while I was still a Ph.D. student in the mid to late 1980s, and I always looked to him as one of the academics who had a formative impact on environmental engineering research and education. To be recognized with an award in his name by my colleagues in environmental engineering is a very meaningful highlight of my career. “

Dr. Morton Barlaz



Dr. Morton Barlaz

Barlaz started his academic career at NC State as an assistant professor in 1989, served as associate department head for about seven years and is in his 11th year as department head. “Our department is among the largest in the country with more than 50 faculty, almost 800 undergraduates, over 300 graduate students and three ABET accredited degrees,” said **DR. FRANCIS DE LOS REYES, III**. “Since 2011, he has overseen the hiring of 21 faculty and transformed the department. While leading the department, he also has become one of the most well-known and accomplished scholars in solid waste engineering today.”

Barlaz’s research focus includes the microbiological and chemical processes that occur in landfills and anaerobic digestors, as well as the application of life-cycle analysis to solid waste management systems. His research has included the impact of solid waste collection, treatment and disposal processes on the production of greenhouse gases including methane and carbon dioxide. His work is highly regarded by both academics and industry, and he has had a profound impact on the way landfills are managed.

In addition to leading the department, lecturing, and researching, Barlaz has published over 150 peer-reviewed journal articles. He participates in prestigious national and international symposia, and mentors several graduate students each semester.

We extend heartfelt congratulations and a deep sense of gratitude for all that Barlaz has done for this department, and his field. His research findings continue to be translated into policy and practice, contributing to a more sustainable world. ■

How Did We Get Here?

For almost a decade, CCEE researcher Detlef Knappe has been studying the Cape Fear River basin and other North Carolina rivers and streams, identifying contaminants and their concentrations in drinking water. His water quality research was not widely known by the public until a paper published by his research group in late 2016 got the media's attention.

In June 2017, people in Wilmington woke up to an article in the *Wilmington Star News* explaining that the drinking water of more than 200,000 North Carolinians contained high levels of PFAS, including the chemical GenX. To understand levels of human exposure, Knappe has been a co-investigator on the GenX Exposure Study, led by **DR. JANE HOPPIN**, a professor in the Department of Biological Sciences at NC State.

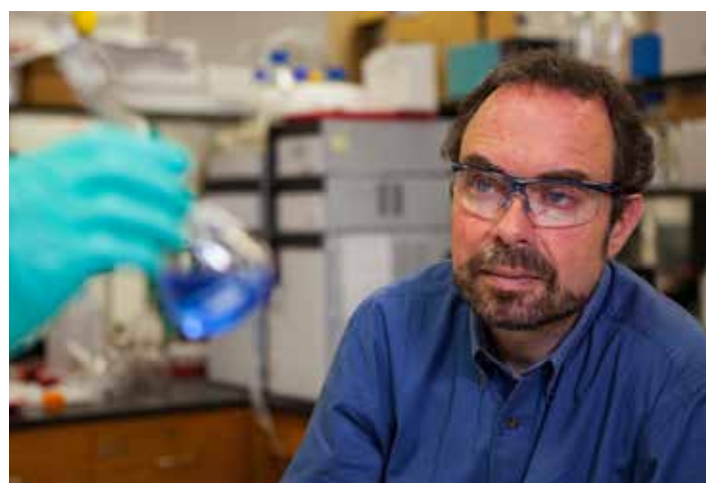
"Detlef's early work was absolutely critical in laying the groundwork for our ability to receive funding for the new Superfund Research Center."

DR. JANE HOPPIN

"A lot of the PFAS we found have never been studied, and the question that is on everybody's mind in impacted communities, where residents drank the water, is 'how much of this stuff is in me, what health effects might it have caused, and what has this potentially done to my children?' I have witnessed some deeply moving moments at community meetings and when we collected people's blood and drinking water for PFAS analysis. The other big question everyone has is 'how can we better treat or filter our water to lessen our future exposure?'"

DR. DETLEF KNAPPE

NIEHS Superfund Research Center allows for continuation of important PFAS research



Dr. Detlef Knappe in the lab.

In March 2020, researchers from NC State received a five-year, \$7.4 million grant from the National Institute of Environmental Health Sciences (NIEHS) Superfund Research Program to establish a Center for Environmental and Human Health Effects of Per- and Polyfluoroalkyl Substances (PFAS). This Superfund Research Center will bring together collaborators from NC State and East Carolina University (ECU), the Cape Fear River Watch, Sustainable Sandhills, and the Haw River Assembly. The researchers include environmental

engineers, biologists, chemists, medical doctors, veterinarians, molecular biomedical scientists, and individuals with expertise in bioinformatics and data visualization. This interdisciplinary group is led by **DR. CAROLYN MATTINGLY**, Head of NC State's Department of Biological Sciences. **DR. DETLEF KNAPPE**, the James Ellen Distinguished Professor in the Department of Civil, Construction, and Environmental Engineering (CCEE), is the Deputy Director.

WHAT WILL THE SUPERFUND RESEARCH CENTER DO?

The Superfund Research Center will bring together collaborators to study the toxicity of PFAS which are now recognized as a major public health concern. Research will explore how they might accumulate in the environment and the human body, and how human exposure can be reduced through effective water treatment technologies. The Center will also foster partnerships with policy makers and the general public.

FOUR DISTINCT PROJECTS WILL BE CARRIED OUT SIMULTANEOUSLY

- *PFAS exposure and thyroid related health outcomes in communities along the Cape Fear River, NC.*

This project will build on the GenX exposure study that started in 2017. With additional funding, the cohort of individuals who will provide blood and urine samples will be increased from about 500 individuals to 1,000. The focus is on the potential detriments to the thyroid function in people who were exposed to PFAS. This project will be led by Dr. Jane Hoppin and Knappe will continue to participate in this project.

- *Uncovering the mechanisms of PFAS-induced immunotoxicity: an important public health endpoint.*

Concerns are that PFAS might negatively impact the human immune system, manifesting in greater susceptibility to disease. Using animals including mice and zebrafish, investigators from ECU and the NC State Vet school conducting this toxicology study will try to better understand the effect of novel PFAS on the immune system.

- *Integrating experimental and field studies to understand PFAS bioaccumulation and impact in aquatic food webs.*

This study seeks to understand how PFAS behave in the food chain. If algae take up PFAS, and the algae are eaten by insect larvae or fish, and the fish are eaten by alligators or people, will

the chemicals accumulate throughout the food chain and lead to greater toxicity at the top of the food chain? Laboratory and field studies will examine mayflies, zebrafish, and wildlife in the Cape Fear River Basin.

- *Uncovering Mechanisms of PFAS Adsorption by Granular Activated Carbon to Support PFAS Remediation.*

This study will be led by Knappe with co-investigator CCEE Department Head **DR. MORTON BARLAZ**. They seek to better understand how granular activated carbon adsorbs PFAS so that more effective materials for PFAS remediation can be designed. They will also investigate potential long-term release associated with disposal of spent activated carbon in landfills in order to contribute to the creation of safer and more cost-effective drinking water treatment and groundwater remediation systems.

