

# CORNERSTONE

Fall 2020

Tackling COVID-19  
From All Sides

**Page 4**

**T** CIVIL & ENVIRONMENTAL ENGINEERING

Better Bonds • Creating Stability • Impact of E-Vehicles

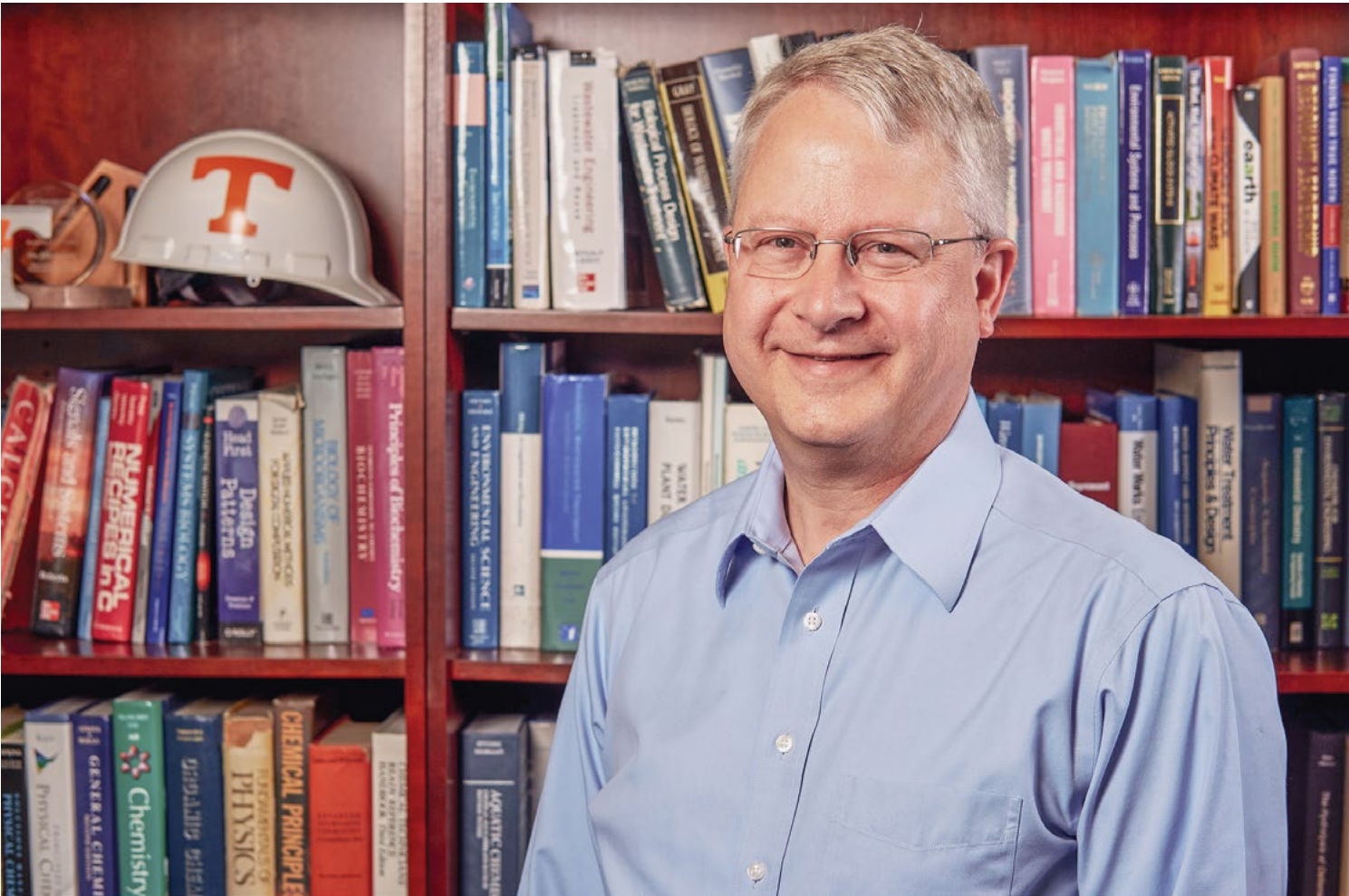
# Table of CONTENTS

Department Head Message	1
A Sense of Stability	2
Nicholas Wierschem earns CAREER Award with earthquake research	
Countering COVID-19	4
Engineers tackle from all sides	
Penumadu Eyes Better Bonds for Auto, Aerospace Industries	8
Research can provide on-demand health assessment for joints	
Hazen Hopes to Fix the Fracking Flow	10
ERC would join CURENT as college's second funded by the NSF	
E-Vehicles Cut the Smog, Even with Coal-Based Power	11
Joshua Fu examines the key to improving air quality	
NSF Boost Helps Hathaway Get Smart with Stormwater	12
Jon Hathaway is leading communities to adopt smart technologies	
Khattak Study Gets Around Traffic Jam Data	13
Asad Khattak looks to cut down on huge travel delay	
Cherry Examines Road Traffic Injuries and the Opioid Crisis	14
Study finds link between prescription monitoring and crash databases	
From One Student to Another	17
Wes Darling graduates with transportation on his mind	
Ready to Fly	20
The Air Force awaits CEE senior Kadee Klimowicz	
Corps Connections	22
Three CEE seniors connect through prior military experience	
DEPARTMENTS	
Faculty Notes	15
Student Notes	16
Staff Spotlights	18
In Memoriam	19
CEE Photo Gallery	25

Cornerstone is published annually by the Department of Civil and Environmental Engineering at the University of Tennessee. [cee.utk.edu](http://cee.utk.edu)

Department Head <b>Chris Cox</b> Assoc. Department Head of Graduate Studies <b>Khalid Alshibli</b> Assoc. Department Head of Undergraduate Studies <b>Chris Cherry</b> TCE Director of Communications <b>Christie Kennedy</b> Project Manager <b>Melissa Callahan</b> Designer <b>Andy Gallaher</b>	Photography/Illustrations <b>Steven Bridges</b> <b>Randall Brown</b> <b>Jack Parker</b> <b>Victoria Wheelock</b> Writers <b>Randall Brown</b> <b>David Goddard</b> <b>Élan Young</b> Printer <b>University Printing and Mail</b>
--	--

## From the Department Head



An academic year unlike any other is underway on Rocky Top. In contrast to the spring semester, in which we rapidly and unexpectedly transitioned to working remotely and teaching online, months of meticulous planning preceded our return to campus this fall. Facial coverings and social distancing are now the norm and we are offering classes entirely face-to-face, entirely online, and everything in between. Our business office has returned to regular hours, but with staggered work shifts and reduced on-campus staff levels. The relocation of many of our face-to-face classes to buildings with larger classrooms to accommodate physical distancing has left the John D. Tickle building strangely quiet. Even as we settle into this new way of doing things, we are already embarking on plans for the spring semester, which we expect to be similar to the fall. I am proud of the resilience demonstrated by our students, faculty, and staff in persevering toward our goals in these difficult times.

Unlike many campuses, on-campus research has continued at UT throughout the pandemic, albeit at a reduced level. Our researchers quickly developed health safety plans that include physical distancing, additional personal protective equipment, revised protocols, and increased cleaning and sanitation. Moreover, many CEE faculty and students were able to quickly adapt

their research to address pandemic-related issues being faced by campus and society at large. From campus-level surveillance monitoring of SARS-CoV-2 in wastewater and saliva and understanding how buildings and infrastructure can be re-engineered to limit spread of infectious diseases to understanding how the pandemic affects commuter choices, our faculty and students are well-positioned to contribute. I encourage you to read about their pandemic-related work beginning on page 4.

