ANNUAL REPORT
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By the Numbers

No. 2 undergraduate civil engineering program
No. 4 undergraduate environmental engineering program
No. 4 graduate civil engineering program
No. 5 graduate environmental engineering program
1,109 students
43% women
62% of environmental engineering undergraduates are women
27% of undergraduate students are underrepresented minorities
348 degrees conferred
56 tenure-track faculty members
6 National Academy of Engineering members
12,000+ living alumni
1 in 10 CEEatGT alumni serve as a company founder, CEO, or president
Our motto, if you will — or perhaps our brand statement — in the School of Civil and Environmental Engineering at Georgia Tech is an enduring one: People are our priority. The world is our laboratory.

What does that mean? How does it manifest every day? The first declaration — the people part, speaks to the central focus of our field on creating engineering solutions and approaches that make people’s lives better and build stronger communities. Yet it’s that second part, about the world being the place where we do that work, that I’ve been reflecting on recently. It’s a simple sentence with a significant heft: It means that we’re driven to deploy our work into a world that needs clean air and water, resilient infrastructure, healthy communities, renewable energy, and sustainable new approaches to our way of life. In a word, it means that we must be innovators.

And we are. I’m pleased to deliver to you this broad look at what we’ve been up to during the last year, where you’ll see plenty of evidence of the new methods and designs and approaches pursued by our faculty and students. Those include discovering new applications for the principles of origami; developing new, inexpensive ways to purify drinking water; recovering vital nutrients from wastewater to grow produce; and laying the groundwork for a future of autonomous flying taxis. We’re also re-evaluating how we develop innovations that reflect real-world problems rather than traditional disciplinary boundaries of civil and environmental engineering. In the year ahead, we’ll have more to say about that.

We continue to reimagine how we prepare the next generation of engineers. We provide rigorous education that builds successful students while offering them opportunities to hack big construction projects with professional engineers, develop global cultural awareness and competencies, see the connections of engineering and art, and develop crucial leadership and communications skills. Meanwhile, we’re also adding to our faculty, bringing in rising stars in geotechnical natural hazards, air quality and climate, and energy and sustainability as well as a standard-setting scholar in transportation and travel behavior research. They will help us keep answering the call of service and impact.

Of course, this is a regrettably small sample of all that we’ve been up to. I encourage you to visit us online or in person to see for yourself all that happens on a daily basis. You can stay connected at ce.gatech.edu or on social media — we’re CEEatGT on Facebook, Twitter, Instagram and LinkedIn.

Looking through these pages, I hope you’ll be as impressed with the breadth of our impact as I am. This is a special place, and these are special people. What’s more, you are a crucial part of what we do; thank you for your ongoing support.

Donald R. Webster, Ph.D., P.E.
Karen and John Huff School Chair and Professor
GIULIANA STOVALL is pretty sure she knows one of every 64 students at Georgia Tech.
She’s a Yellow Jacket and an engineering student, so, of course, she’s done the math to back up her hypothesis.
“'To me, that is just a great, great thing,' Stovall said. ‘I like to see people’s faces and smile and say, ‘How have you been doing?’ and know something about them.
“That’s one of the reasons, I think, that Tech has not been as hard to me as it has been to others. So many people are so invested in knowing who I am and what I’m doing.’

For Stovall, a fourth-year civil engineering student, those connections have built a sense of community.
And community — well, that’s what it’s all about for her. It’s what makes Tech feel like home.

“I’m passionate about bringing people together,” she said. That’s why she became a resident assistant.
And why she sings in two different Georgia Tech vocal groups (plus a band on the side).
And why she founded Tech’s first club dedicated to roller derby.

“It’s the most team sport that I’ve ever played. It’s a lot about knowing your team and their strengths and their weaknesses and really just learning something together,” Stovall said.
She has played all over, from Oxford, England, to College Station, Texas. She traveled with the professional Savannah Derby Devils one summer. Yet there was no roller derby at Tech.

“The most challenging thing was coming to school and thinking that I wouldn't be able to do something that I loved,” she said, pausing for a moment:

“Actually, I knew I was going to do it, but I didn’t know how I was going to do it yet.”

Yellow Jacket Rollery Derby has grown from about half a dozen committed members initially to several dozen people signing up this year to learn the sport — and join a community known for its openness.

“We're trying to reach out to everybody,” Stovall said. “If anybody wants to play, we'll teach them.”

More recently, the challenge for Stovall has shifted from creating something from scratch to letting it go. Another member took over as president of the roller derby club this year, because Stovall recognized others would need to lead if the group was to continue after she graduates.

Not that she’s not staying plenty busy with the
“I want to make people’s lives better. I want to serve the public in a way that only I can, using all the skills and knowledge and experience I have.”

Georgia Tech Chamber Choir (where she also has served as president) and the all-women a cappella group Nothin’ But Treble. Music has long been part of her life — she studied vocal performance in high school — and likely would’ve figured into her career until her physics teacher suggested Stovall would make a great engineer.

It’s probably not surprising civil engineering resonated with Stovall, given her penchant for community-building.

“I want to make people’s lives better,” Stovall said. “I want to serve the public in a way that only I can, using all the skills and the knowledge and experience I have. We know so much; we should use it to make the world a better place.”

Stovall comes by her interest in physics and engineering naturally: her dad is also a Georgia Tech civil engineer, class of 1988. She’s planning for a decidedly different career, however. He works in wastewater and environmental engineering; she’s interested in structures, especially skyscrapers and other signature buildings, like performance spaces.

It’s a perfect blend of her desire to build and make lives better and her love of the arts. Plus, it’s challenging, she said.

“There are very few firms that specialize in just skyscrapers; usually they’re designing skyscrapers and these big performing arts centers, or these big megaprojects like Atlantic Station,” Stovall said. “That’s where I’m leaning right now, to go work on those big projects.”

In the meantime, she’s balancing all of her interests with one other way she’s involved at Tech: talking to young students about engineering as a College of Engineering Champion.

“I like to tell them that civil engineering is the best major, because you’re building things for people, you’re building something that someone will use every day — be it a road, water systems, or a building,” she said.

“It’s rewarding. You feel good at the end of the day.” Just as good, perhaps, as when you can greet 1/64th of the faces you see on campus.
A Lifetime of Service

An hour after the National Academy of Engineering announced John Koon was one of its newest members, he was doing what he does every Thursday: teaching his Senior Design course.

Never mind that election to the NAE is one of the most prestigious honors — perhaps THE most prestigious — an engineer can receive, and one that’s been reserved for only about 2,500 people worldwide.

“It is an incredible honor,” Koon said. “I’m delighted to be included in this remarkable group of engineers.”

Koon was one of two Georgia Tech professors among the 104 new members for 2019. The National Academy said it was recognizing Koon “for contributions to the design of systems to treat chemically complex industrial wastewaters.”

Koon has built a career as one of the foremost experts in that field and helped develop some of the fundamental practices environmental engineers use today. Now he uses his 40 years of experience to shape a new generation of engineers as a professor of the practice in the School of Civil and Environmental Engineering.

“Dr. Koon brings a wealth of practical experience to the classroom based on his many distinguished years of professional practice. He has been a tremendous advocate for student experiential learning, particularly in our environmental engineering design courses,” said Donald Webster, Karen and John Huff School Chair. “I am so pleased that his contributions have been honored with election to the NAE.”

“I woke up one day and realized that the purpose of my 40 years or so of practice was preparation for teaching at Georgia Tech,” said Koon, who has been teaching in the School for more than a decade and joined the full-time faculty in 2012. “I frequently draw upon instances where I was working on engineering projects and bring that to the classroom. And I thought, all of that experience was just preparation for what I’m doing now.”

His is a career that may have turned out very differently, had he finished his Ph.D. even a few years earlier or later, Koon noted. But the country was waking up to the impact humans were having on the environment, opening the door for him to help take new theories and approaches from the lab and classroom and put them into practice.

“When I got into the field, it was very new and undergoing very rapid change,” Koon said. “When I was in graduate school, [President Richard] Nixon formed the Environmental Protection Agency. The first year I was working, Congress passed the Clean Water Act that basically required all cities and industries in the country to start treating their wastewaters. Before that, there were lots of them, easily the majority, that didn’t do that or did very little of it. So we were right at the cusp of us, as a country, developing our environmental ethic.”

Over the course of his career, Koon worked at something like 500 industrial sites. He implemented new systems that allowed pharmaceutical companies to treat and reuse their wastewater, which was laden with chemicals. He helped develop biological processes to treat industrial toxic wastes. He also worked with pesticide makers to manage chemicals that turned out to be very persistent in the environment.

About a decade ago, Koon started to consider how he wanted to spend the rest of his career.

“I thought that education and, specifically, science were being undervalued by the country, and I thought, ‘Maybe I should help young people appreciate science and get excited about it,’” he said.

Koon still consults and serves as an expert witness. A few years ago, the Water Environment Federation gave him a lifetime achievement award and the University of California, Berkeley, inducted him into its civil and environmental engineering Academy of Distinguished Alumni.

“I’ve thought about what role luck played in all of this,” Koon said. “My undergraduate and master’s degree adviser went to Cal Berkeley and encouraged me to go there to graduate school. When I was there, I took the first offering of a course in applying chemical reactor theory to environmental engineering processes. That gave me a big piece of the technical background I needed.

“I went to work with this startup firm — I had a couple other offers, but I chose this one. That work gave me lots of opportunities early in my career. And being at Georgia Tech — I was nominated as a practitioner, but I’m sure my work at Georgia Tech strengthened my nomination.”
“I woke up one day and realized that the purpose of my 40 years or so of practice was preparation for teaching at Georgia Tech.”
Ph.D. student and Sandia National Labs intern Rebecca Nylen kneels next to blasted steel cylinders, some of her handy work as a computational shock physicist at the labs.
If you didn’t know better, you’d think Rebecca Nylen had a terrible start to her summer internship a few years ago. She didn’t understand the work her group did. She had to be escorted everywhere because she worked in a tech area without a clearance. She tried picking up trail running, but fire restrictions closed the trails. When she joined a group of interns on a mountain climbing trip to Colorado, she tripped and broke her ankle. But none of that mattered, she said. At least not compared to what she loved about Sandia — supportive people, world-class technology, Southwest sunsets. In fact, she returned for a second summer internship — and then a third. “I mean, it’s Sandia,” she said, surveying a bulging, six-foot-tall steel cylinder deformed from explosives. Nylen and her team sacrifice cylinders and other objects to refine the accuracy of computer simulations of damaging blasts, part of a field known as computational shock physics. But as a doctoral student in civil engineering at Georgia Tech, she’s more of an experimentalist, pummeling materials like reinforced concrete with high-powered actuators to study how the materials deteriorate and how to improve their post-impact strength. It took about a month, she said, to feel comfortable with the entirely new skills and computational techniques, but her teammates throughout the computational structural mechanics organization played a key role aiding her ascent along a steep learning curve. “Rebecca brings a number of positive qualities to our team,” said Russ Teeter, Nylen’s Sandia mentor. “She is self-motivated and excited to learn, while her background in civil engineering helps us when modeling blast effects on concrete.” Her expertise, he added, “fits into a number of Sandia mission spaces where it is important to understand the residual capacity of a structure after it has been subjected to blast or other damaging loads.” Now fluent in CTH, a widely used software tool for modeling the behavior of explosives, Nylen enjoys chatting with developers, picking their brains about material characteristics and how they’re represented mathematically. CTH was developed at Sandia, so the developers are always nearby to discuss the code. She can’t do that for the commercial software she uses at Georgia Tech. “Extending the network of sharing between academia and the national labs is important,” said Nylen’s Ph.D. adviser, Lauren Stewart, an associate professor in the School of Civil and Environmental Engineering. “Rebecca will be able to return to Georgia Tech with new knowledge that she can share with our entire research lab. I look forward to her experiences and approaches stimulating new ways of thinking for our group.” And that’s exactly what Nylen plans to do. Civil engineering, she said, is largely driven by observation, but that makes certain scenarios hard to plan for. If you want to study a structure in an earthquake, you have to wait for an earthquake, and for obvious safety reasons, you can’t intentionally build a bridge that will fall apart to study its weak points, or violate building codes to experiment with new materials or techniques. But a computer model can reveal ways to improve roads, bridges and other infrastructure in ways that are otherwise difficult to observe. Nylen aims to combine her experimental and computational perspectives to propel her field. “I’d like to advance the state of computational abilities for civil engineering structures.” – Troy Rummler
Professor **JOHN CRITTENDEN** and President Emeritus **G. WAYNE CLOUGH** have helped chart the course for the future of environmental engineering in a new report from the National Academy Engineering. *Environmental Engineering for the 21st Century: Addressing Grand Challenges* lays out five grand challenges facing society that environmental engineers are uniquely positioned to address:

- Sustainably supply food, water, and energy.
- Curb climate change and adapt to its impacts.
- Design a future without pollution and waste.
- Create efficient, healthy, and resilient cities.
- Foster informed decisions and actions.

Answering these challenges, however, will require an evolution in environmental engineering education, research and practice, according to the report.

"The field of environmental engineering has made remarkable strides in the last five decades, but we are rapidly approaching constraints and tipping points that our profession is ill equipped to deal with," said Crittenden, director of the Brook Byers Institute for Sustainable Systems at Georgia Tech and Hightower Chair and Georgia Research Alliance Eminent Scholar in Environmental Technologies. He's also a professor in the School of Civil and Environmental Engineering. "The vision of the future for environmental engineering laid out in this report will help guide today's educators and academics in fostering the next generation of environmental engineers that will build a world where we can create knowledge and technology to improve the human condition and the environment. This is a world where people and ecosystems can symbiotically benefit each other."

Crittenden and Clough served as co-authors of the report, along with more than a dozen other leaders in the field. They distilled the five grand challenges from more than 450 ideas collected from engineers, scientists, professional associations, nongovernmental organizations and the public.

"This is a seminal report, because it is ambitious and game changing," said Clough, who also is secretary emeritus of the Smithsonian Institution and a graduate of Tech's civil engineering program. "While it respects the history of the environmental engineering profession, it recognizes that, going forward, new directions are required in education, research and practice."

"To my knowledge, it is the first document of its type to embed climate change and sustainability within its goals for the future," Clough said. "It was a pleasure to serve on the committee with so many outstanding colleagues, including our own John Crittenden."

*– with contributions from Brent Verrill*
Environmental engineering practitioners should work collaboratively with stakeholders and other disciplines to more holistically analyze, design, and implement practical, systems-based solutions. To support these efforts, the environmental engineering field should cultivate a more diverse workforce, focusing especially on increasing the racial and ethnic diversity of the pipeline of scientists who enter this field.

Environmental engineering education programs should strengthen foundational knowledge in two areas: complex system dynamics and the social and behavioral dimensions of environmental challenges. In addition, programs should ensure that the scientific content of their curricula keeps pace with current and anticipated global challenges and the most promising tools for developing solutions.

To facilitate the collaboration necessary to meet future challenges, research universities and organizations should evolve to value and incentivize interdisciplinary work.

Funding organizations and research institutions can assist effective interdisciplinary collaboration through well-designed grant programs and by fostering environments where relationships and collaborations can develop organically.

Access the full report: ce.gatech.edu/annualreport
Images are still not given the attention that they deserve, and there is room for disruption in many markets that currently undervalue image management.

Fikret Atalay, left, and Mahdi Roozbahani work on their image management app Filio, which went live in June. The web and mobile app allows contractors, insurance companies and other businesses to take photos at a worksite and instantly caption and catalog those images. Atalay and Roozbahani developed the app while they were Ph.D. students in the School and participated in Georgia Tech’s CREATE-X program to help students turn their ideas into startup ventures.
There's an App for That

It's a problem many of us can relate to: you take a bunch of photos at an event or on a vacation and then never get around to organizing them.

They just sit in your phone's gallery, or maybe in a folder on your computer. But all the details are often lost to history.

It's no different for construction companies, contractors or insurance companies. Employees frequently document a work site but might miss important details or, when they download the photos days later, forget the exact location of many of the images.

A startup created by two School of Civil and Environmental Engineering graduate students aims to fix all that and make image management a snap (pun intended).

MAHDI ROOZBAHANI and FIKRET ATALAY went live in June with a mobile and web app called Filio (pronounced FILL-ee-oh) that automatically tags photos with GPS coordinates and the direction the camera was pointing. It allows the photographer to then quickly caption the image with voice-to-text capabilities. The image is uploaded immediately to a central cloud platform, where it's searchable on a map or by keyword. Photos can be integrated with Google Earth and mapping software ArcGIS.

“Images are still not given the attention that they deserve, and there is room for disruption in many markets that currently undervalue image management,” said Roozbahani, Filio's founder. “With the advances in computer vision and machine learning, images will become even more valuable in the future, and it is our goal to be at the forefront of this emerging sector.”

Roozbahani said capturing and organizing construction photos, for example, has been a cumbersome, inefficient process. Often, key information is lost between when the photos were taken and when they’re put to use.

“For example, if good field notes were not taken, one may not recall where exactly the picture was taken, or what the picture is trying to convey,” he said. “In addition, creating reports or presentations for clients involves extra steps, like copying and pasting photos into a template and typing all of the photo's information all over again.”

Filio allows users to skip all that, inputting information once and then generating reports with a few clicks. On-site employees and project managers in the office also can collaborate in real-time, discussing issues or addressing questions right away.

“In some cases, there may not be an opportunity to go back and take more pictures,” said Atalay, the startup's co-founder. “Filio greatly reduces the risk of lost information, increases productivity, and allows users to treat their images like the valuable assets that they are.”

Filio is one of the latest startups to emerge from Georgia Tech's CREATE-X entrepreneurship incubator. The app — available for iPhone and Android — beta tested with about a half-dozen companies. Some of those early testers immediately signed up as paying customers.

So how do a couple of geotechnical engineering Ph.D. students end up creating an app to manage images for contractors, banks, insurers and developers?

“It was a case of being at the right place and at the right time with a combination of the right talent,” Atalay said. “We were both Ph.D. students under the same adviser and with different, yet complementary, backgrounds.”

Roozbahani has a background in mobile and web app development, and Atalay has worked as an engineering consultant and in geotechnical engineering construction.

“This allows us to come up with ideas and implement them rapidly,” Roozbahani said.

Both have now finished their doctoral degrees — Roozbahani in computational science and engineering and Atalay in civil engineering — and they continue to teach and do research at Tech. But they said they’re actively courting investors (Tech alumnus Chris Klaus is already on board) and hope to make Filio their primary focus in a year or two.

“We hope to rapidly expand and grow our market presence,” Roozbahani said. “Our vision for the company is to become a leader in photo asset management.”
How could robots improve the installation of new canopies at Hartsfield-Jackson Atlanta International Airport?

That was the challenge for teams of School of Civil and Environmental Engineering students and industry mentors at Tech Blitz in November, a day-long hack-a-thon designed to highlight the School’s work driving technological change in the architecture-engineering-construction industry.

The winning team offered a suite of options, including autonomous, rail-mounted robots using lasers and cameras to track canopy installation and find trouble spots; robotic arms to weld and inspect the welds; “zipper” robots to install the translucent canopy covering; and a network of sensors to improve worker safety and efficiency.

“The most challenging thing about working on a short time scale was getting people on board with a couple big ideas very quickly, and then setting them to improve upon those ideas in a cohesive manner,” said Rachel Samuels, a Ph.D. student who helped come up with the winning ideas. “You need to be creative but focused, which involves a special kind of precision chaos. In fact, one of the industry professionals and I had been operating under very different visions of our solution up until I was sketching out the design half an hour before we needed to present. We had to improvise quite quickly.”

The steel-trussed canopies are part of a massive infrastructure improvement project at the airport called ATL Next. Samuels’ team said their system would improve safety, provide constantly updated information about the work’s progress, and shave nearly three months off the project schedule.

Calling themselves the “Autobots,” the team included Samuels, Matt Vanture from Whiting-Turner, Roya Agharahim from Swinerton, Kirk Voelkel from H.J. Russell, and civil engineering undergraduate Santiago Escobar.

All told, 15 professionals and 13 students in five teams spent the day brainstorming ideas for the canopy construction process. They had about six hours to formulate a plan and present it.

“It was a little pressure, obviously, but not the bad kind of pressure — the good kind of pressure that gets the best out of you,” said Sakshi Hattargi, a master’s student studying construction and infrastructure systems engineering.

“I loved it. Talking to industry people directly, the direct one-to-one conversation, and then getting insights from them about how things go at their sites,” she said, “it’s a big thing, getting in touch with the industry.”

Hattargi’s group mate and fellow master’s student Rajshree Bhardwaj agreed.

“It was an amazing experience,” she said. Raj Sharma from another team said he also benefitted from talking to the professionals who were
The most challenging thing about working on a short time scale was getting people on board with a couple big ideas very quickly, and then setting them to improve upon those ideas in a cohesive manner.

on his team — though he was a little nervous to present their ideas to the judges and other teams.

“It was a learning experience. I’m pretty happy with the entire thing. It was a productive day,” he said.

It’s the second time faculty members John E. Taylor and Eric Marks have organized the Tech Blitz, which they said is the only event of its kind in the field. The idea came from conversations with a group of alumni and industry professionals who sit on the School’s Construction Advisory Board. The challenge at the first blitz used Building Information Modeling to “radically” improve construction of Georgia Tech’s Living Building.

“We think of our construction and infrastructure systems engineering program as the platform for technological change in the AEC industry,” Taylor said, “so we want to foster these kinds of interactions between our students and professionals to explore and expand the cutting edge of technology in our industry.”

“PHOTOS: JOSHUA STEWART

Top left: Santiago Escobar, left, and Swinerton’s Roya Agharahim listen as Matt Vanture from Whiting-Turner discusses their approach to using robotics in the installation of steel canopy trusses at Hartsfield-Jackson Atlanta International Airport. Top right: Ph.D. student Rachel Samuels and Venture work out final details of the team’s plan. Their team’s combination of ideas won the second Tech Blitz, a sort of construction hack-a-thon at the School of Civil and Environmental Engineering. Bottom left: Rajshree Bhardwaj, right, and Sakshi Hattargi brainstorm their team’s robotic “hack” for the canopies.