Four Supporting Cores

In addition to specific research projects, the Center includes supporting functions to manage data between projects, provide analytical support, engage with community stakeholders and provide training for graduate students and postdocs to engage in interdisciplinary research. CCEE’s **DR. RANJI RANJITHAN** is co-director of the Research Experience and Training Coordination Core. “Our training program will involve authentic learning with a focus on real-world projects involving PFAS. We will build communications skills and increase fluency across disciplines and integration of the trainees into the team science approach,” Ranjithan said. “We want to develop future leaders and outstanding investigators capable of conducting high-impact research.” ■

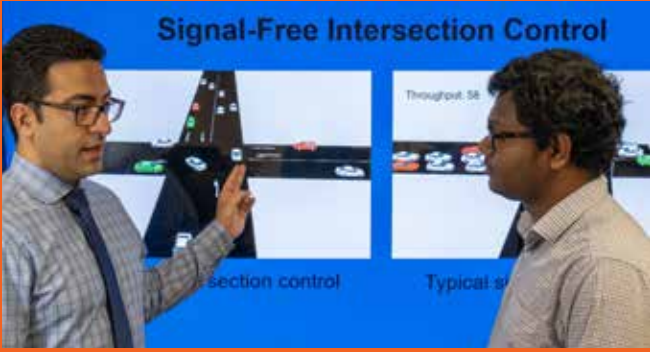
Cape Fear River Watch and NC State University, Department of Biological Sciences, cooperate in the capture and release of alligators on Greenfield Lake. Once captured, the animals are measured, tagged and blood is drawn to determine if GenX has entered the bodies of animals in the watershed. (Photo courtesy of Alan Cradick).



Center of Excellence on Mobility and Congestion established at NC State

In late 2019, the North Carolina Department of Transportation (NCDOT) announced the creation of three university-based Centers of Excellence (CoE) to develop solutions to the problem of increasing traffic congestion. The NCDOT plans to bring innovation to the state’s transportation system by drawing on the collective strengths of collaborative, multi-university research teams.

DR. BILLY WILLIAMS, CCEE professor and director of the Institute for Transportation Research and Education (ITRE), is serving as director of the CoE on mobility and congestion led by NC State. NC State researchers are joined by research leaders from Duke University, Fayetteville State University, NC A&T State University and UNC-Chapel Hill. Williams said. “The NC State based Center will research traffic prediction, the role of autonomous vehicle fleet management, and how to provide convenient, reliable and safe transportation options to rural communities and underserved individuals,” Williams said.



A collection of three interdisciplinary projects are under way that together span a broad range of mobility concerns, namely efficient traffic signal control, active management of autonomous vehicles, and transit’s role in healthcare access.

Deep learning software for traffic state prediction

This project aims to create prototype artificial intelligence empowered software to optimize traffic signal control settings using real-time data, including high resolution video. CCEE researchers **DRS. ALI HAJBABAIE** and **GEORGE LIST** are part of the multi-university team working on this project.

Smart connected and automated vehicle fleet management: Developing regional dispatch decision support for congestion mitigation

This project will provide a detailed operational framework for traffic management in the presence of an increasing number of self-driving vehicles. CCEE’s **DRS. ELENI BARDAKA** is a co-principal investigator and **NAGUI ROUPHAIL** a senior researcher.

“Remote monitoring of autonomous and connected vehicles by transportation network operators will probably be required in the future. We are excited to explore and simulate how individual vehicles or vehicle fleets could be monitored and managed remotely and help NCDOT plan for future operations.” Bardaka said.

Transit and MaaS (Mobility as a Service) role in improving economic and healthcare access for underserved populations

Bardaka is also part of a project to develop a decision support tool that enables transit agencies to evaluate strategies to improve access for underserved populations. MaaS solutions integrate all stages of the journey of a commuter, including trip planning, booking, e-tickets, and payments. ■

Left, from top to bottom: Dr. Ali Hajbabaie, left, and Ph.D. student S.M.A. Bin Al Islam, use computational modeling to research the effect of autonomous and connected vehicles on traffic systems.

North Carolina traffic on Interstate 40.

AWARDS & HONORS



Dr. Emily Berglund

DR. EMILY BERGLUND, Professor of Environmental Engineering, received the 2020 Best Seminal Paper Award for her article entitled “State of the Art for Genetic Algorithms and Beyond in Water Resources Planning and Management.” A second article entitled “Review of Modeling Methodologies for Managing Water Distribution Security” was included in the *Editor’s Choice Collection*. These papers were published in the *ASCE Journal of Water Resources Planning and Management*.

DR. FRANCIS DE LOS REYES, III, Professor of Environmental Engineering, was recently elected as a Corresponding Member of the National Academy of Science and Technology, Philippines (NAST PHL). Corresponding Membership is conferred on non-resident Filipino scientists who have made exemplary contributions to the advancement of science and technology, have continuing connections and contributions to Philippine science, and regularly come to the Philippines to practice in their field. NAST PHL is that country’s highest recognition and advises the government on issues related to science and technology. De los Reyes leads the Global Water, Sanitation and Hygiene (WaSH) cluster at NC State.

DR. FRANCIS DE LOS REYES, III, was awarded a 2020 Patents for Humanity Award for the development of the Flexcrevator. The United States Patent and Trademark Office (USPTO) makes this honor to honor game-changing innovations that address



Dr. Francis de los Reyes, III, center, shows a prototype of the Flexcrevator.

long-standing development and humanitarian challenges. The Flexcrevator is a pit emptying machine that removes fecal sludge and trash from pit latrines. It alleviates the need for manual removal of fecal sludge, thereby protecting workers from the dangers of human pathogens. The Flexcrevator has been in development at NC State since 2011 when the very first designs came from an undergraduate senior design project. Its development was initially funded by the Gates Foundation. It has been through several prototypes and tested in South Africa, India and Malawi. Today, de los Reyes and his team are working with partners in Madagascar and Ghana to continuously test the performance and gather business data.



Dr. Joel Ducoste

The Water Environment Federation (WEF) named **DR. JOEL DUCOSTE**, Professor of Environmental Engineering, a WEF Fellow. The WEF is a not-for-profit technical and educational organization of 35,000 individual members and 75 affiliated Member Associations representing water quality professionals around the world. The WEF Fellows Program recognizes the professional achievement, stature, and contributions of WEF members to the preservation and enhancement of the global water environment.



Dr. Chris Frey

DR. CHRIS FREY, the Glenn E. Futrell Distinguished University Professor, received the 2020 Alcoa Foundation Distinguished Research Award. This award is made to a senior faculty member for research achievements over a period of at least five years at NC State. Frey is recognized as an international leader in the area of air quality. In the past five years, Frey’s contributions have focused on measurement and modeling of the activity, energy use, and emissions of on-road and non-road vehicles; and modeling of human exposure to air pollutants and the associated risks.