While the course of the pandemic and its affects on how we carry out our mission is ever-changing, I am confident we will be able to not only adapt and persevere, but also to thrive, despite the challenges. I am thinking of all of you and wishing you and your loved ones the best during these uncertain times.

Go Vols!

**Chris Cox**  
Robert M. Condra Professor and Department Head,  
Civil and Environmental Engineering





CAREER Award Winner  
Nicholas Wierschem



# A Sense of STABILITY

By David Goddard. Photography by Randall Brown.

The Tickle College of Engineering is proud to feature one of three Early CAREER Award winners that have been announced so far in 2020. That makes 19 total for the college since 2016 and speaks highly of the creative research activity for our young faculty members.

If a group is talking about music, terms like resonance and frequency would seem both familiar and perfectly in place, yet many might be surprised to know they also play a key role during earthquakes.

Earthquakes cause resonances and create frequencies in the ground beneath us, with variables like speed and the type of underlying bedrock determining their particular form in a given tremor. Along with the depth and duration of the quake, the resonance and frequency it creates helps determine how destructive it is.

Assistant Professor Nicholas Wierschem has a plan to tackle those concerns, all while better understanding their effect in the first place.

“Every building has a resonance, which is the natural frequency at which a building responds most to given waves in an earthquake,” Wierschem said. “When a quake occurs, the more closely the frequency of the waves it creates underground match the building’s frequency, the greater the swaying and potential damage or even loss of that building.”

To counteract those forces, his project centers around what are known as passive protection devices. Currently, one of the quake-resistant strategies that are commonly used feature sacrificial elements. During an earthquake, these elements take the brunt of the forces and are themselves damaged, but reduce the impact on the whole building.

The systems Wierschem has in mind differ in that they take the vibration caused by the quake and send it into a rotational flywheel, which uses the energy to harmlessly spin a wheel, safely relieving the energy, with a greatly reduced impact on the building.

Importantly, the device also accounts for variances in frequency through what is known as variable inertance, or the ability to react

and shift the frequency of the structure during an earthquake.

“The initial idea came from a device used in Formula One racecars and used in a couple of buildings in Japan that takes in the energy like the models I am developing, but that energy then has to be released,” Wierschem said. “In my approach, the forces are accounted for in a non-linear way, so it’s expended without having to go back into the building.”

His system can be retrofitted to existing buildings with an initial startup cost similar to other methods, but his offers the advantage of not having to be monitored or adjusted, giving it a financially long-term advantage.

As part of his Early CAREER Award, Wierschem will include an education component, which, for him, was an easy choice.

“I’m a Tennessee Promise mentor, so I wanted to leverage that,” he said. “I want to have an outreach event to bring in Tennessee Promise students to the college, to help them move from a two-year community college degree to a four-year degree.”

Wierschem also plans to educate younger students by using toys to show how the engineering behind some of the most popular toys work. Like his research, that work could help serve to give those students a stable foundation.

**“Every building has a resonance, which is the natural frequency at which a building responds most to given waves in an earthquake. When a quake occurs, the more closely the frequency of the waves it creates underground match the building’s frequency, the greater the swaying and potential damage or even loss of that building.”**

—Nicholas Wierschem



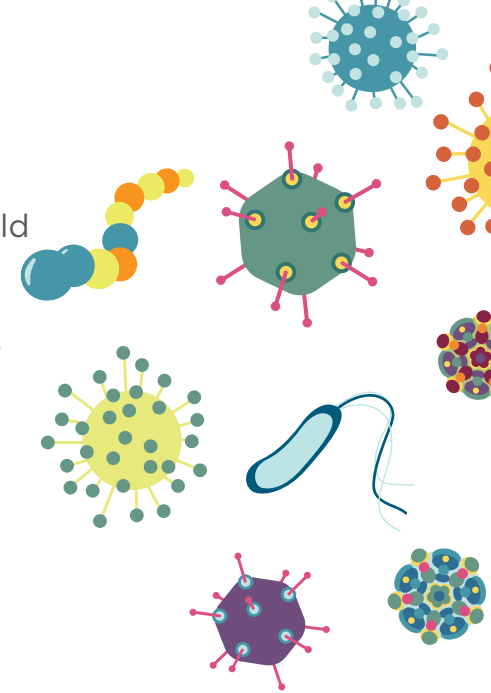
# Countering COVID-19

## Engineers Tackle From All Sides

By Élan Young. Illustration by Victoria Wheelock.



As a picture emerged for how the COVID-19 pandemic could impact the world well beyond the spring semester, CEE students and faculty stepped up to limit the virus' effect. Here we take a look at several ongoing, innovative projects within the department to understand how CEE illuminates the power of the possible in the face of great challenge.



### A Virus Versus Rocky Top

*Hazen and Loeffler's Surveillance Testing Attempts to Keep Campus Safe from COVID-19*

UT is the research home to two CEE faculty who are used to zooming between the micro-scale of microbiology research and the macro-scale of human and environmental systems. So naturally they were tapped to help find solutions to improve the safety of campus with the return of students during the coronavirus pandemic.

Joint UT-Oak Ridge National Laboratory Governor's Chair for Environmental Biotechnology Terry Hazen and UT-Oak Ridge National Laboratory Governor's Chair for Microbiology and Civil and Environmental Engineering Frank Loeffler offer expertise in microbiology that could help UT and other institutions return to a semblance of normal in the wake of COVID-19.

Beginning this fall, Hazen's research team will monitor the wastewater of up to 30 buildings per week, including all of the student dormitories. Wastewater analysis can detect whether the SARS CoV-2 virus is present, which is the organism that causes COVID-19.

"We're just looking for that virus or its remnants in a wastewater that is coming from the building," said Hazen, who reiterates that this type of monitoring does not have the ability to identify an individual person.

Hazen, who chaired the committee reporting on testing options for the university, says this wastewater monitoring can be scaled up or down, depending on the need.

The wastewater surveillance testing dovetails with pooled saliva surveillance teams led by Loeffler and UT-ORNL Graduate School of Genome Science and Technology Director Albrecht von Arnim. If the wastewater team sees the virus in the samples, then that will trigger a response by the saliva surveillance team to

take a pooled sample for everyone in the building, floor by floor.

Pooled saliva sampling is ideal for institutions such as a college campuses. It works by combining individual saliva samples together—from residents of a floor in a dormitory, for example—increasing throughput and allowing for testing more people, thereby saving time and resources.

Pooled sampling also provides a necessary layer of anonymity to allow the university to legally collect saliva samples from individuals without also collecting identifying information. Because it can only identify which floor of a building has an infected patient, the last step is to deploy a contract tracing team in conjunction with the Student Health Center to identify the infected individual by testing everyone on that floor.

Even without a positive hit from the wastewater testing, the pooled saliva surveillance team hopes to test 500 people per day, or 2,500 people per week, beginning with the undergraduate student population.

"Since the early days of the pandemic, many working groups and task forces all over the country have stressed the importance of testing portions of the

**"This is an attempt to implement a widespread testing capacity with very limited resources. Fortunately, everyone at the university has been pulling together in the same direction."**

**—Albrecht von Arnim**

population on a regular basis,” said von Arnim, who is also associate department head of the Department of Biochemistry and Cellular and Molecular Biology.

The team managed to overcome several big hurdles to scale up the testing for the university’s purpose. First was acquiring a new automated instrument to extract the RNA from all of the saliva samples, which was not going to be available until October due to high demand. In stepped Chancellor Donde Plowman to the rescue.