Opposite: McCarthy Building Company Project Manager Justis Brogan, left, tells a group of School of Civil and Environmental Engineering students about the canopies being installed at Hartsfield-Jackson Atlanta International Airport.
There aren’t many engineering courses that include exhibiting artwork at a local gallery, as the final class activity. 

**FRANCESCO FEDELE’S** students did just that in December, showing the drawings they created during his fall course connecting advanced geometry with art through the lenses of Einstein and Picasso.

“They are icons of contemporary art and science, and they were linked in time and ideas,” said Fedele, associate professor in the School of Civil and Environmental Engineering. “Einstein was an artist; Picasso was influenced by ideas about the fourth dimension, space and time.”

The course included students from computer science and almost every kind of engineering. It introduced what Fedele called exotic and complex concepts that don’t typically show up in the engineering curriculum — differential geometry, covariant derivatives and the like. Fedele showed how Einstein used the concepts as he was developing his theories of general and special relativity.

“My main goal was to expose the students to this difficult mathematical concept of differential geometry, and also, I want them to realize that special relativity and general relativity, they are not far away from us,” Fedele said, noting it has only been a century since Einstein’s paper on general relativity was published in 1915.

“We need to appreciate it and understand it. The GPS navigation system we use every day on our phones would not work without Einstein’s relativistic corrections. It is not difficult to understand Einstein’s great physical insights on relativity of space and time; it is just that we think that everything is absolute in the world around us.”

That’s where art and Picasso come in. With a grant from Georgia Tech’s Ferst Center for the Arts, Fedele brought in Atlanta artist Emily Vickers to teach studio sessions and help...
students “unlock” their minds. The resulting artwork hung for an evening at the Kai Lin Gallery on Atlanta’s Westside at a public exhibition.

“It’s very difficult to unlock your mind, but that’s what you have to do to understand Einstein. You need to give up on the idea that space and time are absolute,” Fedele said. “Artists can do that. They are free-thinking; they are unlocked.”

It was the first time Fedele taught the course and likely just as difficult for him as for his students, he said. But he saw how exploring Picasso and Einstein’s insights on relativity and cubism, art and science opened students’ eyes.

“Emily and I saw the evolution in their thinking and drawing skills over the semester. Some of them started very locked in their mind and even very rigid in the way they were holding the pencil,” Fedele said. “In three months, they basically freed their style, and they started to appreciate these concepts. We can see it.”

Fedele and Vickers ended the class with an exhibition simply because, Fedele said, they wanted their students to be proud of what they accomplished over the semester. Fedele also wanted to connect with Atlanta’s art community so that he can find more ways to link local artists with Tech, perhaps even through an artist-in-residence program.

“To me, the future of education has to be art and science. There is not much difference; artists are like scientists, they are thinkers,” Fedele said.

“Each of us, we are all artists. If you put forth the dedication to learn the skills, it will come. We are born to create. The caveman didn’t even talk, and he was creating graffiti.”

Students used various techniques taught by Atlanta artist Emily Vickers to develop their drawing skills in Associate Professor Francesco Fedele’s Visual Arts and Geometry course, which linked advanced geometry with art through the lenses of Picasso and Einstein.
Longtime School of Civil and Environmental Engineering supporters JENNY AND MICHAEL MESSNER made a transformational donation in the fall to support the School’s faculty. Through their family foundation, the Messners established a $5 million challenge fund to spur creation of new program-boosting endowed chairs and professorships. The gift will more than double the number of such positions in the School.

“The overarching goal is to provide up to $10 million in additional permanent endowment for support of the School of Civil and Environmental Engineering,” said Michael Messner, who earned his civil engineering bachelor’s degree in 1976. This infusion of support “will enable the School to be even more successful in retaining and recruiting exceptional faculty at mid- and senior-career levels.”

As a result of the Messner Challenge, the School will have three new endowed chairs and four new professorships to support faculty. “Endowed positions are game-changers in terms of our ability to recruit and retain stellar teachers and scholars who will help us continue to make a difference in our society,” said Donald Webster, Karen and John Huff School Chair. “Providing faculty with the additional resources that such endowments offer gives them flexibility to explore new areas of inquiry or to support the growth and development of their students.”
NEW ENDOWED CHAIRS AND PROFESSORSHIPS

- Higginbotham Family Professorship
- Bonnie W. and Charles W. Moorman IV Professorship
- Dwight H. Evans Professorship
- The Williams Family Professorship
- Turnipseed Family Chair
- Jose Domingo Perez-Muniz Chair
- G. Wayne Clough Chair (created by the School’s External Advisory Board)

“Any opportunity to ensure that Tech stays strong academically is important to Tech graduates, to Georgia, and to the country. And if you believe that civil engineering is a discipline that is important, why wouldn’t you help the Messners achieve this goal to make sure the School of Civil and Environmental Engineering stays strong?”

Bonnie and Charles W. “Wick” Moorman, BCE 1975

“A million dollars is daunting, but the fact that it drops to $500,000 [which is then matched] is wonderful. It takes a little creativity for someone who is still working to figure it out; Mike Messner has enabled a working stiff like me to be able to do this.”

Elizabeth and William “Bill” Higginbotham, BCE 1976

“I had been thinking about other ways to support Georgia Tech, so when this opportunity came about, I decided to support it. [Ensuring the School has excellent faculty] will keep Georgia Tech at the top.”

Dwight H. Evans, BCE 1970, MS SanE 1973
The School of Civil and Environmental Engineering welcomed four new faculty members this year who will advance our tradition of trendsetting excellence. We also elevated two of our early career stars, giving them additional resources to build their research agenda and expertise. Meet these new leaders who will help define our future.
The world of fully autonomous vehicles is inevitable, according to one of the newest faculty members in the School of Civil and Environmental Engineering.

The question is, how do we get there with the right policies and investments — and without so many bumps in the road that public trust erodes along the way.

“There will be a critical transition period from where we are today to get to that future where we will have what I call ‘connected autonomous transportation.’ And transportation engineers will play a key role,” said Srinivas Peeta, the new Frederick R. Dickerson Chair in civil and environmental engineering. “There is the need to inform policy. There is the need to understand what type of solutions would lead to a smooth transition versus a rough one.”

Peeta, who is also a professor in the Stewart School of Industrial and Systems Engineering, said we’re already seeing harbingers of rough patches, with stories about autonomous Uber vehicles striking and killing a pedestrian or the Tesla owner who died when his car crashed using the Autopilot feature.

“[Losing public trust] can be as simple as people perceiving what we have today as autonomous vehicles, which are not,” he said. “We’re not yet at the level where we’re looking at a mature autonomous transportation system.”

Enter Peeta’s decades of research on transportation systems from what you might call a 30,000-foot view — and what engineers call a system-of-systems perspective. Peeta studies transportation in the context of all the connections those systems have to other systems: power, water, natural gas distribution, telecommunications, and more.

“We look at problems holistically rather than just looking at one aspect of a problem, seeing the connections across, which is how societies are set up,” he said.

Autonomous and connected transportation systems are a natural outgrowth of Peeta’s system-of-systems approach because it involves the complicated interactions of people, vehicles and infrastructure, and it demands a multidisciplinary approach. He has long studied traveler behavior and predicting traffic conditions to help drivers make better decisions on the road — a research area called dynamic traffic assignment, where Peeta set the standard for research.

In recent years, his work has included using a driving simulator to understand how drivers think and process information.

“The simulator allows us to look at not just what information people have and how do they act on it, but also what is their ability to process such information?” Peeta said.

Peeta has been correlating brain activity and eye movement to what drivers say they think and do behind the wheel in an effort to inform designs for the future. Vehicle manufacturers need to know how to offer information to drivers — or “passengers” in an autonomous car — and government agencies need to know what information is valuable and how to provide it to vehicles.

“They are questions that need to be answered as we transition to this fully autonomous, connected world,” he said.
Emily Grubert’s work is all about making good decisions. Her domain includes the kind of things you might expect of a civil engineer: big infrastructure systems that make our society possible — energy, water, transportation, buildings. But then she blends in the social impact of these systems and the decisions we make about them.

“Big infrastructure systems are deeply important to society because they support how we live, while at the same time shaping how we live,” said Grubert, who joined the School of Civil and Environmental Engineering faculty in January. “Systems like our energy, water and building infrastructure have many types of impacts, and something that performs well in one area might not perform well in other areas. By thinking about these infrastructures as systems — both technical and social systems — we can make them better and more supportive of human thriving.”

Grubert focused on a stormwater management decision-support tool for the United States during her postdoctoral work at the University of California, Berkeley. She earned her Ph.D. at Stanford University after working for a few years at McKinsey & Company and received a graduate fellowship from the National Science Foundation.

“I am so excited to come to Georgia Tech in part because of the enthusiasm around interdisciplinary work and recognition that engineering serves society,” Grubert said. “The opportunity to continue working as an engineer who is also a social scientist, and the opportunity to work closely with the School of Public Policy through a courtesy appointment, were huge draws and ones that I hope will serve my students and community as well as my own work.”

Grubert studies how we design, build and operate the systems that support our communities and how we make choices about some of the biggest projects human society undertakes.

“For example, when we want to design an energy system, we care about things like cost, environmental attributes, and impacts on the communities hosting the infrastructure,” she said. “I use an analytical tool called life cycle assessment to look at how different options stack up against each other, then I combine that analysis with research on what people think the most important issues are in order to consider how different perspectives might affect our choices.

“I’m particularly interested in getting engineers and social scientists to work together on issues like these.”

Grubert said she’s looking forward to developing relationships with practitioners so she can apply her analyses to real-world decision-making situations and help them make choices that better serve their communities.
Though they’re relatively rare, the consequences of disasters like earthquakes, flooding, and landslides are dire — and growing.

Just ask Jorge Macedo, who thinks a lot about the risks to people, communities, and engineering systems from those kinds of extreme events.

“Geotechnical hazards are a primary cause for thousands of casualties and large economic losses around the world,” said Macedo, who joined the School of Civil and Environmental Engineering faculty in the fall as an assistant professor. “In the United States, the number of people and infrastructures that are at risk continues to increase. Climate change and population growth increase the vulnerability of coastal areas and areas of urban sprawl, which increases risk over time.”

If it sounds like a big problem, well, it is. And it spurs Macedo’s work to make geotechnical infrastructure systems and cities more resilient, saving lives and reducing economic losses.

“I expect, through my research, to contribute to solutions for many of the complex problems at the nexus of cities, water, and energy,” Macedo said. That includes “improving the ability to simulate geotechnical systems’ response under extreme loading conditions, developing more resilient geotechnical systems to mitigate damage, and increasing the sustainability of urban infrastructure.”

To accomplish those goals, Macedo focuses on performance-based engineering, an approach that considers how a project responds to users’ needs over time, especially in extreme events like earthquakes. He combines it with advanced numerical models, reliability engineering, and new technology. The idea is to assess risks, plan for them, and, ultimately, make geotechnical systems more resilient.