Dr. Abhinav Gupta

DR. ABHINAV GUPTA, Professor of Structural Engineering and Mechanics, became President of the International Association of Structural Mechanics in Reactor Technology (IASMiRT) in August 2019. He is the 23rd president of the association and will serve in this role for two years. IASMiRT was established in 1971 in Berlin, Germany, and has had a strong membership of structural mechanics experts from around the world.



Dr. Richard Kim

The American Society of Civil Engineers (ASCE) has honored **DR. Y. RICHARD KIM**, the Jimmy D. Clark Distinguished University Professor, with the 2020 Francis C. Turner Award for his extraordinary contribution to the fundamental characterization of transportation materials and its application to mechanistic pavement analysis and design. Kim is one of the most respected pavement engineers in the nation. His research interests are in the areas of pavement mechanics, material characterization and asphalt concrete behavior modeling.



Dr. James Levis

Research Assistant Professor of Environmental Engineering **DR. JAMES LEVIS** had two papers recognized by the journal *Environmental Science and Technology*. The first article that was part of alumna Dr. Megan Juanich’s (Ph.D. 2019) dissertation is entitled “Solid waste management policy implications on waste process choices and systemwide cost and greenhouse gas performance” and was selected as the 2nd runner up best policy paper. Another paper Levis co-authored entitled “Economics of enhancing nutrient circularity in an organic waste valorization system” was chosen as the 1st runner-up best policy paper.



Dr. Greg Lucier

DR. GREG LUCIER, Research Associate Professor and Constructed Facilities Laboratory Manager, was awarded a Precast / Prestressed Concrete Institute (PCI) Educator of the Year Award. This award recognizes early-career contributions to the PCI education mission or a singular, truly significant contribution to education.

DR. SAMI RIZKALLA, Distinguished Professor Emeritus of Civil and Construction Engineering, was elected as an Honorary Member of the American Concrete Institute (ACI) in recognition of his contributions to the work and mission of the ACI. This honor was bestowed by the 2020 ACI Board of Direction “for lifetime outstanding achievements in education and research, and his pioneering role and long-term dedication to advancing CFRP technology and research.”



Ashley Bittner with her father.

ASHLEY BITTNER, a Ph.D. student in **DR. ANDREW GRIESHOP**’s air quality engineering research group, received the Pursuit of Knowledge Scholarship for the 2020-21 academic year. The scholarship was awarded by VT Group, a private American defense and services firm with over 700 employees. The annual scholarship program aims to support post-secondary education opportunities for children of the company’s employees. Bittner received one of four scholarships awarded by VT Group this year and was noted for her “compelling and inspiring” application, making her father (a VT Group Mechanical Engineer) very proud!



Minerva L. Bonilla Ventura

MINERVA L. BONILLA VENTURA, a Ph.D. student in Construction Engineering advised by **DR. WILLIAM RASDORF**, was awarded

AWARDS & HONORS

continued

an International Research Experience fellowship by the National Science Foundation. This fellowship is provided to support graduate civil engineering students through semester-long world-class research experiences. Ventura will join a research program at the Construction Innovation Centre at the University of Alberta, Canada, which is one of the seven premier international universities in this program. Her work will focus on the constructability of diverse, modern, unique highway interchanges and intersections.



Komal Charania

KOMAL CHARANIA, a master's student advised by **DR. MORTON BARLAZ**, received the Floyd Hasselriis Education Support Award from the American Society of Mechanical Engineers (ASME). This scholarship is awarded to a student that plans to work in the area of solid waste engineering. Her research is focused on the abiotic hydrolysis of cellulose under landfill conditions and the anaerobic biodegradability of different types of cotton under simulated landfill conditions.



Laura Dalton

LAURA DALTON, Ph.D. student advised by **DR. MOHAMMAD POUR-GHAZ**, was selected for a Fulbright award to study in Finland. Her research at NC State focuses on structural engineering and mechanics. Her program in Finland was scheduled to start in the Fall 2020 but has currently been postponed until January 2021. She will work under the guidance of two Finnish professors, Aku Seppänen and Samuli Siltanen, renowned for their expertise in Electrical Impedance Tomography (EIT). The Fulbright U.S. Student Program is the largest U.S. exchange program for students to immerse in another culture, complete research, and learn new skills while acting as an ambassador on behalf of the United States.

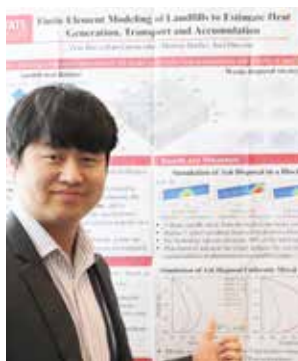
MAKSIM ISLAM, Ph.D. student in Environmental Engineering, was awarded two prestigious scholarships including one from



Maksim Islam

JACOBS Engineering and one from the Air and Waste Management Association (AWMA). He was awarded the Graduate Research Scholarship from JACOBS Engineering for his written proposal titled "Exploring Two Aspects of Cookstove Emissions — Brown Carbon Absorption and the Link Between Emission and Indoor Airquality." Additionally, Islam received the "Dave Benferado

Scholarship" from AWMA in recognition of his academic excellence and professionalism. This international scholarship is awarded each year to a young researcher performing exceptional research in the area of control and / or waste minimization. Islam is advised by **DR. FERNANDO GARCIA MENENDEZ**.



Dr. Zisu Hao presenting.

DR. ZISU HAO was awarded first place for a student poster at the 2020 Global Waste Management Symposium that was held in Palm Springs, CA, in February, 2020. Hao recently completed his Ph.D. under the supervision of **DRS. MORTON BARLAZ** and **JOEL DUCOSTE**. His poster was titled "A Finite Element Model Describing Heat Generation, Transport, and Accumulation in Elevated Temperature Landfills." Hao was one of six students and faculty members from the department that attended the conference.



Megan Johnson

Ph.D. student **MEGAN JOHNSON** was selected as one of the American Geophysical Union's (AGU's) "Voices for Science." AGU's Voices for Science program trains scientists to serve as effective communicators of the value of Earth sciences to decision-makers, journalists, and the general public. The program's

2020-21 class includes a cohort of 40 scientists in all career stages from a diverse group of institutions. Johnson, who is mentored by **DR. FERNANDO GARCIA MENENDEZ**, is researching the use of modeling tools to help land managers estimate smoke impacts and schedule prescribed burns at times that will have the least negative effects on human health.