“The chancellor signed a letter explaining the surveillance testing we wish to implement at UT, and the company responded that they can get the instrument to us by the first week of August,” said Loeffler. “The chancellor’s office helped move it forward.”

The other hurdle was getting plastic saliva test tubes at a reasonable cost. Due to contacts at ORNL, the team was able to secure tubes at 10 cents each compared with the standard cost of \$10 a piece.

The molecular biological technicalities of testing for the virus are well within the capabilities of the personnel at UT, but the logistical hurdles proved to be the biggest challenge.

“This is an attempt to implement a widespread testing capacity with very limited resources,” said von Arnim. “Fortunately, everyone at the university has been pulling together in the same direction.”

The team worked overtime to get the rollout ready before campus resumed courses for the fall.

## Mapping Microbes



### *Disease-Resistant Buildings and Infrastructure for Resilience to COVID-19*

Fears of the novel coronavirus contagion have shut down schools, libraries, public transit, offices, stores, restaurants, and countless other buildings worldwide. With indoor transmission being the primary route for the rapid spread of COVID-19, these fears and shutdowns are well justified; yet, the tolls on our communities are more than astonishing.

There has to be a way to prevent indoor transmission in buildings so that they could stay open, which has been the outcry as the shutdown drags on. With that in mind, CEE’s Professor Qiang He and Assistant Professor Shuai Li have paired their expertise in environmental microbiology and infrastructure engineering to pursue a unique and novel strategy—disease-resistant buildings resilient to pathogen transmission.

Because of the urgency to mitigate transmission in buildings and critical infrastructure, the research team has been awarded a Rapid Response Research (RAPID) grant from the National Science Foundation to advance their novel concept.

“This is an emerging field within civil and environmental engineering, and one which will attempt to provide much needed insights for infrastructure design reconfigurations and operation practices during pandemics and other potential disease outbreaks to support healthy, resilient, and smart communities,” said He.

Li and He are also collaborating with Oak Ridge National Laboratory (ORNL) to establish a consortium of intelligent and healthy environment for all lives (C-IHEAL), pronounced as “See I Heal”.

Their research will focus on disease-resistant buildings and infrastructure to potentially mitigate the spread of infectious pathogens, including COVID-19.

They aim to map microbial transmission pathways in indoor environments and develop strategies for operating and managing buildings and critical civil infrastructure systems so that facility users can limit the spread of pathogenic microorganisms.

Further, findings from this research will support the development of paradigm-shifting design concepts for disease-resistant buildings, which will be highly desirable in the post-pandemic era. Such breakthroughs in research could alleviate burdens on healthcare systems, and will support the society and its citizens to combat and recover from the COVID-19 pandemic.

Their team integrates innovation in artificial intelligence, building information modeling, and molecular and metagenomic techniques to characterize the time and space dynamics of microorganisms, particularly pathogens, associated with spatially and functionally distributed infrastructure system components, and to computationally derive intervention strategies to mitigate the exposure to infectious pathogens.

They hope to combine knowledge from engineering and social science disciplines to advance the fundamental understanding of interactions among the built environment, microbes, and people from all walks of life to discover how intelligent technologies can be deployed to create healthier, safer, and more sustainable buildings and infrastructure for all.



## How Are You Getting Around?

### *UT Researchers Study Pandemic Travel Patterns*

The rapid spread of COVID changed the way most of the world goes about its daily routine, with many businesses having to temporarily close and forcing students of all levels to transition to online courses.

Even so, grocery stores, medical facilities, and some forms of restaurants remain open, requiring workers to commute to and from work. In metro areas, that can often mean taking some form of transit, potentially exposing workers in these vital areas to the disease.

CEE Professor Chris Cherry and Assistant Professor Candace Brakewood have a plan to change that, and it comes with backing from an NSF RAPID Award.

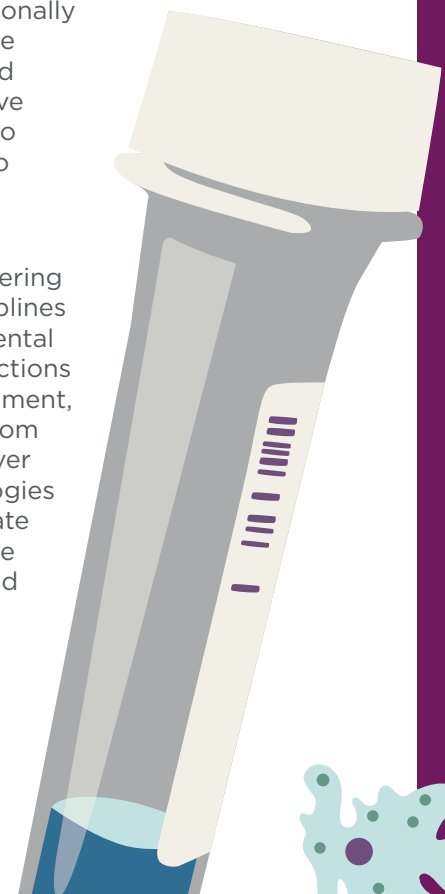
The main question they want to answer is whether adoption of new forms of transportation, such as bikeshares and e-scooters, could provide commuting options that would allow workers a way to get to work without putting them in the close confines of other passengers on traditional transportation methods, and whether people would even choose these alternate methods in the first place.

One of their early findings is that answers to these questions vary greatly by city or region. In New York and Chicago, for example, bike shares are up a minimum of 65 percent from the same date the year before, but in Seattle and San Francisco, their use has plummeted.

The answer as to why there is such a variance lies with the cities themselves.

Moving forward, the program is looking at commuting patterns in Nashville, Tennessee.

The team will also look at ridership trends across various modes of transportation, giving them a more robust understanding of how cities and the workers within them respond to times of crisis, helping guide future decisions.



## Department Sees Success Despite Pandemic

As COVID-19 spread to Tennessee, CEE joined UT in prioritizing human health to work remotely in quarantine. But, even though the global pandemic shook up the way CEE faculty, staff, and students were able to finish out the spring semester, the community proved to be resilient in the face of change.

CEE Senior Lecturer Jenny Retherford reflects on the impact of COVID-19:

“Nothing will replace the events that were missed or the final pats on the back from mentors and clients. But students did a great job of pivoting to share their results virtually. While it was a challenge, the win here extends to the fact that these projects did not fall away once students couldn’t meet in their groups.

I think in the long-run, being able to show that they managed to graduate despite a global pandemic wreaking havoc on society will actually make them better engineers, because in the real world there are many times when you are forced to adapt and problem solve quickly.

We expect to continue this system moving forward and hope to maintain a dedicated activity focused on improving writing and getting folks to meet across some of the writing-intensive classes.”

Just another way that classes marched onward, even through trying times.





## Penumadu Eyes Better Bonds for Auto, Aerospace Industries

By David Goddard. Photography by Jack Parker.

Carbon fiber and fiber-reinforced materials have played a role in automotive manufacturing for decades, with recent years seeing entire vehicles made out of the material, albeit on a limited scale.

Having the strength and stiffness of metal, but at a much-reduced weight, such composites have taken on a critical role in improving the overall fuel efficiency of vehicles, since lighter vehicles require less energy to go the same distance as heavier ones.

As their adoption continues to increase, examining their reliability and durability has become a foremost concern.

CEE's Fred N. Peebles Professor and JIAM Chair of Excellence Dayakar Penumadu is leading a team that might have just the answer for that.

"Auto manufacturers like these materials because they don't corrode, are easier to recycle, and help the manufacturers to produce more eco-friendly cars, but there is a real challenge in joining different pieces together," said Penumadu.