He said his work inherently crosses boundaries between disciplines — a hallmark of his career going back to his years as a practicing geotechnical engineer in South America and Canada working on infrastructure, mining, and oil and gas projects that demanded a multidisciplinary perspective. That’s what drew him to Georgia Tech, a place he said was his first choice after finishing his Ph.D. and postdoctoral work at the University of California, Berkeley.

“Georgia Tech is the perfect place to continue to work on unresolved issues emerging from my previous research,” he said. “At the same time, it also gives me the opportunity to embark on new avenues of research, which is particularly attractive for me, as I am intensely curious.

“It is a great institution with outstanding faculty and talented students in all areas, and particularly, an exceptional geotechnical group that I want to collaborate with.”
Jennifer Kaiser lives and breathes her work. Actually, we all do.

Kaiser studies our atmosphere’s changing conditions and the chemical reactions taking place that shape the literal air we breathe. She joined the School of Civil and Environmental Engineering faculty in the fall to continue that work in what she says is a fascinating region.

“Georgia Tech has great students and an impressive cohort of scientists and engineers working on environmental issues. Also, I’ve studied and written a lot about the southeast United States,” said Kaiser, an assistant professor. “It’s a very interesting place where we can examine the intersection of the human and natural world.”

Kaiser finished a postdoctoral fellowship in atmospheric chemistry at Harvard University after completing her Ph.D. at the University of Wisconsin-Madison. She received fellowships from the National Science Foundation and NASA. At Tech, she has a joint appointment in the School of Earth and Atmospheric Sciences.

Kaiser specifically looks at volatile organic compounds, human-made or naturally occurring chemicals that she called the precursors to air pollution. She combines instrument-measured data with satellite observations and computer models to create a more complete picture of the chemical processes that control air quality.

“My research is guided, in part, by what’s happening in the world. For example, if air quality regulations change, or if new technologies create new emissions, I want to be ready with accurate, predictive models to understand how these changes will affect what we breathe,” Kaiser said.

“Every day is an experiment in how emissions impact atmospheric composition. I feel a sense of urgency to identify and minimize uncertainties so we can generate the most effective responses to poor air quality.”

She said advanced capabilities coming online also will shape how her work shifts in the next few years.

“We’re entering a new era of high-resolution satellite observations, and at the same time, ground-based instrumentation is becoming less expensive and more accurate,” Kaiser said.

“I’m excited to put these technologies together and to gather as much data as possible to help develop accurate air quality models and effective policies.”
Joe Brown has been appointed the newest Carlton S. Wilder Assistant Professor in the School of Civil and Environmental Engineering.

The endowed position is one of two created by the Wilder family to honor their late husband and father, an advocate throughout his long career for young environmental engineers. The family wanted to help boost the careers and research efforts of outstanding early career faculty members at Georgia Tech who study water quantity and quality.

“It is an honor to be recognized with this endowed position, which will provide substantial support for my research group,” said Brown, who joined the School in 2014 after a stint at the London School of Hygiene and Tropical Medicine.

“I am extremely grateful to the Wilder family for creating this professorship to advance water research in the School, and to my colleagues in civil and environmental engineering for nominating me.”

Brown works at the intersection of environmental engineering and public health, especially in underserved communities. He has projects assessing the effects of improved sanitation services on public health in urban areas in the developing world and looking at poultry farms’ impact on downstream water resources. He won a National Science Foundation Early Career Development grant in 2017 to understand how waterborne pathogens might become aerosolized and make people sick in low-income, urban areas.

He’s often invited to speak around the world and has secured research funding from the NSF, the National Institutes of Health, the Centers for Disease Control and Prevention, and the U.S. Agency for International Development, among others.

“Joe has already made remarkable contributions to research, teaching and service,” said Donald Webster, Karen and John Huff School Chair. “I’m thrilled to offer him this additional support to further grow his impact.”
Sam Coogan has been named the Demetrius T. Paris Assistant Professor. The endowed position for early career, untenured faculty members will support Coogan’s work to create efficient, intelligent and autonomous transportation networks.

“This professorship will enable me to explore exciting new research ideas that I otherwise might not have the resources or flexibility to pursue at this stage of my career,” said Coogan, who shares a faculty appointment in civil and environmental engineering as well as electrical and computer engineering, where the Paris professorship is housed.

Coogan, a former Georgia Tech student, returned in 2017 after two years at the University of California, Los Angeles. His work focuses on applying tools from control theory and dynamical systems to build new mathematical models and algorithms to understand and manage transportation systems.

In 2018, Coogan won an Early Career Development Award from the National Science Foundation for that work. He also received a Young Investigator grant from the U.S. Air Force Office of Scientific Research to understand how material moves through physical flow networks like roads, pipes and airspace and provide guarantees about how those systems operate.

“It is an honor to have been selected for the Demetrius T. Paris Junior Professorship,” Coogan said. “This professorship has a long history of supporting exceptional junior researchers, and I look forward to contributing to this legacy.”
Thinking Forward

It’s no surprise to anyone who’s been paying attention that the world faces significant changes in the decades ahead. Growing population, a changing climate, radical advantages in technology, crumbling or inadequate infrastructure, to name but a few.

The exciting and energizing reality is that many of the solutions to these and other global issues will come from the civil and environmental engineers who are today learning, working and leading in the School of Civil and Environmental Engineering at Georgia Tech.

To answer the call of service from our global society, we think beyond the traditional boundaries between disciplines in our field, embracing new ideas, new collaborations, new sources of inspiration, and new areas of inquiry. Now, we view our contributions to society in three broad, cross-cutting research areas: Smart Cities, Sustainable Communities, and Resilient Infrastructure Systems.

This is where we’re working at the front lines of the world’s grand challenges, at the intersection of social and economic systems, the built environment, and our natural world. By no means do these areas cover the full tapestry of creativity and impact of our research endeavors. But these three broad areas represent the interdisciplinary focus of our scientific work.

It’s work that crosses traditional boundaries to develop new knowledge, technology and innovations, and ultimately, to invent a future where our global society thrives.

Silver dipoles are arranged across this folds of a unique origami pattern to create a radio frequency filter that’s tunable. By adjusting its dimensions, the filter can block a wide range of frequencies.
Even if you do your best to eat local, chances are most of the fruits and vegetables you consume come from far away — especially if you live in a big city.

Water and land for growing crops are hard to come by in urban areas. Finding more sustainable methods for growing produce in urban areas would have enormous benefits. A pilot project by YONGSHENG CHEN, a professor in the School of Civil and Environmental Engineering, aims to use wastewater from the campus to do just that.

"The overarching goal is trying to figure out a way to use wastewater nutrients to grow produce in urban areas so we can decentralize vegetable production," Chen said. With a $5 million, five-year grant from the U.S. Department of Agriculture, Chen will create and operate a hydroponic growing system using domestic wastewater extracted from the Georgia Tech campus sewer system. It is the largest USDA award Georgia Tech has received to date.

"Currently, we treat wastewater by taking all the nutrients from it," Chen said. "Then we have to use an energy-intensive process to synthesize and add fertilizer to the food production process."

Chen has proposed an anaerobic membrane biological treatment process to transfer organic contaminants into biogas and remove pathogens like E. coli ensuring food safety but leaving nutrients like nitrogen, phosphorus and potassium. By using a smart membrane or nanomaterials to extract trace contaminants — for example, endocrine disruptors, heavy metals and pharmaceuticals — the nutrients that are left can be pumped through a vertical hydroponic system to grow produce without adding fertilizer. The project will monitor water and produce quality and measure contamination from chemicals and microbes continuously.

The overall goal, Chen said, is to show that using the nutrients and water resources from domestic wastewater in an urban, controlled-environment agriculture system is socially, environmentally and financially sustainable and can be easily replicated in other cities.

"Our model will have options to calculate energy consumption for the system, water consumption, water balance and nutrient balance," Chen said. "We’ll conduct a life-cycle analysis and techno-economic analysis to evaluate whether this type of system will be commercially feasible or profitable in different locations, not just Atlanta."

– Kenna Simmons
The overarching goal is trying to figure out a way to use wastewater nutrients to grow produce in urban areas so we can decentralize vegetable production.

"The overarching goal is trying to figure out a way to use wastewater nutrients to grow produce in urban areas so we can decentralize vegetable production."

Postdoctoral fellow Bopeng Zhang, left, Professor Yongsheng Chen, center, and graduate research assistant Thomas Igou will pilot a project using wastewater nutrients to grow lettuce, tomatoes and other fruits and vegetables. They’ve received $5 million from the U.S. Department of Agriculture to use biological treatment processes, nanomaterials and machine learning to extract contaminants from the wastewater while leaving valuable nitrogen, phosphorus and other nutrients. Their pilot system will use Georgia Tech’s wastewater.
An Airbus Skyway prototype drone lifts off on a test flight. This and other kinds of new aircraft under development may one day fill the skies in and around our cities, hauling things and people. A new center is pulling together researchers and resources across Georgia Tech to address the technological, policy and infrastructure questions raised by a future of flying taxis and cargo drones. Right: Directors of the new center, Professors Brian German and Laurie Garrow.
A recent United Nations study predicts that 70 percent of the world’s population will be living in urban areas by 2050. That’s a lot of cars on the roads come 5 o’clock. Or maybe not.

The new Center for Urban and Regional Air Mobility at Georgia Tech aims to create a different future, one with an efficient, safe, and speedy airborne alternative to ground gridlock. And researchers suggest that could be less than a decade away.

Think: an autonomous (or piloted) electrically powered vertical take-off and landing (eVTOL) aircraft transporting commuters from rooftop vertiports to transit stations across town, or commuter lots in the suburbs. From there, an electric scooter, a bicycle-share, or a car ride-share service might complete the journey.

“This is not just about a [single] really cool technology. It’s about creating a door-to-door, multi-modal transportation infrastructure,” said Mark Moore, keynote speaker at a January event launching the air mobility center. Moore is a Georgia Tech alumnus and director of vehicle systems for Uber Elevate.

“We could cut peak commute times by more than 50 percent and reduce our energy use by a factor of 10.”

Aerospace engineering Professor BRIAN GERMAN, director of the new center, said the challenge for air mobility isn’t just the vehicle itself: “There are over 100 eVTOL aircraft under development by different companies, including traditional aircraft manufacturers and startups. That’s exciting, but we need to focus not only on the vehicle, but also on the 25-35 U.S. cities — and a 50-mile radius around them — that are potential future markets for urban air mobility,” he said.

The center draws together all of the researchers and resources at Georgia Tech to solve the dozens of potential issues such services face — from public acceptance and aircraft design to improved battery performance and reducing noise.

School of Civil and Environmental Engineering Professor LAURIE GARROW is working on a key piece of the puzzle: demand. She’s surveying 2,500 commuters in five regions to determine the potential demand for an air taxi service that would replace what is currently a 30-minute, one-way commute.

Already, Garrow has found that the cost-effectiveness of the new classes of eVTOL aircraft is poised to transform routine transportation by introducing the concept of aerial on-demand mobility — what researchers call ODM — to the market.