Jessi Thangjitham

Ph.D. student **JESSI THANGJITHAM** was awarded the Barbara S. and W. Calvin McCall Carolinas American Concrete Institute (ACI) fellowship. This fellowship offers travel to two ACI Conventions, an educational stipend, an industry mentor, and recognition in Concrete International magazine. Thangjitham's application essay highlighted her research on the seismic behavior of concrete bridge columns constructed with high-strength steel

and her aspirations to advance future generations of engineers through teaching. She will also be participating in the NC State "Preparing for the Professoriate" program this fall. Earlier this Spring, Thangjitham, who is mentored by **DR. MERVYN KOWALSKY**, was also chosen to participate in a national NSF program, the PREEMPTIVE New Zealand Advanced Studies Institute. She was to present her research at the annual Conference of the New Zealand Society for Earthquake Engineering, but the event was postponed due to COVID-19.



Joseph Weaver

Ph.D. candidate **JOSEPH WEAVER** recently received the annual W. Wesley Eckenfelder Graduate Research Award from the Environmental Engineering and Science Foundation (EESF). It recognizes an environmental engineering or environmental science graduate student whose research contributes to the knowledge pool of wastewater management. Weaver works closely with CCEE's **DRS. JOEL DUCOSTE** and **FRANCIS DE LOS REYES, III**. He is particularly

interested in solving environmental problems through beneficial

microbial behavior, and his work combines his former career as a software engineer and his current training in microbial ecology.

Ph.D. student **MARLEE STRONG**, advised by **DR. BRINA MONTOYA**, received a National Science Foundation Graduate Research award for her proposal entitled "Self-healing and Self-sensing of Interlaminar Delamination in Fiber-Reinforced Composites via Thermal Remending." Two other students received honorable mention: Ph.D. student **SAVANNAH SMITH**, advised by **DR. FRANCIS DE LOS REYES, III**, and Master's student **ASHTON STUART**,



Marlee Strong

advised by **DR. GIORGIO PROESTOS**. Smith's proposal was entitled "Harnessing fungi to tackle a global water quality issue," and Stuart's proposal was entitled "Shear Response of Concrete Walls Subjected to Combined In-Plane and Out-of-Plane Loading." This year there were 2,076 awards and 1,787 honorable mentions. In a typical year there are 15,000 to 17,000 total applications.

A team of graduate students including **MOJTABA NOGHABAEI**, **KHASHAYAR ASADI**, and **DOYUN LEE** earned First Place in the ASCE Visualization, Information Modeling and Simulation (VIMS) Datathon at the 2020 Construction Research Congress held at Arizona State University in March 2020. They were advised by **DR. KEVIN HAN**. The Datathon was created to accelerate the transformation of academic concepts into practical, innovative solutions for the construction industry, and to help students generate new ways of thinking and bring to light new ideas for approaching complex problems.

Graduate students **JORGE PESANTEZ**, **MOHAMMAD ALI KHAKSAR FASAAE**, and **FAISAL ALGHAMDI**, advised by CCEE's **DRS. EMILY BERGLUND** and **KUMAR MAHINTHAKUMAR**, collaborated with researchers from TU Berlin to compete in BattLe of Leakage Detection and Isolation Methods (BattLeDIM 2020). The team "Leakbusters" won third place from a group of 18 teams from around the globe. They created a computational model to find leaks in a water pipe network using measurements of pressure, flowrate, and demand. ■



MOVING OUT, MOVING IN, MOVING UP.

In early August, a long-awaited day arrived as we began moving our laboratories from main campus to Fitts-Woolard Hall on Centennial Campus.

DR. DAVID JOHNSTON, Edward I. Weisiger Distinguished Professor Emeritus, has been overseeing the move, which has been carefully planned for well over a year. Original schedules were disrupted by closures due to the COVID-19 pandemic, and had to be revised, and sometimes revised again. Faculty members, already having to reformat lectures and labs to online presentations, also had to assist with getting laboratory equipment and supplies ready for transport. Johnston has worked closely with contractors to ensure clear communication

about moving strategies for heavy equipment, delicate instruments, and research specimens that include everything from asphalt core samples, to carefully balanced microbial communities contained in micro-reactors. Here, we offer a few photos of what is an exciting, if challenging, time. ■



Ph.D. students help assemble new equipment in the Cementitious Materials Lab which doubled its space with the move to Fitts-Woolard Hall.



DRS. TASNIM HASSAN and **DAVID JOHNSTON** seen here instructing moving contractors exactly where to place the base for a shake table used in earthquake engineering research. The base weighs about 4,000 pounds, so placement in the right spot in the new laboratory is important.

"A move of this size will always involve difficulties — research interruption, schedule changes, packing in a pandemic, punch list items still under way in the new lab space — but minimizing those impacts and finding last minute work-arounds is the kind of challenge engineers love. After all, we thrive on solving problems and working as a team."

DR. DAVID JOHNSTON



Above: Pieces of a sediment recirculation flume built in and shipped from Minnesota are unloaded. Below: Once assembled in the Hydraulics Lab the flume will be 45 feet long by 3 feet wide and will be capable of 6 cubic feet per second of water flow.



Asphalt lab

"Much of the equipment in the transportation materials lab is very heavy and awkward, but getting it to Fitts-Woolard (Hall) was only part of the battle. Once moved, the equipment had to be properly positioned and calibrated. The most critical equipment was the universal testing machines, which are hydraulically driven machines that move in precisely controlled ways to apply forces to test specimens. A rigging company had to be used to hoist and position them while the researchers looked on and gave inch-by-inch movement directions. Once the equipment was positioned the power, hydraulic, and pneumatic connections had to be made, which required coordination from multiple sub-contractors and technicians. At the same time that all of this was going on, the graduate students, post-docs and faculty were trying to unpack, organize, and store the thousands of miscellaneous parts and pieces that are used for testing asphalt concrete mixtures."

DR. SHANE UNDERWOOD

There are naming opportunities still available for many of the laboratories. Contact Erica Fuller with the NC State Engineering Foundation, Inc., at eacinder@ncsu.edu or 919.515.9958.

GRADUATE STUDENT SPOTLIGHTS

Our research and teaching would not be possible without the assistance of our more than 200 on campus graduate students, each of whom has a strong personal history and a promising future. We shine a spotlight on a few students.

FRANCISCO JATIVA



What were the influences for your interest in engineering?

J: From a young age, I visited construction sites with my dad, who is a geotechnical engineer. Once, he took me to the construction site of a hydroelectric power dam. I was amazed at how they manipulated the environment to make room so that turbines could be installed to generate electricity. I witnessed mountains of dirt being removed by huge trucks, a change to the course of the river so that the dam could be built, as well as tunnels and bridges created to interconnect the whole site. All this monumental work caught my attention from a young age, making me want to be a part of the construction world.

What problem(s) are you trying to solve? Why was NC State / CCEE a good fit for you?

J: The deterioration of cement-based materials is one of the most important infrastructure problems facing society, with more than \$20 billion spent yearly on repair, protection, and strengthening of concrete structures. My research aims at increasing the durability of cement based material and reducing its carbon footprint by intermixing

FRANCISCO JATIVA is a 4th year Ph.D. candidate with an expected graduation date of May 2021. He is from Quito, Ecuador. His area of focus is cement-based construction materials and he is advised by **Dr. Mohammad Pour-Ghaz**.