"Our study aims to solve some of the complex hybrid material joining issues between carbon and glass fiber

reinforced polymer composites and metals through the use of Smart Joint technology, intellectual property we have developed that integrates fiber optic sensing."

Smart Joints can provide on-demand health assessment for adhesively joined material systems, overcoming a major challenge for evaluating state of bonded joint during manufacturing, during service in real world and harsh-conditions, and evaluation of the joints after an accident. Penumadu expects wide application of this technology for aerospace industry immediately, where the use of carbon fiber composites is growing rapidly and qualified bonding of materials has been a key challenge.

Building off some of his own prior research, Penumadu and the team integrated fiber optic sensors into joints between carbon fiber reinforced composite material and aluminum using a special adhesive developed by Dow Chemical for a project with Ford.

Those results were published recently in an article entitled "Smart Adhesive Joint with High-Definition Fiber-Optic Sensing for Automotive Applications" in the journal *Sensors*.

The team then put the joined materials through a series of tests designed to see how it held up under thermally induced external stresses and resulting residual stresses for E-coat paint process commonly used in auto industry. They tested the durability of the smart joint system by putting it through a simulated painting process that automobiles undergo, where temperatures approach 375 degrees.

Their breakthrough was a big step forward in allowing samples to be tested and data to be collected in real time, something that Penumadu noted could have a big impact for composites and efforts to have more eco-friendly vehicles.

"The standards Europe has adopted call for a reduction of more than 30 percent of emissions for cars and vans by 2030, and since major companies like Ford, General Motors, and Volkswagen are global entities, they will need to meet that target."

Joining of composites is a key aspect of successfully integrating these new class of materials into the automotive industry. When that happens, it will be thanks, in part, to Penumadu's work.

## Driven to Excellence

Volkswagen, UT, and ORNL  
Announce Partnership

By David Goddard. Photography by Steven Bridges.

Volkswagen Group of America, UT Knoxville, the UT Research Foundation, and ORNL announced a partnership this spring to create Volkswagen's first innovation hub in North America at the UT Research Park at Cherokee Farm.

The partnership is leveraging the expertise of ORNL scientists and several faculty members within the Tickle College of Engineering at UT to develop lighter vehicle components made from composite materials and to electrify vehicles—two areas where UT is at the forefront of research and expertise.

In concert with these efforts, CEE's Fred N. Peebles Professor Dayakar Penumadu is providing expertise in materials characterization for lightweight composites. He said that the research opportunities provided by the project would help students and faculty alike, and that the technology being developed would aid both the local and the national economy.

"It is truly gratifying to be involved in developing this VW partnership with UT, which is providing our students and staff with industrially relevant research and development opportunities that are bound to have significant economic and environmental benefits for Tennessee and the country," Penumadu said.

Highlighting the partnership's impact on UT students, Volkswagen has awarded fellowships to engineering doctoral students Andrew Foote, Nathan Strain, and William Henken (CEE) as part of the agreement.





# Hazen Hopes to Fix the Fracking Flow

By Élan Young.

UT-ORNL Governor’s Chair for Environmental Biotechnology Terry Hazen is in the planning stages for what he hopes will become UT’s second Engineering Research Center funded by the National Science Foundation. The Engineering Research Center for Protecting and Advancing Water-Energy-Environment and Sustainability recently received a one-year planning grant with the intention of laying the foundation for bringing a broad, multi-institutional initiative to campus that seeks to address grand challenges related to hydrocarbon production and transforming hydraulic fracturing, or “fracking,” practices.



If fully funded, UT would serve as the leading institution under Hazen’s guidance. Research collaborations for the grant are already underway with Colorado State University and Juniata College in Pennsylvania. In addition to developing systems to remediate water, another goal is to share information with companies to help inform sound decision making impacting water quality and public health.

Fracking involves creating horizontal wells deep underground to extract oil and natural gas. The extraction process involves injecting fluids that can contain upwards of 1200 chemicals. This fluid then flows back with oil and gas, which then gets separated out and funneled into pipes. Some of these chemicals serve the purpose of preventing corrosion in the pipes by preventing bacterial growth, but they are also known for being quite toxic. The flowback fluid contains biocides that destroy living organisms and can create antibiotic resistance in waterways.

While horizontal wells have been used for a long time, they have not been used in shales that contain oil and gas until the last decade or so. Now that fracking has taken off, the US has actually become energy independent; however, states that have the most fracking wells are dealing with some side effects. As Hazen explains, because of the boom in the fracking industry that has allowed smaller companies to reap profits fairly quickly, there has been an uptick in illegal dumping of flowback fluid. In fact, sometimes companies have even been granted permission to dump this flowback fluid into streams. In addition to water quality issues, in places where many wells are located near one another, there have been recorded seismic events, or manmade earthquakes.

“What we want to do is have an Engineering Research Center that focuses on all of these issues and has a strong social and community aspect,” Hazen said.

One of the water remediation methods Hazen wants to explore involves a patented process he developed more than 20 years ago that utilizes methane as a feedstock. Some bacteria feed off of methane, and so by adding it to the flowback fluid, and then removing the methane, it triggers the bacteria’s ability to continue degrading the toxins to remediate the water.

The current planning grant is \$100,000 for one year. After this grant expires, Hazen will enter the next phase of seeking long-term funding for a UT-based ERC.

# E-Vehicles Cut the Smog, Even with Coal-Based Power

By Élan Young.

Both the haze that obscures the view on the horizon and the air that leads to shortness of breath are caused in large part by particle pollution, or particulate matter (PM), also known as aerosols. While PM technically also includes fine particles of naturally occurring solid or liquid droplets such as dust and fog, it’s PM from air pollution that is highly toxic for humans, plants, and animals.

Examples of PM include soot or fly ash as well as specific chemical compounds like arsenic, benzene, fluorine, mercury, ammonium sulfate, ammonium nitrate, and organic aerosol.

The International Agency for Research on Cancer and the World Health Organization list PM as a Group 1 carcinogen. Because of their incredibly small size, they can be breathed deep into the lungs and enter the blood stream, leading to an increase in respiratory diseases, heart attacks, endocrine disruption, low birth weight, premature death, and other health issues.

As the known dangers of PM are growing, many countries have sought to limit emissions from motor vehicles and industrial sources.

“As countries seek to transition to electric vehicles, those vehicles still need to get power from charging, which results in burning more fossil fuels and installation of renewable power generation to meet demands. What we want to know is whether that outweighs the good of going electric.”  
—Joshua Fu

Tickle Professor Joshua Fu recently collaborated with researchers in Taiwan to evaluate a policy promoted by the Environmental Protection Administration of Taiwan (TEPA) that would ban the sale of all cars powered by fossil fuels in the country by the year 2040.

The team integrated weather, air quality, and health models to evaluate four different scenarios—the location of power plants in the north, south, and central part of the country as well as seasonal variations to consider atmospheric transportation effects.

For example, incorporating the direction of prevailing winds in different seasons gives a better picture for how air pollutants are moved throughout the year. Knowing



this could help determine which power plant should increase or decrease production in a particular season to result in the best possible air quality and health benefits.

To perform the study, Fu and the team used the Emission Inventory announced by TEPA as the base emission database. The base year was set as 2013, when only 0.2 percent of the 21.5 million vehicles in Taiwan were electric. The study used the Weather Research and Forecasting (WRF)-Community Multiscale Air Quality model (CMAQ) and Benefits Mapping and Analysis Program (BenMAP) that are the US Environmental Protection Agency’s regulatory assessment tools.