“There is now widespread belief that ODM could be served by small, electric propulsion aircraft that operate not necessarily from airports, but from relatively simple rooftop vertiports. You use an app to order a flight on your own schedule,” said Garrow, who also serves as co-director of the new air mobility center. “Dozens of companies have publicly acknowledged designing eVTOL aircraft, including Airbus, Uber, Embraer, Joby Aviation, Aurora Flight Sciences, and Pipistrel.”

Meanwhile, continued improvements in battery life and autonomy promise to further reduce costs, making it accessible for commuters at all income levels. In particular, Moore said, removing an onboard pilot would make the economics hard to beat.

Getting the general public to accept this last innovation — autonomy — may be one of the biggest hurdles ahead, however.

“That’s why I am thrilled that Georgia Tech has created this center that’s bringing together all of the players from business, academia, research, [and] government,” Moore said. “The technology is there and the commitment is there, but we need all of the players working together to put the jigsaw puzzle [of urban air mobility] together.”

– Kathleen Moore

Read the full story at ce.gatech.edu/annualreport
If you're someone who looks at the carbon footprint of the things you buy, you could be significantly underestimating your impact on the environment. That's because most carbon footprint calculations don't have accurate data about the impact of methane leakage through the natural gas transmission system, according to new research published in June in the Journal of Cleaner Production.

Methane, the most important greenhouse gas after carbon dioxide, often escapes from distribution systems inadvertently and sometimes is purposely vented to relieve excess pressure. Current assessments vastly underestimate the quantities of gas leaking from these systems, however.

“When you account for underestimates of leakage plus the uncertainty of how we calculate the global warming potential [of methane], the methane impact [on American carbon emissions] is maybe three times what we thought it was,” said Emily Grubert, an assistant professor in the School of Civil and Environmental Engineering.

The effects of that stretch throughout the economy, she said, from generating electricity to producing plastic or steel or fertilizer. “You're probably going to encounter natural gas if you're doing a carbon-emissions assessment of electricity systems, but you might not realize you're using natural gas numbers if you're doing an assessment of, say, a chair or something like that,” Grubert said.

“Even if you don't care about the energy system, this impacts you: You're probably using plastic or steel or fertilizer that uses a lot of natural gas. So, this methane number that sounds like you don't care about, it actually does matter quite a lot.”

Working with Adam Brandt from Stanford University, Grubert looked at databases used in a process called lifecycle assessment that evaluates the lifetime impact of products, systems and infrastructure. They suspected the databases systematically underestimate the contribution of methane leakage and its environmental impact. Fixing those shortfalls could help decision-makers better understand the carbon footprints of their products.

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COLD STORAGE, E.T. STYLE

Trillions of cubic feet of natural gas are thought to lie in cold storage within Earth’s permafrost and under its oceans. That gas, however, is trapped within cage-like chemical structures called methane clathrates. Scientists are very interested in these structures, because they may have cousins hidden under the surface of the icy moons in the outer solar system.

Whether the clathrates are on Earth or the Jovian moon Europa, science wants to know: What role did microbes play in their formation and stability? How are they involved when Earthbound clathrates start deteriorating, releasing this greenhouse methane gas into an already warming global atmosphere? Is that process underway millions of miles from Earth?

An interdisciplinary team of Georgia Tech scientists will answer those questions with support from the NASA Exobiology Program. The investigators will search for DNA blueprints of potential clathrate-binding proteins, reproduce those proteins in a laboratory, and test their impact on methane clathrate properties.

“This is a truly interdisciplinary project to understand how microbial life survives in methane clathrates under the seafloor,” said JENNIFER GLASS, assistant professor in the School of Earth and Atmospheric Sciences and the team’s principal investigator.

“These deep microbes encode genes that are different from any found on the Earth’s surface,” Glass said. “This grant will be one of the first efforts to study the biochemistry of these new biomolecules, and how they affect the structure and properties of methane clathrate.”

Glass will work with SHENG DAI, an assistant professor in the School of Civil and Environmental Engineering, and other researchers across campus. Dai has long studied sediments from deep beneath the seafloor that have trapped methane hydrate crystals. His lab has one-of-a-kind tools to maintain the enormous pressures of samples collected under thousands of meters of water and soil.

“Back in 2015, we found viable cells in deep-sea sediments from the Nankai Trough in Japan,” Dai said. “It was an eye-opening for me to see these biologically active sediments. We have focused on fundamental physical properties of hydrate-bearing sediments over the past decade, but never had the chance to look into their biological behavior.

“This project gives us the opportunity to unravel microbial survival strategies at extreme conditions, understand the roles of microbes in the fate methane in hydrate reservoirs, and expands our research capability.”

— Renay San Miguel

This methane clathrate block was found embedded in sediment 4,000 feet below the ocean’s surface in the subduction zone off Oregon’s coast. Georgia Tech researchers are collaborating on a project to understand how microbes help this frozen natural gas form and remain stable.

Read the full story at ce.gatech.edu/annualreport
SHAPE SHIFTERS

Origami-based structures have been used to create deployable solar arrays for space, adaptable acoustic systems for symphony halls, and even crash protection systems for flying drones.

Now researchers at Georgia Tech have discovered new ways to create structures from origami that change shapes and, as a result, change their characteristics.

In one set of experiments, they created a new type of origami that can morph from one pattern into another — or even a hybrid of two patterns — instantly altering many of its structural characteristics. In a second set, they developed a method to create radio frequency filters from origami-based structures that have adjustable dimensions, enabling the devices to change which signals they block throughout a large range of frequencies.
Tunable filters

The new approach to creating these tunable filters could have a variety of uses, from antenna systems capable of adapting in real-time to ambient conditions to the next generation of electromagnetic cloaking systems that could be reconfigured on the fly to reflect or absorb different frequencies.

The team focused on one particular pattern of origami, called Miura-ori, which has the ability to expand and contract like an accordion.

“The Miura-ori pattern has an infinite number of possible positions along its range of extension from fully compressed to fully expanded,” said GLAUCIO PAULINO, the Raymond Allen Jones Chair in the School of Civil and Environmental Engineering. “A spatial filter made in this fashion can achieve similar versatility, changing which frequency it blocks as the filter is compressed or expanded.”

Results from the study, which was supported by the National Science Foundation, the U.S. Department of Defense, and the Semiconductor Research Corporation, were reported in December in the journal *Proceedings of the National Academy of Sciences*.

The researchers used a special printer that scored paper to allow a sheet to be folded in the origami pattern. An inkjet-type printer was then used to apply lines of silver ink across those perforations, forming the dipole elements that gave the object its radio frequency filtering ability.

Morphing origami

The second piece of research, which was supported by the National Science Foundation and appeared in April in the journal *Physical Review Letters*, could unlock new types of origami-based structures or metamaterials that leverage the characteristics of two types of origami.

“This hybrid origami allows for reprogrammable mechanical properties and the ability to change those properties while the material is in service,” Paulino said.

The researchers started with two types of origami patterns: the Miura-ori and the eggbox, both of which can be formed into sheets of repeating patterns. The Miura-ori looks like rows of folded zig-zags, while the eggbox pattern resembles a mountain range with repeating peaks and valleys.

Both are capable of being compressed into a very small space, but when expanded they respond differently to bending. The eggbox pattern resembles a dome when bent, and the Miura-ori takes the shape of a saddle.

The new origami pattern is also capable of taking on a hybrid structure, where certain rows are folded into one configuration and others were folded in the other. In such a configuration, the structure would exhibit characteristics of both types.

“There are a large number of combinations in terms of how these could be configured, which offers a lot of customization possibilities for structures based on the morph pattern,” said Ke Liu, a former graduate student at Georgia Tech and now a postdoctoral scholar at the California Institute of Technology.
Most of us don’t think much about it; we trust that the water pouring from our faucets is safe.
And it is, thanks to a reliable water purification system in use all over the world that filters out contaminants and uses chlorine to kill pathogens. There’s just one problem that’s been bothering environmental engineers since the 1970s: chlorine disinfection generates carcinogenic byproducts.

To be clear: the risk is absolutely minimal — and far less than the risk of fatal diseases from bad water, especially in developing countries. But what if there was another way to reliably decontaminate water and avoid those disinfection byproducts altogether?

XING XIE is working on new technology to do just that, using a strong electric field to kill bacteria and other pathogens in water without the need for chlorine. The National Science Foundation sees promise in the idea and has given Xie a five-year Early Career Development Award to pursue this locally enhanced electric field treatment, or LEEFT.

“LEEFT is a promising and transformative technology, and at the same time, there are a lot of challenges that need to be addressed before practical implementation of such technology,” said Xie, Carlton S. Wilder Assistant Professor in the School of Civil and Environmental Engineering. “For example, we know little about how exactly the microbes are killed in the LEEFT system, even though very high killing efficiencies have been demonstrated.”

Xie is working to answer that question and improve the designs of these systems. Already, researchers have shown that a low-voltage system can treat water in just a few seconds. They’re inexpensive, robust and easy to operate. But there’s a key barrier to their widespread use.

“One big challenge is the stability of the electrodes used in the LEEFT systems,” Xie said. “When I started two years ago, the demonstrated lifetime of electrodes in the first several LEEFT systems was only about 10 minutes. My group is developing better electrodes, and now we have improved it to more than 10 days of continuous operation time.”

Xie said that timeframe makes the system feasible for portable devices that could be deployed in emergency situations, for example. To really scale up for long-term, permanent use, though, he said the electrodes need to last at least 10 times longer than that.

Combining his work on the electrodes with the new NSF grant to understand how the systems effectively inactivate pathogens could make electrical disinfection of water a practical approach for large- and small-scale systems.

Read the full story at ce.gatech.edu/annualreport
THE POOP PROBLEM

As demand for meat and dairy products increases across the world, much attention has landed on how livestock impact the environment, from land usage to greenhouse gas emissions.

Now researchers at Georgia Tech and the Centers for Disease Control and Prevention are highlighting another effect from animals raised for food and the humans who eat them: the waste they all leave behind.

In a paper published in November in *Nature Sustainability*, the research team put forth what they believe is the first global estimate of annual recoverable human and animal fecal biomass. In 2014, the most recent year with data, the number was 4.3 billion tons and growing, and waste from livestock outweighed that from humans five-to-one at the country level.

“Exposure to both human and animal waste represents a threat to public health, particularly in low-income areas of the world that may not have resources to implement the best management and sanitation practices,” said Joe Brown, Carlton S. Wilder Assistant Professor in the School of Civil and Environmental Engineering. “But estimating the amount of recoverable feces in the world also highlights the enormous potential from a resource perspective.”

Metals, phosphorus, nitrogen and potassium are all among the resources that could be recovered from human and animal waste. The researchers pointed to an earlier analysis that estimated the value of recoverable metals alone reaches $13 million a year from the waste of one million people.

The researchers looked at data from 2003 to 2014 as well as projections through 2030. The study combined global animal population data from the United Nations, human population data from the World Bank as well as earlier research on animal-specific estimates of fecal production.