CO₂ with concrete; CO₂ stabilizes components in concrete that contribute to durability problems. I researched the profiles of the professors here at NC State, and I found very knowledgeable and respected individuals in the area in which I wanted to specialize. Also, CCEE offers a way to earn a Ph.D. without the burden of debt, which is much appreciated by all students.

Where did your passion for this particular focus come from?

J: During my third year of undergrad studies, I joined the student chapter of the American Concrete Institute (ACI) at Universidad San Francisco de Quito. In 2013, I was on a team that participated in the ACI International Student Competition. This event changed my perspective of civil engineering and gave me the push I needed to pursue expertise in concrete technology.

Current thoughts about where you might be or what you might be doing in five years?

J: I envision myself helping push the boundaries of concrete technology by working in academia with a close partnership with the construction industry. ■

NANCY INGABIRE ABAYO is a 2nd year Ph.D. student who is from Rwanda. She is studying geotechnical earthquake engineering and is advised by **Drs. Ashly Cabas** and **Brina Montoya**. She first came to our CCEE department as part of the RISE program, which she writes about below. RISE stands for Research Institute Summer Experience and is intended to introduce our department and the NC State campus and surroundings to potential graduate students from traditionally underrepresented populations.



What were the influences for your interest in engineering?

A: When I was young, I would make mud bricks from scratch and build additional small walls onto my parent's house, but every time it rained my walls would fall. It was fun to try to find new tricks to make the wall stronger. When I was 8 years old, my parents' house was flooded from heavy rain, destroying not just my walls but other 'real' walls in the neighborhood. The flood also destroyed the buried electric pipes and many lost power. I remember asking my older sister what profession would help address such issues and she said "civil engineering." From then on, I decided I wanted to become a civil engineer, even though I didn't fully understand what that was. In 8th grade, I made myself a little badge that said "Ingénieure en génie civil," which is a repetitive way of saying "civil engineer" in French.

I have six sisters, and at least half of my immediate family are engineers or studying engineering.

What problem(s) are you trying to solve? Why was NC State / CCEE a good fit for you?

A: My research seeks to help improve predictive models of liquefaction-induced lateral spreading from seismic events by, in part, exploring the influence of various geologic variables. Sometimes, soils behave as a liquid due to repeated shaking from an earthquake, leading to consequences such as lateral spreading which can

manifest as a series of ground cracks. Predictive models are essential for safer designs in earthquake-prone regions where liquefaction may be expected.

Where did your passion for this particular focus come from?

A: I started working on this research project in the summer of 2018 through the RISE program under the supervision of Drs. Cabas and Montoya. This became the foundation for my doctoral research. The RISE program opened doors that were not on my radar. In 2018, I received the undergraduate research paper award from the Earthquake Engineering Research Institute and then we submitted another paper to an international conference. It was great to work closely with successful female professors. They supported me in my academic success as well as in my outreach project aiming at enhancing STEM education in my home country. These relationships at NC State and the fact that my research topic allowed me to apply my background in both Geology and Civil Engineering made NC State a good fit for me.

Current thoughts about where you might be or what you might be doing in five years?

A: God-willing I will have a job in academia. I do want to teach back home in Rwanda one way or another and also continue to be involved in outreach projects to give back to my community via academia. In fact, it is a big component of my drive for graduate studies. ■

NANCY INGABIRE ABAYO

GRADUATE STUDENT SPOTLIGHT

continued

QIAN LUO



QIAN LUO is from Chongqing, China. She is a 3rd year Ph.D. candidate who hopes to finish her degree by the end of 2022. Her research focuses on the impacts of power systems emissions on air quality and human health as well as how to mitigate these negative impacts through operational strategies. She is advised by **Drs. Jeremiah Johnson** and **Fernando Garcia Menendez**.

What were the influences for your interest in engineering?

L: When I was an undergraduate, I was studying ecology instead of environmental engineering. There is some prejudice against women in China that women are not as good as men in engineering and I almost never thought about being an engineer when I chose the major. But during my undergraduate study, I realized that I really liked math and physics compared with ecology-related courses. So I applied for environmental engineering for my master's program and enjoyed developing models to understand environmental processes.

What problem(s) are you trying to solve? Why was NC State / CCEE a good fit for you? Where did your passion for this particular focus come from?

L: The problem I want to solve in the real world is how to make the power system cleaner in terms of technology or operational strategies. I feel very lucky that I have two advisors in two different fields at NC State. I have been exposed to different projects, such as health impacts of wildfire, the impact of climate

change on air quality, application of energy storage, and building energy efficiency. I also appreciate the friendly vibe not just within my research group but also within the whole department. In addition to my advisors, several other professors have also been helpful to me in my research. CCEE is a good fit because the department does not place any restrictions on what courses a Ph.D. student needs to take and it enabled me to take courses outside of my department that benefit my research most.

Current thoughts about where you might be or what you might be doing in five years?

L: I hope to be working in the field of clean energy and sustainable development. I would like to be working in academia because there will be more freedom to work on what I really want to do, but I also think being a scientist in industry is a cool job. I have some friends working in energy and environmental consulting firms and they are solving problems in real life and also helping promote the establishment of clean energy policy or regulation. I also want to contribute what I learn here by working in a developing country like China on energy transition or air quality control. ■

ALIREZA GHARAGOZLOU is from Iran, where he completed an undergraduate and Master's degree. He is studying the erosion and breaching of barrier islands during storm events. He is advised by **Dr. Casey Dietrich**.



What were the influences for your interest in engineering?

G: After I got my undergraduate degree in civil engineering, I was planning to start my master's in geotechnical engineering. Coincidentally, a friend who had a job on the shore of the Persian Gulf talked about coastal projects and marine science and suggested I consider studies in the coastal-related fields. I researched the topic and surprisingly, it turned out to be exactly what I wanted to pursue. It sounded like a new discipline that I barely touched on during my undergraduate program and I was very excited to learn about waves and beaches!

What problem(s) are you trying to solve? Why was NC State / CCEE a good fit for you? Where did your passion for this particular focus come from?

G: I study the erosion of the sandy dunes and beaches as well as the breaching of the barrier islands during storm events. Hurricanes produce strong waves and surge that can impact the coastal areas significantly. I use computer models to predict these impacts on the beach morphology and the flooding in

the coastal communities. These predictions can help emergency managers take measures to protect the vulnerable regions along the coastline.

It was a challenging decision to leave my home country, but luckily, I joined an amazing and supportive team at NC State. The collaborative environment in the CCEE Department and availability of the computational resources have contributed a lot to my education. In the past four years, I have had the chance to attend many conferences, present my research, and meet students, professors, and engineers in the coastal field which has been a great platform to make contacts and exchange ideas.

Current thoughts about where you might be or what you might be doing in five years?