The WRF-CMAQ model, which was established under the concept of “One Atmosphere Approach,” was applied to assess the effects on air quality by placing additional electric power in different areas. The BenMAP system then quantifies the resulting health benefits in dollars resulting from the improvement in air quality.

The results of the study suggest that Taiwan’s forward-thinking policy to shift to electric vehicles will in fact dramatically decrease the country’s PM and improve air quality. The study showed that the benefits of reducing transportation emissions would offset the increased emissions from coal-fired power plants needed to charge electric vehicles, as long as advanced emission control technologies were also installed.





# NSF Boost Helps Hathaway Get Smart with Stormwater

By Élan Young. Photography by Steven Bridges.

Associate Professor Jon Hathaway envisions that smart technologies will help city managers and environmental nonprofits sense changes in weather, flows, and/or water quality and adapt stormwater system operation using active controls such as gates, valves, and pumps.

For instance, in advance of major rain events, a smart stormwater system could allow managers to slowly release water being stored in local ponds or other detention systems to make room for incoming runoff to help stem flooding.

In addition to the \$1.8M NSF grant that is about halfway through, the team has received an additional supplement of \$310K to help community groups adopt sensors, data analysis algorithms, and control systems developed by the research team. The team intends to use the vast majority of additional funding to supply community partners with reliable open source sensors, hardware, and software, while working with community staff to deploy them.

**“We feel there is an immense opportunity to accelerate the adoption of our technologies by new communities and non-profit environmental groups, effectively expanding our transition to practice. Our role will be to put these technologies into their hands, support them in the deployments, and help operationalize these systems.”**

—Jon Hathaway

Hathaway says he hopes this supplemental grant will have significant impacts on the day-to-day operations, environmental health, and the cost-benefit of stormwater management for four distinct community groups in the US.

The groups supported by funding include Washtenaw County Water Resource Office in Washtenaw, Michigan; Knox County Stormwater in Knoxville; the Huron River Watershed Council, which includes seven Michigan counties; and Sierra Club of Detroit and Friends of the Rouge River.

Hathaway anticipates the positive impact of the project so far will have the added benefit of empowering other communities to join the growing group of adopters.

# Khattak Study Gets Around Traffic Jam Data

By Élan Young.

For a commuter, nothing quite sinks the heart like having to slow to a stop in a seemingly never-ending line of traffic.

According to the 2019 Urban Mobility Report, in 2017, the average commuter sat in traffic for nearly seven working days, accounting for more than \$1,000 in personal costs. Also alarming, commuting delays were 15 percent higher that year when compared with just five years before.

This trend also correlates with an increase in crash frequencies. Larger scale traffic incidents in particular can come with challenges in the incident management process, especially if multiple agencies such as police, fire, and emergency medical response are needed. Gathering information about incidents is a chronological process, and it can be time consuming to collect all the necessary information needed for a tightly coordinated response.

Beaman Professor Asad Khattak recently collaborated on a study, published in *Transportation Research Record: Journal of the Transportation Research Board*, to develop a sequential prediction method to handle the chronological process of incident information gathering. The method is based upon parametric survival modeling, which is a statistical technique used to link the duration of an incident to covariates often used to predict incident duration.

Khattak said the study was motivated by a disproportionately high effect of large-scale incidents on traffic. He further elaborated that accurate and timely prediction of incident durations using advanced statistical and artificial intelligence tools will help us better manage large-scale incidents.

A wide range of studies exist regarding traffic incident duration, but few studies have attempted to analyze the incident duration by incorporating chronological incident information gathering.

Khattak’s study took advantage of a unique incident database and identified more than 600 large-scale incidents in the East Tennessee area from 2015 through 2016. From this data, the team was able to develop a five-stage prediction method according to the chronological process by which information becomes available during incident operations.

Future research is needed to dig deeper into various incident management areas such as on-site operational



sequences, crash injury severity information integration (e.g., the reason the multi-agency response is requested), and traffic detour operations resulting from huge travel delays after large-scale incidents, all of which are based on additional information obtained from other sources.

An accurate and timely prediction of incident duration could help manage large-scale incidents in a proactive manner.





# Cherry Examines Road Traffic Injuries and the Opioid Crisis

By Élan Young.

At any given time, about 20 percent of drivers have a potentially impairing drug in their system. Road traffic injuries and drug overdoses are the two leading causes of injury death in the United States (US), with about 2 million people injured in the US each year.

Opioids and other drugs affect driving abilities, and crash-related injuries often result in opioid prescribing, creating a potential feedback loop from crash to injury and pain to opioid use and back to crash. However, very little is actually known about the interactions between transportation and opioid use, which is one reason Professor Chris Cherry and a collaborative research team was interested in learning more about the connection between prescription monitoring and crash databases.

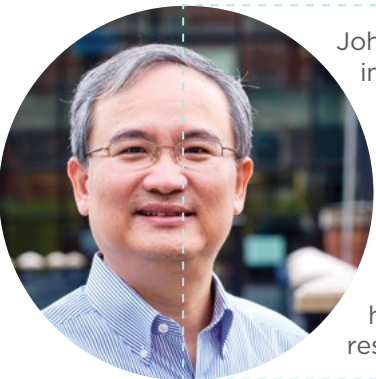
Their research, published in *American Journal of Preventive Medicine*, provides an overview of how police crash databases and prescription drug monitoring programs (PDMP) data can be linked with a follow-up discussion of PDMP-crash data, potentially transferable lessons from other efforts, and knowledge gaps that could be addressed using linked PDMP and police crash data.

The PDMP have population-based data systems that contain information on prescription drug histories. Coupled with detailed traffic crash circumstances, they can provide a window to advance understanding of prescription drug trajectories leading to crash events and effects of improving road safety as a strategy to reduce injury and subsequent prescription drug use.

The team's findings show that routine, ongoing linkage of these data sources is lacking. However, many states have strong linkage foundations in opioid or road safety arenas, providing opportunities to improve system understanding.

Their paper concludes that a complete exploration of opioid and traffic-safety system requires comprehensive health, substance, and travel data.

# FACULTY NOTES



John D. Tickle Professor Joshua Fu was invited to be a member of the Scientific Leadership Team at the World Meteorological Organization meeting in Geneva, Switzerland. The group helps support international science and policy stakeholders in the areas of food production and agriculture, food security, climate change, biodiversity, ecosystem health, human health, atmospheric research, and materials research.

**“The Scientific Leadership Team of the WMO is an important voice in the scientific community and has an important role in engaging stakeholders. I’m honored to be among them in the quest for mitigating climate change.”**  
—Joshua Fu

Associate Department Head and Professor **Chris Cherry** is the research lead from UT on a multi-institutional consortium focused on examining the emerging safety issues related to electric scooters (or e-scooters). The Behavioral Traffic Safety Cooperative Research program launched a 30-month, \$490K study in June, one of the first large-scale studies that will look closely at how behavior affects safety.

Former Interim Chancellor, Dean Emeritus of the college, and CEE Professor Emeritus **Wayne T. Davis** was named the 2020 Nathan W. Dougherty Award winner, the highest honor bestowed by the college. The award recognizes engineers whose accomplishments have brought acclaim to the university.

Faculty members across the college enjoyed well-earned promotions at the start of the 2019 fall semester: Promoted to full professor: **Qiang He**; Tenured and promoted to associate professor: **Jon Hathaway** and **Timothy Truster**.

Associate Professor **Jon Hathaway** is the newest associate editor for the *Journal of Environmental Engineering*. Published by the American Society of Civil Engineering, the journal shares info on research in environmental engineering science, systems engineering, and sanitation. Hathaway will contribute with his expertise in urban hydrology and green infrastructure.