From 2003 to 2014, the amount of waste biomatter produced grew annually by more than 57 million tons as both human and livestock populations grew. The researchers estimated that by 2030, the total amount of global fecal biomass produced each year would reach at least five billion tons, with livestock waste outweighing that from humans six-to-one at the country level.

“This paper demonstrates that building more latrines in developing parts of the world isn’t going to solve all of our waste management problems,” Brown said. “Animal waste has the potential to negatively impact health in many of the same ways as human waste, from spreading enteric infections to hurting growth and cognitive development of the humans exposed.”

The researchers estimated that by 2030, the planet’s total annual fecal and urinary biomass could contain as much as 100 million tons of phosphorus, 30 million tons of potassium, 18 million tons of calcium, and 5.5 million tons of magnesium, to name a few recoverable materials.

– Josh Brown

Read the full story at ce.gatech.edu/annualreport
“There are few very catastrophic events, and the chances are that there’s pretty much no data or the data’s very far away.”

Professor Hermann Fritz helps install a unique the volcanic tsunami generator at the O.H. Hinsdale Wave Research Laboratory at Oregon State University. Fritz and his colleagues simulated underwater volcanic eruptions to better understand the tsunamis sometimes generated by such eruptions. Fritz’s experiments will help improve prediction models that could give coastal residents more warning in the event of an eruption and tsunami.
In the summer of 2015, an underwater volcano off the coast of Grenada in the Caribbean started rumbling.

Kick ‘em Jenny has erupted around a dozen times since it was discovered in 1939, so scientists perked up and authorities issued an “orange alert,” warning another eruption could be imminent.

Ultimately, the volcano settled down and nothing happened. But the possibility of a major volcanic event under the Caribbean made tsunami researchers like HERMANN FRITZ start asking some tough questions.

“It was not really clear to the [nearby] community what kind of tsunami you could get if Kick ‘em Jenny were to go red and erupt,” said Fritz, a professor in the School of Civil and Environmental Engineering. “It's speculated that this could be one of the ones that could produce an explosive eruption that creates a giant crater in the Caribbean Sea and then a tsunami that would travel on to the neighboring islands.”

Understanding those kinds of volcano-generated tsunamis led Fritz and collaborators in Oregon and Texas to build their own mini volcano to study underwater volcanic eruptions that cause landslides and tsunamis.

“One of reasons we want to study events like this in the laboratory is, they’re very rare in the real world, there are few very catastrophic events, and the chances are that there’s pretty much no data or the data's very far away,” Fritz told the DesignSafeRadio podcast.

“You can wait for decades and you might never be able to observe an event or you might be at the wrong place at the wrong time,” he said, “so even if you are prepared, you still might get no data. Or no useful data.”

Constructed at the O.H. Hinsdale Wave Research Laboratory at Oregon State University, Fritz's setup is likely the first lab-based volcanic tsunami generator in the world. The team ran more than 300 experiments over the course of the summer with about 120 different combinations of eruption velocity and water depth.

It’s particularly timely work: a chunk of the Anak Krakatau volcano in Indonesia collapsed in December 2018, causing an underwater landslide and a tsunami that killed nearly 400 people along the coast of the Sunda Strait between the islands of Java and Sumatra. The event triggered calls for a better tsunami early warning system in the region.

The team’s experimental data will help researchers understand how tsunami waves propagate from such an eruption and, perhaps more importantly, validate and improve prediction models to inform such systems.

“We’re trying to see what kind of waves do we get and how do they relate to other, better studied tsunami sources. Are they comparable to tsunamis from submarine landslides or are they very different?” Fritz said.

“Some of the models that have been in operation have been very well established for tsunami warning purposes for earthquakes, [but] their associated tsunamis may not be directly applicable.”

LISTEN: Fritz discusses the volcano tsunami generator and his career trying to better understand tsunamis on the DesignSafeRadio podcast: ee.gatech.edu/annualreport
GO WITH THE FLOW

SAM COOGAN is developing a new approach to understanding and controlling physical networks like roads, air space and other critical infrastructure.

These networks are growing larger, more complex and more distributed, said Coogan, Demetrius T. Paris Assistant Professor in the School of Civil and Environmental Engineering. It’s essential to create new mathematical tools to understand the dynamics of how materials move through these systems — whether those are cars, airplanes, water or gas — and to provide guarantees about how they operate.

He’ll build the critical foundation on new tools to do that with the support of a Young Investigator grant from the U.S. Air Force Office of Scientific Research. Coogan also is an assistant professor in the School of Electrical and Computer Engineering.

One of the techniques Coogan will apply to physical networks involves using inexpensive simulations to sample some of the possible behaviors in the system and then extrapolating the flow of material through the network.

“This allows for formal guarantees over all possible outcomes by sampling only a limited number of representative points,” Coogan said. “Efficiently approximating all possible scenarios is a critical theoretical tool for ensuring safe and provably correct behavior of complex and large-scale physical flow networks.”

His work applies to all kinds of systems with interconnected components, “such as roads, airspace, pipes, and factories capable of accommodating physical material such as vehicles, aircraft, natural gas and manufactured goods. Material flows from component to component, and thus the contents of the network change over time,” Coogan said.

He said all of those networks exhibit commonalities that lend themselves to a similar modeling approach. Pairing that with the unique characteristics of each different kind of network will lead to better understanding of how these systems behave and, ultimately, to efficient ways to control that behavior.

Read the full story at ce.gatech.edu/annualreport
MODELING ATTITUDES

Will we continue to own personal vehicles? Can public transit survive in a world with Uber and Lyft? What ever happened to those flying cars we used to dream about? PATRICIA MOKHTARIAN explores all of that, along with how she’s using machine learning to predict travelers’ attitudes and improve transportation planning, in the November episode of The Uncommon Engineer podcast from the College of Engineering.

“Attitudes are fundamental to the decisions we make, and you will never find an attitudinal variable in any of these regional [transportation] models,” Mokhtarian told host Steve McLaughlin, Georgia Tech’s dean of engineering. “One [reason] is, how do we forecast them? To apply a regional model to look at what transportation will be like in 2025 or 2040, you’ll need to predict the input variables that far into the future. And if you’re talking about an attitude, who knows what they’ll be?”

Mokhtarian is one of the world’s leading experts on travel behavior and the impact of information technology on transportation. She’s using machine learning to analyze the attitude data she’s collected in smaller surveys and then estimate attitudes in the larger travel behavior data that regional transportation planners use in their forecasts.

“If we can do that successfully, we can start incorporating attitudinal variables into the models that use those datasets,” said Mokhtarian, the Susan G. and Christopher D. Pappas Professor in the School of Civil and Environmental Engineering. “Right now, they can’t keep up with all the things we’ve just been talking about — automation, ride-hailing. None of these things can really be handled well by today’s models, and we need to improve them so that they can.”

In a conversation that ranged from how millennials travel to telecommuting, Mokhtarian said her work has never been more exciting.

“Information technology was changing rapidly, which was one of the attractions to me of studying telecommuting and other applications, but transportation itself was pretty much same-old, same-old for decades on end,” she said. “Now, with the convergence of information technology and transportation technology, we’re seeing this explosion of new transportation services, such as ride hailing, and, of course, automated vehicles just over the horizon.”

LISTEN to Mokhtarian’s full conversation on The Uncommon Engineer podcast at ce.gatech.edu/annualreport

MORE RESEARCH AT CE.GATECH.EDU/ANNUALREPORT
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People are our priority. The world is our laboratory.
Global Engineering Leadership Minor

Georgia Tech engineering students can supplement their technical studies with a minor in global engineering leadership through a partnership between the School of Civil and Environmental Engineering and the Office of Leadership Education and Development.

The minor builds engineer-leaders imbued with the technical expertise, global awareness, and leadership skills necessary to solve 21st century issues. Students take foundational courses in leadership theory, then they engage with engineering grand challenges through courses where they apply leadership skills and learn from professional mentors.

Several of the courses include an embedded international trip where students conduct research or experience other cultures while diving more deeply into course material. Here, students who traveled in 2019 reflect on those experiences.

LEARN MORE: CE.GATECH.EDU/LEADERSHIP

International Disaster Reconnaissance Studies | China and Japan

We learned about the reconstruction efforts of several communities after two major disasters: the 2008 Wenchuan earthquake in central China and the 2011 Tohoku earthquake and resulting tsunami that washed ashore on the northeastern coast of Japan. Witnessing the effects of the disasters first-hand was an eye-opening experience. Learning about individual communities’ approach to rebuilding challenged us to not only consider the types of engineered structures they built post-disaster, but also the cultural and political factors that likely played a role. For example, the rebuilding of Yingxui town in China was very important economically to the Sichuan Province, because it was the midway point between a major farming community and the large city of Chengdu. On the other hand, Old Beichuan, a city where many students attended boarding schools, remains a town of ruins to this day due to the heartache it brought families of children who did not survive the 2008 earthquake. Instead, they built New Beichuan in a different location, creating a new city with no haunting memories.

Both China and Japan are extraordinary, not only in the subject of infrastructure reconstruction, but also in history, culture, food, natural beauty and people.

China is a country that is very rich in history, so their culture revolves very much around traditions and ancestral accomplishments. Many Chinese we encountered were fascinated by our group, because they had never seen an ethnicity other than their own. They were kind, snapping photos and treating us almost as celebrities. They also were fond of touching our hair, often without permission, which was uncomfortable at times.

In Japan, the culture focused on respect and rules. People were quiet, friendly, and they made time for each part of their day. Here we tend to multitask — eating and doing homework, or talking on the phone and walking to class. Those are very foreign concepts in Japan. For a country that has four times the population density of the U.S., their ability to organize and focus on the task at hand is spectacular.

– KATIE POPP, third-year undergraduate, civil engineering, minor in global engineering leadership

– LYNNAE LUETTICH, Ph.D. student, civil engineering

LEARN MORE: CE.GATECH.EDU/LEADERSHIP

PHOTO COURTESY: LYNNAE LUETTICH AND KATIE POPP
I was aware that the Dutch maintain a considerable population of everyday cyclists, especially compared to the United States. They have more bicycles than they do people! After traveling to the Netherlands, I understand how they achieved this strong cycling culture. Cyclists are prioritized through a range of infrastructure design features, from separate bike paths to intersection protections. After visiting cities varying in size, atmosphere, and culture — Delft, Utrecht and Amsterdam — I realized that the inclination for cycling goes beyond the infrastructure alone.

The overarching key to increasing bike use for daily transportation is the straightforward connection between cycling infrastructure and public mass transit. Seamless transitions from bicycle to train or tram allows the Dutch system to work so well and create a cycling culture that resulted in the highest rates of cycling in the world.

Now that I’m home, I am visualizing realistic improvements that can be made in Atlanta: creating access to more bike parking at MARTA stations, incentivizing biking on campus, and adding traffic calming features to slow cars. Together, they would protect cyclists and encourage more people to ride. I now see cycling as a relaxing, fun way to save time navigating the busy streets of Atlanta, not just as a form of exercise.