G: I want to work at a research center or a consulting company. I am excited to work on sustainable beach design, storm surge and flood modeling, and coastal morphological analysis. I think it is time to take a new challenge, to gain new experiences, and to have more responsibility. ■

ALIREZA GHARAGOZLOU

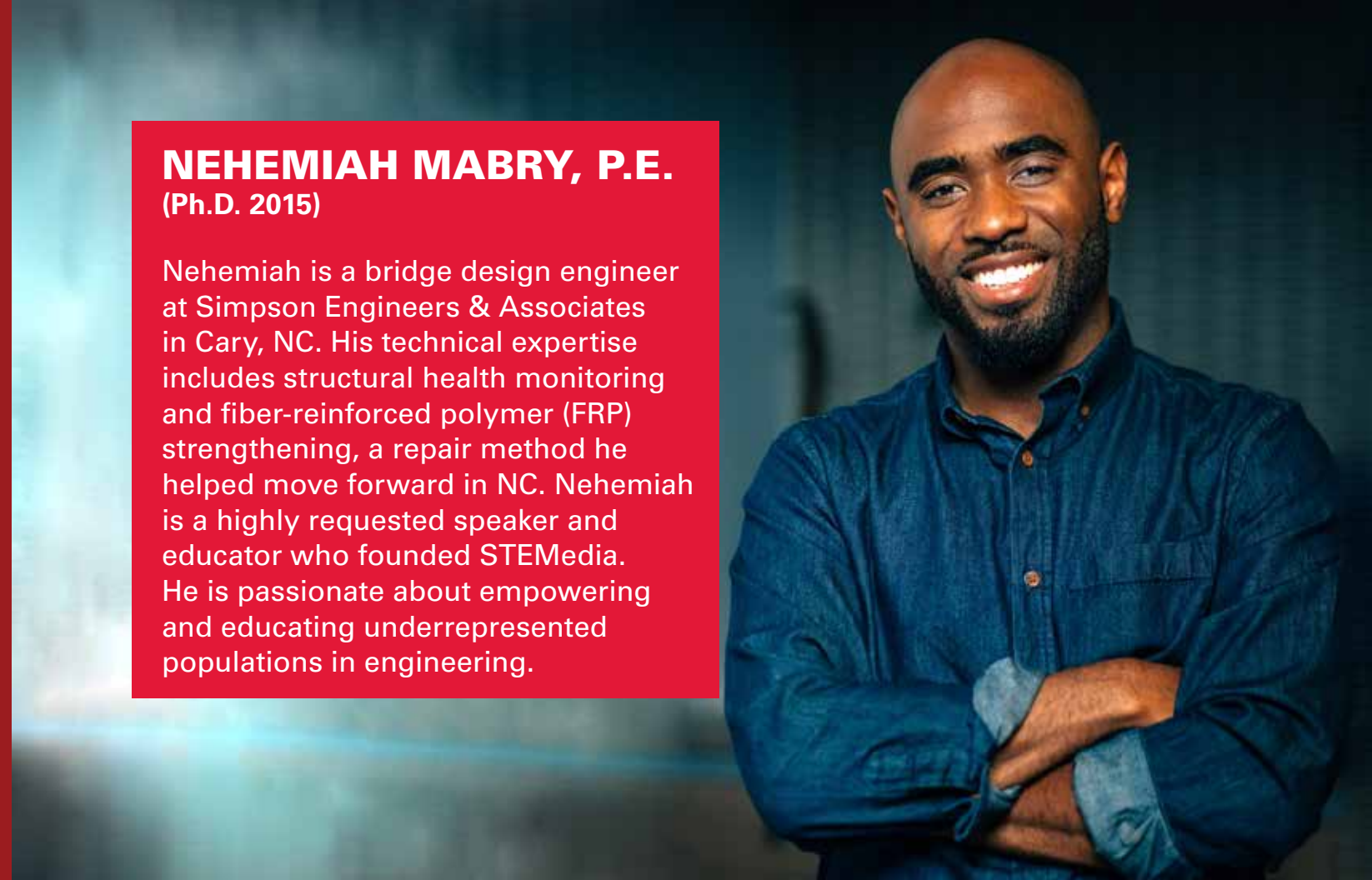
FACES OF CCEE

In this issue instead of our regular alumni feature, we share examples from a media project we are creating for display in Fitts-Woolard Hall. **FACES of CCEE will celebrate outstanding alumni** while at the same time serving to illustrate to current students the many varied careers available to them. This will be an ongoing project in our new building, so if you'd like to bring someone to our attention (*including yourself!*), then please do. We are always interested in keeping up with what our alumni are doing. You can send an inquiry to jwdixon2@ncsu.edu.



CHRISTINE NGUYEN HERRICK
(BSCE 2011)

Christine is a project manager and emerging practice builder for Kimley-Horn in Salt Lake City, UT. Avid Hiker. Tireless Volunteer. Her motto? "Always accept the greater challenge."



NEHEMIAH MABRY, P.E.
(Ph.D. 2015)

Nehemiah is a bridge design engineer at Simpson Engineers & Associates in Cary, NC. His technical expertise includes structural health monitoring and fiber-reinforced polymer (FRP) strengthening, a repair method he helped move forward in NC. Nehemiah is a highly requested speaker and educator who founded STEMedia. He is passionate about empowering and educating underrepresented populations in engineering.

PRASHANT PAI
(MSCE 2001)

Prashant is vice president and general manager of Cyber Solutions at Verisk, a data analytics organization. He works in cyber security developing innovative approaches to management of digital risk and catastrophes. He likens his work to understanding and mitigating the physical risks from earthquakes, or hurricanes. While at NC State, Prashant helped develop computer models to support lifecycle management of solid waste.



LEAH-CRAIG PERKINS, P.E.
(BSCE 2016)

Leah-Craig is a civil engineer at ColeJenest & Stone working in land development for private and public clients. She designs and permits civil sites, including stormwater treatment and detention, storm drainage systems, grading, erosion control, and water and sewer utilities. While at NC State she was the President of the American Society of Civil Engineers Student Chapter.



LEIGH-ANN DUDLEY
(MSENE 2010)

Leigh-Ann is an associate with Dewberry Engineers in Raleigh, NC. She supports manufacturing clients on wastewater process engineering projects. Her work primarily includes process evaluations and troubleshooting, concept level design, and alternative discharge analyses and permitting.



SUSAN DUNN AUTEN, P.E.
(BSENE 2009, MSENE 2011)

Susan is a civil engineer with Black & Veatch in their Cary, NC, office. She specializes in water and wastewater treatment as well as water distribution, wastewater collection systems, and wastewater master planning.



HANNAH MARTIN FORD (BSCE 2018)

Hannah is a staff engineer and assistant project manager at Atlas Engineering. Her responsibilities include field inspections of buildings and structural components for engineering assessments. She also designs and manages creative solutions for existing buildings.