**John Schwartz**, professor and director of the Tennessee Water Resources Research Center, spent the fall 2019 semester researching and teaching at Czech Technical University in Prague. In CTU's Department of Landscape Water Conservation, he worked on three research projects and taught a stream restoration (revitalization) class.

Jerry E. Stoneking *engage* Engineering Fundamentals Program Director and Professor **Richard Bennett** was honored with the Industry Champion Award by the National Concrete Masonry Association. The award recognizes individuals who make significant contributions in roles beyond what can be accomplished by the association alone. Bennett was nominated by ten different individuals across the industry in recognition of his career and the work he's put forward to advancing concrete masonry design and construction.

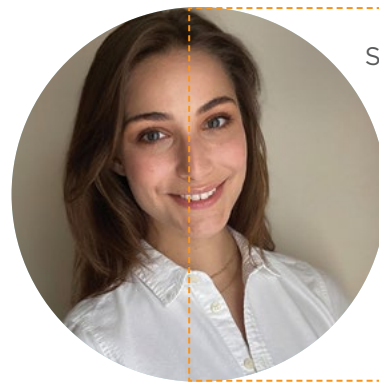
**Adrian Gonzalez**, lab manager for the Water Quality Core Facility, was recently accepted into membership of the Chemistry Expert Committee of the National Environmental Laboratory Accreditation Conference Institute. TNI establishes and enforces national standards for laboratory quality and proficiency and has national experts in operating laboratories under strict quality management systems.

Other CEE faculty members were recognized as part of the 2020 TCE Faculty and Staff Awards:

- ▶ **Outstanding Outreach and Engagement**  
Senior Lecturer Jenny Retherford
- ▶ **Charles E. Ferris Faculty Award**  
Professor and Associate Department Head Chris Cherry
- ▶ **Teaching Fellow**  
Associate Professor Tim Truster
- ▶ **Research Achievement Award**  
Fred. N. Peebles Professor and JIAM Chair of Excellence Dayakar Penumadu



# STUDENT NOTES



Senior **Ana Koumtcheva** was one of 17 Tennessee students offered a Fulbright Award this spring. Koumtcheva is headed to Bulgaria where she will merge her studies of civil engineering and architecture to research mass residential construction with a focus on environmental sustainability. Bulgarian homes built during the late 19th century will provide an excellent source for research, since they were constructed with sustainability principles in mind. Her research will be based in Sofia, the capital of Bulgaria, at the New Bulgarian University.

“I’m very interested in mass development such as residential construction. The way we do it in the US is actually pretty lacking in sustainability policies, and there’s an absence of architects and engineers in that area. During the Bulgarian Revival, the country flourished economically and culturally, and due to a massive preservation effort of buildings from this period, there is a large amount of preserved, long-lasting homes to study and bring insight to US mass construction.”

—**Ana Koumtcheva**

Recent graduate **Zachary Jerome** was one of four TCE seniors to receive prestigious NSF Graduate Research Fellowship program awards. Jerome will receive a \$34,000 annual stipend for three years, \$12,000 for tuition and fees, and an increased chance to take part in international research. Jerome credits Beaman Professor and Transportation Program Coordinator Asad Khattak, Professor Qiang He, and the School of Music’s Associate Professor of Viola Hillary Herndon for making an impact on his education.

Eleven students were recognized for their exceptional contributions to UT with Chancellor’s Awards this year. The following undergraduates were recognized for their extraordinary academic achievement: **Wes Darling, Zachary Jerome, and Andrew Patchen**. Darling was also named a Top Collegiate Scholar. Students recognized for their extraordinary professional promise include **Colby Gilbert, John Newman, Andrew Shanan, Nicolo Franschetti, Wadi Imseeh, Zaher Jarrar, Clint Jordan, and Mohmad Thakur**.

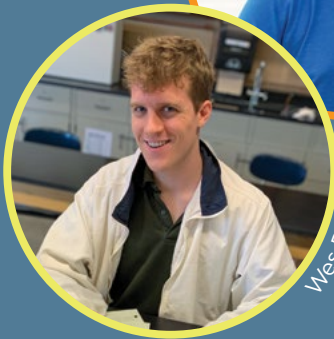
Five students were part of a cohort of UT students invited to present at the Composites World 2019 Fiber Conference, held in Knoxville in December. This annual event brings together leading researchers in composites manufacturing from businesses, laboratories, and universities around the world. Professor Penumadu advised the following students: **Phillip Barnett, Hannah Maeser, Darren Foster, Josh Crabtree, and Stephen Young**.

Graduate students **Ramin Arvin, Nima Hoseinzadeh, Iman Mahdinia, Amin Mohammadnazar, Nitesh Shah, and Yi Wen** were named 2020 Traffic Safety Scholars. These six scholars were recognized through a rigorous selection process from a group of 50 US and international students. The scholars will attend next year’s Lifesavers National Conference free of charge.

The Tennessee Section Institute of Transportation Engineers (TSITE) recently awarded seven individuals and one team award to transportation students, bestowing \$8,200 in scholarships. **Mojdeh Azaddisfany, Nitesh Shah, Yi Wen, and Nima Hoseinzadeh** were each awarded scholarships while **Yuandong Liu, Zhihua Zhang, and Amin Mohammadnazar** swept the top three spots in the student paper competition. In the TSITE Distracted Driving PSA Poster competition, the team of **Sameer Aryal, Jing Guo, Kanghao He**, along with Azaddisfany, Shah, Wen, and Zhang placed second.

## From One Student to Another

Wes Darling Graduates with Transportation on His Mind



Yi Wen, a PhD student in CEE’s transportation engineering program, conducted an interview with Wesley Darling, and is currently pursuing a transportation engineering graduate degree at the University of California, Berkeley.

**Yi Wen:** Why did you choose to study civil engineering and transportation?

**Wes Darling:** I chose to study civil engineering, and specifically transportation engineering, because I find the quantification and modeling of human behavior incredibly interesting, in particular how the design of certain systems and pieces of infrastructure affects that behavior. This extends to transportation because, as humans, we spend so much time thinking about and actually moving from place to place.

**Yi Wen:** What do you like the most about UT?

**WD:** One thing I like most about UT is how open and available the professors have been to students. Many of the opportunities I have now would not have been possible had I not been able to form such close relationships with the faculty (both in class and in research work), and I can really attribute this to them always making themselves available to schedule a time to talk (even virtually during the coronavirus!). I have attended other universities, and this is not always the case, and it says a lot about the care the faculty have for the success of their students.

**Yi Wen:** Anything to share about applying for graduate school? How to prepare for the GRE?

**WD:** My biggest piece of advice is to start early! Most program application deadlines are in mid-December, but I think I started researching schools and potential advisors in July or August. I believe I asked my professors about writing me a letter of recommendation in late September or early October, though I followed up regularly to let them know how my application process was going.

**YW:** Tell us about your previous summer internship. What is it about and what have you learned from it?

**WD:** My previous summer internship was with BNSF Railway, where I was a track engineering intern based in Flagstaff, Arizona. The program was mostly experiential learning-based, and I spent much of the 10 weeks out on the rails shadowing the many different job functions required to build and maintain the company’s railroad tracks.

The biggest thing I learned from my railroad internship was how important the workers who actually construct infrastructure are to transportation and civil engineering as a whole. In our courses, we focus mainly on design and standards and rarely talk about the people who actually use our designs to construct the infrastructure.