— LAURA KELLY, third-year undergraduate, civil engineering
Environmental Technology in the Developing World | La Paz, Bolivia

We had worked all semester to prepare for the trip: writing up detailed schedules, practicing field sampling, and learning about the culture of Bolivia in class. Our goal was to research bioaerosols and use spatial mapping to quantify urban sanitation problems in La Paz. But nothing could prepare the class for all of the challenges and unexpected learning opportunities that this trip gave us.

Before we departed, we reviewed the basic travel information for our trip: be careful what you eat, be aware of the high altitude, drink only bottled water. After a smooth plane ride to La Paz, the taxi driver dropped us off at our hotel. All we had to do was climb up a hill and a flight of stairs to reach the hotel.

We quickly realized that being at an altitude of around 11,000 feet makes it pretty challenging to go uphill, and the hotel’s hill and stairs combination became infamous among our group as a challenge of physical exertion. Then, on our fourth day of the trip, the salmonella hit. We watched helplessly as fellow classmates succumbed to the illness and our numbers rapidly dwindled.

Despite these challenges, our class continued to conduct research and learn about the environmental problems in La Paz. We recovered from our illnesses. We climbed up staircases, hills and mountains to obtain air and water samples. And perhaps most importantly, we connected with Bolivian students from the Universidad Catolica Boliviana who were studying the same environmental engineering issues that we were. We exchanged cultural songs and performances and talked about our common academic interests while teaming up on research in the field.

This class showed me the global application of environmental engineering and allowed me to connect with students who had completely different backgrounds and spoke a different language than me. Through my Bolivia experience, I saw that science and engineering transcends cultural and geographical boundaries.

— SARAH LOWRY, third-year undergraduate, environmental engineering

Students in Environmental Technology in the Developing World collect water samples from the polluted Choqueyapu River in La Paz during their Spring Break trip to Bolivia. They were researching bioaerosols and using spatial mapping to quantify urban sanitation problems in the city.

PHOTO: JOE BROWN

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**By the Numbers**

$4M CEEatGT travel scholarship fund
$3K Average funding per student
6 continents & 60+ countries visited
326 students funded (54 this year)
32 students declared in Global Engineering Leadership Minor
169 students took leadership and grand challenges courses in 2018-2019
17 Graduates with the global engineering leadership minor (since 2016)
Notes from the Field

Our dedicated travel, internship and study abroad funds

Joe S. Mundy Global Learning Endowment
Elizabeth B. and William E. Higginbotham Beyond the Classroom Experience Fund
James B. Feldman Study Abroad Endowment
Nadia A. and Robert W. Tyson Study Abroad Fund
Kaylyn Sinisgalli
GRANADA, SPAIN

I believe community is the most important aspect of engineering yet the least recognized. Problem solving is more than a solution; it is about integrating a solution to it’s help people.

I entered Georgia Tech as a freshman with a desire to be an engineer capable of mixing design with practicality — mixing machine with man. To combine these things as seamlessly as possible, I knew that I had to learn to communicate beyond barriers. Language is a large barrier. If I, as an English-speaking American, were to travel to another country and work in the field of environmental engineering, I would want to be able to speak the country’s language so that I could work directly with the community to find the best solution to their problem. I’ve always had an interest in South America. I’m an outdoor enthusiast and have a desire to help people in need. The Serve-Learn-Sustain semester in Spain offered me the perfect opportunity to reduce that language barrier and learn what it means to live and work in another country.

While living in Spain, I completed numerous service hours in the community of Granada, which not only enhanced my language skills, but also allowed me to see the inner workings of Granada. I had the pleasure of working with three organizations: OFECUM, ECOCAMPUS, and Sierra Nevada Limpia.

OFECUM is a cultural center for retired people. They offer a wide variety of classes and activities including language, computing, dance, choir, and hiking. I assisted in the center’s English language courses. I really enjoyed spending time with the students — after class we would go out to coffee or for a walk. Conversing with older people in the community was a great way not only to learn Spanish, but also to understand the Granadian mentality.

ECOCAMPUS promotes environmental education through the University of Granada. I worked with students from the university to plant trees and shrubs in a regrowth area of the Sierra Nevada Mountains. ECOCAMPUS also has a program to educate elderly people about the environment where I taught them the importance of recycling and the beauty of nature.

Sierra Nevada Limpia, also known as Batallon de Basura, is an organization that fights for clean lands. Enrique, the president, started the organization after being upset about the amount of litter in natural spaces. Ever since, he and his friends have worked to clean the Sierra Nevada Mountains and the surrounding areas. I was lucky enough to spend a Saturday morning working with him on the outskirts of Granada.

When people ask me about life in Spain, I tell them that it’s the opposite of Georgia Tech. At Tech, you have everything you need at your fingertips. It’s easy to go grocery shopping, order things online, go grab a bite with friends, ask for directions if you’re lost. It’s easy to get a broken laptop fixed and pay your phone bill all from the comfort of campus. Yes, class is hard, but day-to-day life is simplified by our awesome Institute.

In Spain, learning never stops. You leave class and then enter the real world to walk home to your real Spanish family and the challenge of communicating in a non-native language. Class was easy in comparison. Class was preparation for living with a family and living in a Spanish-speaking country. We had amazing projects and activities that prepared us for the difficult situations we found ourselves in at home. Watching a movie with the family was a not a relaxing afternoon — it was two hours of intense concentration to understand what was happening in the film. And the first few weeks were hard; I felt confused and absolutely exhausted all the time. But as I spent more time with my family and conversed, it became much easier to understand the Spanish lifestyle and what everyone was saying, and I eventually found myself at a point where I could share aspects of my American life with my Spanish family.

I’m so incredibly thankful for all the hard work Dr. Kelly Comfort put in to make her vision a reality for other Georgia Tech students and myself! I’m also so appreciative to the Mundy Global Learning Endowment for making this experience possible.
Katelyn Iles spent last summer studying in Nice and Paris, France. During her stay — and in the weeks after — she also made her way to Park Güell in Barcelona, Spain, top left; Èze, France, where she hiked to the top of the city to explore a botanical garden featuring many species of cacti; and to Ireland, below, where she visited the Cliffs of Moher: “The cliffs were beautiful — pictures don’t do them justice,” she said.
My goal for the summer abroad was to become a more global civil engineer and citizen. Thanks to the Mundy Endowment, I was able to complete this goal. By living in France and traveling during my free time, my perspective on civil engineering and the world has changed.

During my time abroad, I was introduced to many ways to save energy and be “green” that aren’t common in America. Public transportation is more relevant in Europe. Cars are smaller, and there are more electric vehicles. Roads are designed with safe bike lanes and walkways. I realized that many of the things we consider necessities in America are actually just luxuries.

In Nice, the apartment where I stayed did not have air conditioning or a dryer. At first, I didn’t understand why people would not have these things — they seemed like essentials to me. But by the end of my stay, I realized I could easily do without them and thereby save energy and resources. During my time in France, I learned several ways that I, as a civil engineer and a consumer, can better respect the environment.

Throughout the summer, I learned a great deal about France and its culture. I was able to practice my French daily with my classmates, professors and host family. I visited countless museums, cathedrals, attractions and historical sites. I ate new foods, went shopping, and explored the city. I was lucky enough to be in France during the World Cup. Feeling the excitement during each game and celebrating after each win was a very cool experience. Through all of these activities, I learned first-hand about a culture different from my own. I became more open to new ideas and ways of life.

On some of our long weekends, I traveled to other countries around Europe. I visited Oslo, Galway, London and Geneva. I only spent a few days in each of these cities, but I was able to get a taste of their unique cultures. I now want to learn more about the countries I visited and travel to new places. These travels helped me become a more confident and independent traveler.

I am so grateful to the Mundy Endowment for the funds I received this summer. The experiences and opportunities I had thanks to those funds have been life-changing. I have learned so much about myself, civil engineering, and the world.
Shubhneet Singh used the Higginbotham Fund to pursue an internship at his dream company in New Zealand. The trip helped him grow professionally and gave him the opportunity to explore the culture and sights of New Zealand, including Ben Lomond Summit outside Queenstown (top photos) and the northernmost point of the island at Cape Reinga (lower left). Singh also toured the hydraulics lab at the University of Auckland (lower right) and learned how researchers use a scale model of a riverbed to model water flow.
Having twice witnessed devastating flooding in my hometown and the plight of people affected by it, I am inspired to pursue research to address water problems now and in the future. With that motivation, and Georgia Tech’s rigorous training, I secured an internship at my dream company, DHI Water and Environment, one of the pioneering companies in the field. And best of all, it was based in New Zealand, one of the most picturesque countries on the planet. I went there with a goal of augmenting my technical skills in hydraulic modelling and GIS techniques and to getting exposure to real-world water resource challenges.

During my Internship, I worked to model catchments, river hydrology and hydraulics as well as flood hazard assessments — including model development, options assessment, flood map production, and river flood forecasting for regional authorities in New Zealand. I also was exposed to other domains like urban pipe modeling, water quality and marine projects.

While this internship helped me to grow professionally and learn new technical skills, it also helped me grow personally in soft skills like communication and developing interpersonal relationships. But my main accomplishment through this internship was getting exposure to community challenges in the water industry and learning that there is more to the corporate setting than just having learned your lessons in hydraulics. One has to develop a network and human connections to find work and to be able to contribute to society.

I also feel fortunate to have had the chance to live and travel in New Zealand, which was an amazing opportunity to get to know the Maori and Kiwi cultures. I really liked watching the haka performances before rugby matches and came to understand that rugby is to Kiwi people what cricket is to India: Everything stops when there is big match.

Six months of living abroad has fanned the fire in me to explore more, because you realize there’s so much to be seen. DHI’s Auckland office was really a melting pot of cultures: my boss was Serbian, our managing director was from Croatia, and I had peers from France, Singapore, Sudan, New Caledonia, Zambia and Portugal. I never thought there could be such a diverse crowd in one office in such a small country. It proved to be a blessing; it has helped me better understand people from different cultures, encouraged me try cuisines from around the world, and even taught me a bit of French!

I want to earnestly thank the Higginbotham family for supporting my internship. My experience working at DHI has supplemented my training as an engineer, but it also made me realize that regardless of different native languages, food, or cultures, fundamentally, every human has similar aspirations, and this has made me more empathetic to diverse diaspora.
“Will Driverless Cars Make Our Traffic Problems Worse?” | Newsweek (Op-Ed)

Even if most people eschew car ownership, we will suffer many of the same inefficiencies if they insist on riding alone. Single-occupancy AV services would create nearly the same number of trips as privately-owned vehicles; some research indicates that they may even create more miles traveled, as vehicles search far and wide for the next passenger or wait around for the next paid trip. When cars start making passenger-less trips to deliver groceries and pizza and services, vehicle-miles traveled may increase drastically.

Kari Watkins, Michael Hunter

“Legal Battle Over Crumbling Sidewalks Unfolds In Atlanta” | NPR/All Things Considered

“You know, sidewalks have a 30- to 40-year lifespan. If you’re not paying attention to them at all, then it becomes a problem.”