JOHN MERRILL (BSENE 2018)

John is a staff engineer at Geosyntec Consultants in the San Francisco Bay Area. He works on environmental site characterization and remediation with a focus on emerging contaminants. During his time at NC State, he was a project manager for Engineers Without Borders, leading a student team in the design and construction of a potable water system for a school in West Africa.

Gov. Roy Cooper reappointed **NEAL ANDREW** (BSCE 1993), president of Andrew Consulting Engineers, to the 13-member NC Coastal Resources Commission (CRC) for a four-year term to last through 2023. The CRC designates areas of environmental concern, adopts rules and policies for coastal development within those areas, and certifies local land use plans. In addition to a degree from our department, Andrew earned a master's degree in structural engineering from the Georgia Institute of Technology. During his undergraduate years, Andrew was a University Foundation Scholar and Honor Roll Student. As an undergraduate Research Assistant, he mixed and tested a wide variety of high-performance concrete for a Strategic Highway Research Project.

TYRUS CLAYTON (BSCE 1998, MSCE 2000) was recently elected Principal by the Board of Directors of Draper Aden. He is a senior project manager in the Site Development and Infrastructure Division and the firm's go-to person in Raleigh, NC. He also was recently named the regional growth manager for the Central North Carolina area. He joined the firm in 2011 and has over 20 years of experience in geotechnical engineering, environmental engineering, solid waste designs, and utility engineering.

KYLE COMPTON, P.E. (BSCE 2009, MSCE 2012) was recently named Office Leader at the New Bern, NC, branch of Vaughn & Melton Consulting Engineering. Compton will oversee multi-disciplinary projects with teams of engineers and technicians. He has a bachelor's and master's degree in civil engineering with a focus in structures. He has provided design and inspection services for large clients such as Duke Energy and the NC Department of Transportation since joining Vaughn & Melton.

CHRIS CORRIHER (BSCE 1998) retired from NCDOT as District Engineer for Rowan and Davidson Counties. He had been with DOT for 31 years. At his retirement dinner, he was presented with the highest award given to a North Carolina Citizen — the Order of the Long Leaf Pine. His experience in planning, managing, and supervising highway maintenance and construction projects for 2,000 plus miles of roads across North Carolina for over three decades will be used in his new position as a project manager in the Asset Management + Maintenance Department at SEPI.

CHRIS MACK (BSCE 1988, MSCE 2000) has joined Freese and Nichols as part of the firm's expansion in Coastal and Navigation Services. Mack is based in the Carolinas and will

be leading their projects across the Southeast. He earned his master's degree through a collaborative program between NC State and the United States Army Corps of Engineers Coastal Engineering Education Program. In addition to his degrees from our department, he also holds an MBA from the Citadel and a master's in computer science from a joint program between the College of Charleston and the Citadel.

HARITHA MALLADI (MSCE 2012, Ph.D. 2015) started as an assistant professor of Civil and Environmental Engineering and the director of first-year engineering at the University of Delaware this fall. She teaches the first-year seminar course for the incoming class of engineering students. Her research interests are in engineering education and sustainability in asphalt pavements using material considerations, green technologies, and efficient pavement preservation techniques.

DR. JIMMY C.M. KAO, P.E. (Ph.D. 1989) was recently named as a 2020 International Honorary member by the American Academy of Environmental Engineers and Scientists. Kao has more than 28 years of experience as a researcher and environmental engineer in water treatment and reuse, water quality modeling, watershed management, soil and groundwater remediation, contaminated site characterization, wastewater treatment, natural disaster investigation, and risk assessment. He is currently a chair professor at National Sun Yat-Sen University, Kaohsiung, Taiwan, and is the director of their Institute of Environmental Engineering. Kao is the former Coordinator of the Environmental Engineering Program at Ministry of Science and Technology, former President of the Chinese Institute of Environmental Engineering, and former President of the Taiwan Association of Soil and Groundwater Environmental Protection.

KELLY RACE, P.E. (BSCE 1994) joined BGE as a practice leader to expand land and site development services in Raleigh, NC. She joins assistant project manager **CHARLIE TOWNSEND**, P.E. (BSCE 2015). Together, they will be responsible for the Raleigh market including business development, client management, recruiting, hiring, and training of staff within their respective areas. Race leads all aspects of the office's private development practice, with an emphasis on entitlement services and project management for projects within the Triangle.

STEPHEN REECE (MSENE 2017) graduated from NC State in January 2017 with a Master of Science in Environmental

Engineering. Following his graduation, he worked as an ORISE participant hosted by the EPA National Exposure Research Laboratory (NERL) in Durham, NC, and published two papers. Currently, Reece is working as a Design Engineer I in Greenville, NC, with Rivers & Associates.

JO E. SIAS (MSCE 1996, Ph.D. 2001) has been named the University of New Hampshire Carpenter Professor for 2019-22 and was recently awarded the 2020 College of Engineering and Physical Sciences Excellence in Research Award. She was

elected to the Association of Asphalt Paving Technologists Board of Directors as 2nd Vice President in 2019 and is in line to serve as president of the organization. Sias first came to NC State as a participant in the NSF REU program during the summer of 1993 and worked under the guidance of **DR. RICHARD KIM**.

HAIBO ZHAI (Ph.D. 2008) has accepted a position at the University of Wyoming as an associate professor in the Department of Civil and Architectural Engineering and as the Cline Chair of Engineering, Environment and Natural Resources. ■

Department Advisory Board

The following distinguished alumni and friends of the department currently serve on the board:

Jennifer Brandenburg
BSCEC 1986
AgileAssets

Glenda Gibson
BSCE 1987
Mott McDonald

Christine Herrick
BSCE 2011
Kimley-Horn & Associates

Joe Hines
BSCE 1991
Timmons Engineers

Tyler Highfill, *Vice Chair / Nominating Chair*
BSCE 1992, MSCE 1994
Highfill Infrastructure Engineering, P.C.

Jonathan Holtvedt
BSCE 2015, MCE 2017
Lennar

Street Lee
BSCE 1983
McKim & Creed

Will Letchworth
BSCE 2002, MSCE 2004
WSP USA

Mark McIntire
BSENE 1995, MSCE 1997
Duke Energy Corporation

Tonya Mills
BSCE / BSENE 1994
Tri Properties, Inc.

Mike Munn
BSCEC 1995
McAdams

Lisa Patterson
BSCE 1989, MCE 1990
Hazen and Sawyer

Dan Pleasant
BSCE 1972, MCE 1973
Dewberry

Sandra Stepney
BSCE 1983
Simpson Engineers & Associates

Gray Talley, *Chair*
BSCEC 1998
Shelco, Inc.

Steve Thomas
BSCE 1984, MSCE 1986
Sepi Engineering

Mike Wayts, *Secretary*
Freese and Nichols, Inc.

How your support makes a difference



Ph.D. students **Victor Calderon** and **Diego Sosa** take time out of their research to help set up the new Student Groups space in Fitts-Woolard Hall. They are carrying a Balsa Wood model built by the student chapter of the Earthquake Engineering Research Institute for a Seismic Design competition they attended early in 2020.