My respect for the men and women dedicated to building infrastructure has grown so much after spending time at railroad construction and project sites.

**Yi Wen:** What will you miss the most about UT and Knoxville?

**WD:** I will miss all of the faculty and students who have made UT home for me these past two years. As an out-of-state transfer student entering a program at a time when most other students would have spent several semesters getting to know each other, I was very worried about “finding my place” in the department.

I was truly concerned over nothing, as the students were immediately welcoming and I quickly found friends through class and organizations like ASCE and ITE. The faculty were very helpful in guiding me along my way, and I have learned more from them than I truly ever expected. Though I will miss the students and faculty dearly when I leave, the relationships I have formed during my time at UT are ones I look forward to carrying with me wherever I go.



# STAFF SPOTLIGHTS

Writing and photography by Randall Brown.

**Jeremy Mobley** joined the college last summer as the department’s academic advisor for undergraduates. He immediately began the groundwork to build a mutual rapport and trust with students.

“I want to help them explore their strengths, interests, and values so they can effectively identify curricular and co-curricular opportunities that are relevant to their immediate and long-term professional goals,” Mobley said.

Mobley is from Roanoke, Virginia, but calls the entire southwest Virginia region “home.” He earned his bachelor’s in sociology with minors in psychology and women’s studies at Radford University in 2013 and his master’s in global and sociocultural studies, with a focus on race, gender, and sexuality at Florida International University in 2019.

“With a background in social science, I love to do research,” he said. “Let’s collaborate.”

Mobley has worked in higher education since 2012, and plans to make a career of it.

“I have previous experience with advising at Radford University,” he said. “I served as the main advisor for the Scholar Citizen Initiative, a program focused on interdisciplinary civic engagement and service learning.”

Career opportunities brought Mobley and his partner to Knoxville earlier this year from Johnson City. His partner, Jon, works just across the river from the engineering campus at the Regal Cinemas headquarters—which is good for movie-buff Mobley.



“I am an avid consumer of comic books and the Marvel Cinematic Universe,” he said. His favorite pastimes also include tabletop board games, video games, and hanging around with the family pets—a “seasoned” cat named Tip and a newly adopted kitten named Tum Tum.

Earlier this year, Mobley received the Outstanding New Advisor Award from the Tennessee Academic Advising Association, an organization of professional and faculty advisors and student support personnel at UT. This award specifically recognizes advisors who have not served more than two years at UT and who have exhibited excellence in their advising.

**Lisa Smith** is an administrative specialist within the department. She came to UT and Knoxville 19 years ago from her hometown of Columbus, Mississippi.

Smith earned her associate’s in accounting from East Mississippi Community College and her bachelor’s in business administration from Mississippi State University.

She applies these skills to help keep CEE’s wheels turning with attention to a variety of administrative duties. She handles invoices for payment processing, travel requests and reimbursements, and other assorted financial details.

“It is rewarding to be able to help guide new and old undergraduate students, graduate students, faculty, and staff through the reimbursement process,” said Smith. “Travel can be challenging because each one is so different, but it keeps things interesting.”

She learned that she entered the most travel for the entire UT Knoxville campus last year. Smith enters travel with CEE and other accounts across multiple campus units like the Center for Transportation Research and the Institute for a Secure and Sustainable Environment.

She provides additional information to traveling faculty, staff, and students beyond just entering their travel requests.

“After entering a travel request where the traveler is going to a particular conference,” explained Smith, “I pull all necessary information about the conference such as name and dates of the conference, registration, and lodging to have as backup documentation for when the traveler returns from the trip prior to entering their travel reimbursement.”

She also uses [www.gsa.gov](http://www.gsa.gov) to pull information about the city or county the traveler will visit if it is not a major city, and she gathers airfare price quotes.

Outside of her work, Smith enjoys exercising, reading, watching movies, and—you might have guessed—travel and relaxation.



## In Memoriam: Zach Cook

**Zach Cook**, of Knoxville, died December 30, 2019. Cook was a sophomore honors student studying materials science, but conducted research across disciplines, including civil engineering. Cook was working as an intern at IACMI—The Composites Institute and was also part of Professor Penumadu’s research group.



Several members of the Engineering Vols community shared fond memories of Cook:

“Zach was a brilliant and dedicated student and I had every intention of recruiting him to graduate school. He was well ahead of his age for his maturity, dedication, and most importantly kindness to others he was working with and learning from. Zach served both my group and Dr. Vaidya’s group on various materials characterization tasks associated with various IACMI projects and he will be dearly missed. He was a great MSE undergraduate student and was also considering physics as well.”

—**Dayakar Penumadu**, professor, CEE

“Zach was one of my interns, and I’m just devastated by this loss. Zach was one of the best. He was sweet, humble, smart, and a genuinely wonderful person. My prayers and thoughts are with his family and all those fortunate enough to know him.”

—**Joannie Harmon Heath**, IACMI workforce director

“Zach was a complete pleasure to work with.”

—**Matthew Kant**, research assistant professor, CEE

## In Memoriam

The Department of Civil and Environmental Engineering extends its deepest sympathies to the families of two friends of the department who passed away earlier this year.



**Eric C. Drumm**, of Knoxville, died February 7, 2020, at UT Hospital. He enjoyed a 37-year career at UT, most recently as the head of the Department of Biosystems Engineering and Soil Science from 2008 to 2016, and before that as a professor in CEE. During his tenure as department head, he initiated the Construction Science concentration, which became its own degree program in 2019.



**Bill Miller**, of Knoxville, passed away on May 10, 2020. Miller served as a faculty member in the department and later as both the associate dean of the college and associate department head until his retirement in 2000. He received his bachelor’s in civil engineering and master’s in fluid mechanics. After serving in the Army Corp of Engineers in Europe, he began his career at UT in 1957.





A U-2 Dragon Lady pilot poses for a portrait inside a pressure suit at Beale Air Force Base, California, Oct. 31, 2019. Courtesy US Air Force.

# Ready to Fly

*The Air Force Awaits CEE Senior Kadee Klimowicz*

*By Élan Young.*

Graduation is already a special time to reflect on the strength and growth that comes from hard work in academics, but for recent graduate Kadee Klimowicz, training for the Air Force gave her the added foundation of discipline to see herself as an emerging leader.

“The Air Force has given me a track toward adventure and relieved my parents of paying for tuition,” she said. “But it’s also evolved into so much more as the years went on. I found strength I never knew I had and it pushed me to fail and determine who I will be as a leader when I serve.”

Klimowicz was selected for OP-EX, an operational expeditionary career track that puts her first assignment in the Space Operations, overseeing space surveillance, space lift, space warning, and satellite command and control. Her first step will be training at Vandenberg Air Force Base in California.

While Klimowicz’s academic focus is in water resources and environmental engineering, she also has a passion for aircraft and space operations, so commissioning in the Air Force to pay for college was a great fit. For her, the ability to travel through the military is an added bonus.

Klimowicz comes from the small town of Spring City, Tennessee, and was attracted to UT and Knoxville because it would give her an experience of being in a bigger place.

**“I wanted to experience a school that was going to give me a taste of the real world and push my boundaries academically and socially,” Klimowicz said.**

During her senior year, she had the chance to travel to one of the biggest cities in the US when her senior design team went to Chicago for the Water Environment Federation Technical Exhibition Conference where they felt inspired amid the skyscrapers.

“Spending the day marveling at the skyscrapers with structural guru Senior Lecturer Jenny Retherford and actually going to the top of Willis Tower and standing in the glass box with the team created a sense of



family that motivated us to make our senior design project the best it could be!” she said.

As someone who is interested in sustainability practices for all aspects of civil engineering, CEE was a great fit. For her senior design project, she worked with teammates to design and build a portable water treatment device to produce potable water from wastewater effluent. The team planned to use the treated water to brew beer to increase awareness on water re-use applications

She also sees the civil and environmental engineering discipline as giving her the ability to approach any problem with a critical mindset.

“Graduating in civil engineering taught me how to evaluate and critically think in a deliberate manner within a time constraint,” she said. “I am confident in my abilities to come onto a task and work to be competent in my role. My engineering degree has taught me ‘how to learn.’”

Klimowicz hopes to tie these passions of sustainability and space as she begins her career in the Air Force.

“As space is becoming the new war domain, space debris is exponentially increasing,” she said. “To help develop a technology that allows us to continue our growth but lessen our waste is my ultimate goal.”



# Corps Connections



## Three CEE Seniors Connect Through Prior Military Experience

By Élan Young.

**“Serving the community is an honorable attribute I admire and one of the things that attracted me to the field of civil engineering.”**

—Ross Armstrong

Recent graduates Ross Armstrong, Joshua Clanton, and David Swinney each pursued careers in the military before coming to UT.

In their senior year, they all ended up on the same senior design team where they were tasked with designing a prefabricated bridge to mitigate the level of recurring flooding at the Maryville Little League baseball fields. While the work was engaging and grew their skillset, having the shared military experience between them gave them an even deeper bond of lasting friendship.

When deciding on a career in civil and environmental engineering, Armstrong says he saw similarities to the Marine Corps, where he served for four years before coming to UT.

“Serving the community is an honorable attribute I admire and one of the things that attracted me to the field of civil engineering,” Armstrong said.

Armstrong was responsible for environmental and site surveying services such as water quality testing, streambank erosion mitigation, environmental permitting, and topographic surveying. He loved working with the team.

“Every member contributed substantially, and each member had a mutual respect for each other’s ideas and motives,” he said.

Clanton joined the Air Force in 2004 and worked as an electrician in a combat engineering squadron whose mission was to go anywhere in the world and build air bases capable of sustaining missions. He was a part of some of the Department of Defense’s largest military construction projects and got to watch buildings go vertical in record time.

“My passion for construction really transformed as I gained more responsibility on the projects,” he said. “I knew that I wanted to go back to school to learn the engineering behind the dirty work. So, in 2015 I separated from active duty and joined the Tennessee Air National Guard and enrolled at UT.”

Clanton’s role on the senior design project evolved over the past two semesters. He was part of the initial site

survey, geotechnical exploration, and hydrology analysis, but in the second semester he took on some of the structural and geotechnical design by designing the wing walls to accompany the bridge designs.

“I will always remember the friends I made on this project,” said Clanton. “This project forced me to connect to other students that I normally would not have had a chance to get to know. Of course, getting to work with two other veterans definitely is something I will never forget. Those guys understood me in ways that a traditional student or faculty couldn’t even fathom. I am very proud of the work we did but mostly I am proud to call my teammates friends.”

Swinney joined the US Navy Seabees in 2009 as a heavy equipment operator. During his six years, he was deployed to Afghanistan, Spain, Cambodia, and Romania and worked on projects ranging from building entry control points, to drilling water wells, and even paving a few roads.

“My passion has always been construction, so when my enlistment was coming to an end in 2015, I decided to take a leap of faith and pursue my degree in civil engineering at UT,” Swinney said.

Swinney enjoyed being the senior design team’s geotechnical engineer, working with other team members to gather information about the soil conditions and creating soil reports of the site so it could be used to assist in design, but said the most memorable part of the project was being able to get to know other students.

“Transitioning from active duty to full-time student wasn’t easy, but sharing the struggle with other people who have the same goals made it enjoyable,” he said.

After graduation, Armstrong moved to Minneapolis, Minnesota, to be closer to his fiancé and work as a field engineer for railroading company Railworks.

Clanton began a new career with the Army Corps of Engineers in Knoxville, while Swinney is working at the Y-12 National Security Complex.

**“My passion for construction really transformed as I gained more responsibility on the projects. I knew that I wanted to go back to school to learn the engineering behind the dirty work.”**

—Joshua Clanton





“I am thankful for how impactful these [co-op] experiences were on my undergraduate and future career. All three rotations helped develop me into the more capable engineer that I am today.”  
—Hannah Loftis,  
BS/CEE, '20

Your support helps improve educational experiences for students like Hannah within and beyond the classroom. We are Volunteers. Be Proud. Be Involved. Be Invested.  
Call 865-974-8890 or visit [giving.utk.edu/cee](https://giving.utk.edu/cee).

# Find us on Instagram

Follow the department on Instagram @cee\_utk.



cee\_utk Several of our #EngineeringVols, including Hannah Maeser, Stephen Young, & Sean Lee, presented their automobile liftgate research at “UT Day on the Hill.”



cee\_utk We're competing in the inaugural TCE Office Decorating Contest. The theme was At the Movies, and we are obviously Clue.



cee\_utk Colby Gilbert spent part of his summer break in #Thailand on a Global Initiatives trip. Lucky for us, he wrote about his experience and shared a few photos in the latest Above Grade blog post. #engineeringVols #GlobalInitiatives



cee\_utk CEE is well-represented at the Annual Meeting of the Transportation Research Board thanks to Assistant Professor Candace Brakewood (center) and her students (left to right): Antora Haque, Cassidy Crossland, Abubakr Ziedan, and Jing Guo. #TRB #TRB2020 #transportationresearchboard



DEPARTMENT OF CIVIL &  
ENVIRONMENTAL ENGINEERING

325 John D. Tickle Building  
Knoxville, Tennessee 37996-2313  
Phone: 865-974-2503  
Fax: 865-974-2669  
Web: [cee.utk.edu](http://cee.utk.edu)  
Email: [cee@utk.edu](mailto:cee@utk.edu)

 [CEEUTK](https://www.facebook.com/CEEUTK)

 [@cee\\_utm](https://twitter.com/cee_utm)

 [@cee\\_utm](https://www.instagram.com/cee_utm)

The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment without regard to race, color, national origin, religion, sex, pregnancy, marital status, sexual orientation, gender identity, age, physical or mental disability, or covered veteran status. The university name and its indicia within are trademarks of the University of Tennessee. A project of the Department of Civil and Environmental Engineering with assistance from the Tickle College of Engineering Office of Communications. PAN E01-1392-001-001-21. Job 443790.

*big orange. big ideas.*



**iacmi** SHEET MOLDING COMPOUND FOR VOLKSWAGEN LIFTGATE

**THE UNIVERSITY OF TENNESSEE**

**VOLKSWAGEN** GROUP OF AMERICA

**ACCELERATING INNOVATION AND DISCOVERY TOGETHER**

**Reducing weight and cost through lightweight body panels**

**CHALLENGE**  
Incorporate part into vehicle that has:  
» Lighter weight than conventional parts  
» Less susceptibility to corrosion  
» Class A finish and is less likely than steel to show damage from minor impacts

**APPROACH**  
Collaboration led by Volkswagen between research institutions and industry partners to integrate liftgate into liftgate

**RESULTS**  
» 35%+ reduction in weight from comparable steel  
» Parts consolidation  
» Cost competitive  
» Composite solution and performance industry standard

**PROJECT PARTNERS**  
**IDI** Composite International  
**UT** THE UNIVERSITY OF TENNESSEE  
**OAK RIDGE** National Laboratory

**UT Announces Partnership with Volkswagen for Innovation Hub.**

**PAGE 9**