Departmental rankings, faculty recruitment, research success, and undergraduate education all depend on the presence of talented graduate students. Competition for the best graduate students is intense, and finances can be a deciding factor for students when choosing a graduate program. To recruit the best students, and to create a vibrant learning environment for undergraduate students, CCEE must be able to recruit students and provide competitive graduate fellowships.

ENDOWED UNDERGRADUATE SCHOLARSHIPS

Undergraduate scholarships enable us to prepare tomorrow's leaders in Civil, Construction, and Environmental Engineering. Students are drawn to NC State and CCEE by our reputation for excellence. Cost is a major consideration for students and their families. Scholarships represent a mechanism to support and reward our top students.

CCEE ENHANCEMENT FUND

A regular gift to the CCEE Enhancement Fund makes it possible to provide students the best possible education and extracurricular experiences. The enhancement fund allows us to respond to emerging needs and exciting challenges. For example, this year we deployed teams to the field for time sensitive monitoring of SARS-CoV-2 before external funding was available. Your support enables recruitment and retention of the best and brightest faculty and students, support for our student organizations, field trips to complement classroom instruction, and opportunities for faculty and students to present at conferences. Our needs are particularly broad this year as we have a large number of incidental expenses associated with our move as well as hardware purchases to enable 100% online instruction. Our enhancement fund is critical to the department as we strive to continue to provide opportunities for students and faculty.

ENDOWED FACULTY SUPPORT

Faculty are the heart and soul of the Civil, Construction, and Environmental Engineering Department, which is home to more than 50 dedicated scholars and educators. Endowments and named professorships are an essential part of our effort to recruit and retain the very best faculty and then provide them with opportunities to explore new research ideas with the involvement of graduate and undergraduate research assistants. Relative to our peer institutions, the department has a low number of endowed professorships.

ENDOWED GRADUATE FELLOWSHIPS

We strive to attract the best and brightest graduate students from the U.S. and around the world.

Investing in the Department

We invite you to invest in the future of the department. Your gift will help us take CCEE to a new level of excellence.

You can choose an annual gift, an endowed gift, or a one-time gift. Outright gifts of cash can be made by simply writing a check payable to:

NC State Engineering Foundation
Campus Box 7901
Raleigh, NC 27695-7901

Please indicate on the check, or with a note, the purpose of your gift and that it is directed to CCEE.

If you prefer to make your donation online, you can use your credit card with our online feature at www.engr.ncsu.edu/alumni-and-giving/ways-to-give. Drop down menus will allow you the chance to specify that you want your gift to be directed to our department or to the Fitts-Woolard Hall Building Project Fund.

For more information contact:

Lindsay Smith, CCEE Director of Development
Phone: **919.515.7738**
Email: lksmith4@ncsu.edu

RECOGNIZING OUR CORPORATE SPONSORS

Our corporate sponsors may opt to provide support for specific research areas, enabling faculty to pursue a new research idea. Sponsorships are also available for this newsletter, the welcome back ice cream each fall and our graduate symposia. These symposia allow students to prepare a poster to describe their research and make a presentation to the local engineering community. The activities of our student groups are also dependent on external financial support.

The ***Firm of the Month*** program recognizes corporate

partners who have made an ongoing commitment to the department. It allows us to thank and promote our partners while educating our students about current engineering practice. Firms prepare a series of slides for our monitor in the lobby and also display posters throughout Fitts-Woolard Hall to highlight notable projects. The Firm of the Month program provides participating firms with name recognition for recruiting and business opportunities, demonstrates to students the ways in which they can use their degrees, and provides information on employment opportunities. ■

2020 CORPORATE DONORS

The firms listed here have provided endowments or made contributions from January 2020 through August 2020. Many on the list have supported multiple activities in the department. We would like to extend our sincere appreciation.

ACI Carolinas Chapter	EOS Remediation, LLC	McGill Associates	RTP Chapter Air & Waste Management Association
American Society of Civil Engineers	Frank L. Blum Construction Company	McKim & Creed	SEPI Engineering & Construction
Braddock Built Renovations	Freese & Nichols	NC Department of Transportation	Smith Gardner, Inc.
Brasfield & Gorrie	General Contractors Association of Raleigh	NC Licensing Board for General Contractors	Stantec Consulting Services, Inc.
Brown and Caldwell	Giles Flythe Engineers, Inc.	OWLE Construction	Stewart Engineering
CDM Smith	Hazen and Sawyer	PG & E	Structural Engineers Association
Clancy & Theys Construction	Highfill Infrastructure Engineering	Pope Custom Homes, Inc	WithersRavenel, Inc.
Dewberry	Holder Construction Company	Roanoke Cement	
Environmental Research and Education Foundation			

The department has a wide variety of programs that are made possible by private financial support. For more information on opportunities to help, please contact **Lindsay Smith**, our Director of Development, at lksmith4@ncsu.edu or **919.515.7738**.

SHARE YOUR NEWS

There are thousands of alumni of the Department of Civil, Construction, and Environmental Engineering working throughout the nation, and around the globe. We invite you to provide us with updates about career accomplishments, awards or recognitions, as well as other news. We aspire to create a community of alumni that remain connected to the department and to each other. We also want to keep your contact information current so we can keep you up-to-date on department events. Send your information to Julie Dixon at jwdixon2@ncsu.edu.

Name, Mailing and Email Address
Company Name and Address
Degree, Major and Class Year
Announcements

Also, we invite you to connect with us on social media to keep up with the latest news.

- facebook.com/ccee.ncsu
- @NCStateCCEE
- go.ncsu.edu/cceelinked

ENGINEERING
ONLINE

Join the hundreds of professional engineers who have advanced their career by taking graduate courses online. Take just a few courses to support your area of interest, or commit to earning an online Master's Degree.

We offer great opportunities for development.

NC State has been offering distance education in engineering for more than four decades, and is consistently ranked among the top online engineering programs in the country. Our CCEE Department offers two degrees, Master of Civil Engineering (MCE), and Master of Environmental Engineering (MENE). In 2018 rankings by Best College reviews our online Environmental Engineering degree was ranked #1 in the country, and our Civil Engineering degree earned the #2 spot! With numerous courses available each semester, our online students are able to customize their degrees to support their area of professional interest. The online degree requires the completion of 10 courses, which some students complete in as little as two years, though three to four years is more typical given their other responsibilities.

Go to the Engineering Online Registration Portal at www.engineeringonline.ncsu.edu/apply-and-enroll/enroll.

CCEE AT NC STATE SUSTAINABLE INFRASTRUCTURE FOR SOCIETY

- \$23 million in research expenditures
- 234 ongoing research projects
- 15 winners of CAREER and other NSF young faculty awards
- 54 faculty members
- 289 graduate students
- 799 undergraduate students



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