Randall Guensler

“How climate change could break the internet” | Popular Mechanics

“We’re extremely dependent on technology, but at the same time, it’s also quite vulnerable to any kind of environmental or climate change issues,” Hermann Fritz

“Gender pay gap still an issue at state colleges” | Atlanta Journal Constitution

Georgia Tech has more female faculty members than any engineering college or university in the nation, she said. Still, more than 75 percent of Tech’s faculty are men, according to an annual report by the University System. “We’re definitely conscious that this is something we need to keep an eye on,” Kurtis said. “I think we’re doing a reasonably good job. I think there are some issues we need to address. We’re not perfect but it’s something we definitely try to stay on top of.”

Kimberly Kurtis
“Air taxis could help connect people and jobs in ways that aren’t viable via today’s existing roadway or transit network,” he said in a telephone interview from his home in North Georgia. Climate change is one of the first things they want to talk about in his classes on business and international affairs, he said.

G. Wayne Clough

“A new generation of flying cars is taking to the air. But without the cars” | Los Angeles Times

“A new generation of flying cars is taking to the air. But without the cars” | Los Angeles Times

“Air taxis could help connect people and jobs in ways that aren’t viable via today’s existing roadway or transit network” | Laurie Garrow

“How Humans Get in the Way of Clean Water” | Scientific American

Brown, one of the lead authors, thinks direct feedback like this might help people get involved in tackling their water issues. “Most water that’s unsafe looks and smells perfectly fine. The challenge is making this invisible problem visible,” he says.

Joe Brown
Ph.D students **ABIGAIL COHEN** and **AMANDA LAI**’s new approach to sustainable fertilizer won first place at Georgia Tech’s 2019 Ideas to Serve competition.

**ITS Georgia** awarded Wayne Shackelford Scholarships to Ph.D. students **APRIL GADSBY,** **HANYAN “ANN” LI, CIBI PRANAV** and **SOMDUT ROY** along with undergraduate **KATIE POPP**. The students had to submit ideas for using technology to eliminate roadway deaths.

**GADSBY** also won a Graduate International Research Experiences award from the Institute of International Education. She’ll travel to the Netherlands to continue her research on bicyclist behavior. But first, she went to Washington D.C. to attend the Future Leaders Development Conference as an Eno Center for Transportation Fellow.

Civil engineering honor society Chi Epsilon rewarded undergrads **MARISSA GRANT** and **SULEMAN RANA** with national scholarships for embodying the society’s four pillars of scholarship, practicality, sociability, and character.

The Geosynthetics Institute awarded a 2018 fellowship to **SANGY HANUMASAGAR** to support his research on using geosynthetics to improve the durability and performance of pavement.

Freshman **ALEX IP** was selected to participate in former Vice President Al Gore’s Climate Reality Leadership Corps training.

**ERIC JOHNSTON** and **SHELLY ZHANG** produced two of Georgia Tech’s best Ph.D. dissertations this year, according to the Sigma Xi honor society.

Ph.D student **SETH MALLETT** and master’s student **NICHOLAS SIANTA** won national scholarships from ADSC: The International Association of Foundation Drilling.

**LAURA MAST** was invited to get a taste of science policy and advocacy at the Catalyzing Advocacy for Scientists and Engineers workshop in Washington.

Tapping Georgia’s resources to make stronger concrete for bridges won Ph.D. student **AARON MILLER** the Katharine and Bryant Mather Scholarship from the American Concrete Institute.

Ph.D. student **ATIYYA SHAW** represented one of the nation’s major research centers at the Transportation Research Board meeting in January as its Student of the Year. Shaw was the top student from TOMNET, the Center for Teaching Old Models New Tricks.

In the same month, **SHAW** also won a Dwight D. Eisenhower Transportation Fellowship from the Federal Highway Administration. So did fellow grad students **DAVE EDERER** and **ANDREAS WOLFE.**

**TUO ZHAO** was honored as an Institute-wide TA of the Year for 2019.

Second-year Ph.D. student **JIANFENG ZHOU** won a two-year NWRI-BioLargo Graduate Fellowship from the National Water Research Institute to support his work using low-voltage electricity to disinfect water.
Put simply, Jackie Knee wants to make people healthier.
She’s worked at that singular goal in rural Thailand as a Fulbright Fellow, in the United States at the Center for Disease Control and Prevention, and at Georgia Tech as a fifth-year Ph.D. student in environmental engineering. Once she finishes her degree later this year, she’ll continue it in Britain as the 2019 Marshall Sherfield Fellow.

“The burden of infectious enteric disease is too high and disproportionately affects the most vulnerable worldwide — young children, the elderly, and the poor,” Knee said. “I have worked in the [water, sanitation and hygiene] sector for over 10 years because I have seen the progress that has been made in terms of disease reductions, and I want to help ensure that progress continues.”

The Marshall Commission selects one engineer or scientist from the United States to do postdoctoral research in the United Kingdom for up to two years. Knee has proposed several new avenues of inquiry as the Marshall Sherfield Fellow, including tracking microbial exposure risk in the food chain.

“The idea is to understand when, where and how food becomes contaminated and to quantify exposure risks to consumers in Mozambique and Kenya. These data will then be used to inform the design and implementation of an intervention aimed at decreasing exposure and health risks.”

Dean wins Robert Wood Johnson Foundation Health Policy Fellowship

Ph.D. student Victoria Dean became an engineer to, in her words, “save the world.” Now she’s one of a small group of young leaders who’ve earned the support of the Robert Wood Johnson Foundation to collaborate and use their influence to make communities healthier and more equitable.

The foundation named Dean to its 2018 class of Health Policy Research Scholars, pledging to support her work for up to five years. She’s the only person from Georgia selected to participate.

“This program is a unique opportunity to learn about how research can work hand in hand with policy and potentially increase the effectiveness of the change you wish to see in a community,” said Dean, who’s pursuing an MBA at Georgia Tech in addition to her doctoral studies in environmental engineering.

Health Policy Research Scholars are typically Ph.D. students from underrepresented populations and fields as wide-ranging as economics and epidemiology, according to the foundation. What they have in common is the desire to use their work to improve equity and health.

That mission spoke to Dean, who said she’s focused on “research that seeks to address various environmental, educational and health equity disparities in marginalized communities.”
The Transportation Research Board recognized a partnership between BAABAK ASHURI and the Georgia Department of Transportation as an example of research that has paid dividends, improving how the state builds transportation infrastructure.

The Construction Industry Institute named YONG CHO its distinguished professor of 2018, recognizing his commitment to incorporating the latest industry research in his courses.

The American Society of Civil Engineers selected JOHN CRITTENDEN for the 2020 Simon W. Freese Environmental Engineering Award and Lecture, honoring his work using fundamental science and research to solve challenging water quality problems.

Georgia Tech’s Center for Teaching and Learning named HERMANN FRITZ a Hesburgh Award Teaching Fellow, recognizing his demonstrated excellence in teaching and interest in enhancing student learning.

Members of the Institute for Operations Research and the Management Sciences elected LAURIE GARROW to their board as vice president for sections and societies.

SPIE, the international society for optics and photonics, gave LAURENCE JACOBS a lifetime achievement award for his work on nondestructive evaluation.

At the invitation of the National Academy of Sciences and the Kuwait Foundation for the Advancement of Science, KOSTAS KONSTANTINIDIS joined top young leaders at the Arab-American Frontiers of Science, Engineering and Medicine symposium.

KIMBERLY KURTIS became just the second woman to receive the Arthur R. Anderson Medal from the American Concrete Institute, joining a list of the world’s top concrete scholars.

KURTIS also joined the Council of Trustees for the American Society of Civil Engineers Foundation.

ERIC MARKS won Georgia Tech’s top award for effective teaching based on how students in his courses rated his instruction.

GLAUCIO PAULINO was elected a fellow of the American Society of Mechanical Engineering.

SPYROS PAVLOSTATIS received the Frederick George Pohland Medal for bridging education, research and practice in environmental engineering. The award from the Association of Environmental Engineering & Science Professors and the American Academy of Environmental Engineers and Scientists is named for Pavlostathis’ predecessor on the School’s faculty.

The Indian Institute of Technology Madras named SRINIVAS PEETA a distinguished alumnus, an honor reserved for a small handful of the school’s top graduates.

PEETA also presented a keynote address on reinventing public transportation to transportation ministers and tech and transportation industry leaders at the Move Global Mobility Summit.
MICHAEL RODGERS received the University System of Georgia's highest research recognition in August when the Board of Regents named him a Regents Researcher. The title honors researchers with distinguished careers and is only awarded with the unanimous support of Georgia Tech's president, provost and executive vice president for research.

Rodgers, principal research scientist in the School of Civil and Environmental Engineering and deputy director of the Georgia Transportation Institute, called the honor "humbling" and quickly deflected credit. "Whatever success I’ve had is due in large part to the exceptional colleagues, students and staff with whom I’ve worked," he said. "While I’ve received other awards for individual things, the Regents titles are, in a sense, lifetime achievement awards, and I find that very rewarding."

Rodgers has been working at Tech since 1978, when he joined the predecessor of the Georgia Tech Research Institute. He had earned degrees in physics at Tech and went to work on a project using lasers to measure compounds in the atmosphere.

He eventually earned a Ph.D. in geophysical sciences for developing a specialized instrument to detect air pollution and traveled the world using it for NASA and the National Science Foundation.

"Georgia Tech is an extraordinary place," Rodgers said. "I have had a wide-ranging career, and yet, I have never had to leave the Institute to pursue different research areas. I doubt that there are many places where I would have been able to explore the range of activities that I have here."
Alumni

Vandegrift one of Mass Transit’s 40 under 40

Self-described ‘TranspoNerd’ AMANDA WALL VANDEGRIFT was one of Mass Transit magazine's 40 Under 40 for 2018. Vandegrift has worked in transportation funding and finance at WSP and HDR since she finished her civil engineering degrees in 2012 and 2013. Now she's helping launch a new firm, InfraStrategies, as a senior consultant.

“I absolutely love my job, because what I do gets down to the core of what is required to advance much-needed public transportation infrastructure and ultimately improve mobility, accessibility, and quality of life in communities across our country,” Vandegrift told Mass Transit. “We can put a wealth of visionary plans on the shelf, but we won’t be able to implement them without a sustainable funding strategy and financial plan.”

Sanborn becomes first woman to command Honolulu Army Corps of Engineers

Just two months after finishing her civil engineering Ph.D., KATE SANBORN made history when she became the first woman to lead the U.S. Army Corps of Engineers Honolulu District.

Sanborn, a lieutenant colonel in the Army, assumed command of the district July 20.

“Marc and I feel very blessed and honored to be a part of the Honolulu District,” Sanborn said at her change of command ceremony. “We're eager to get settled in, to contribute as part of this great community, and to make the most of this phenomenal opportunity.”

“Marc” is Sanborn’s husband, who also finished his civil engineering doctorate at Georgia Tech in May and is an Army officer. He took command of the 29th Brigade Engineer Battalion at Schofield Barracks in Hawaii.
Thirteen civil and environmental engineering alumnae made Engineering Georgia’s list of 100 influential women in the state’s engineering industry. They include women in private practice and public service, entrepreneurs, and rising stars.

They also included two faculty members — LAUREN STEWART and KARI WATKINS (who also is an alumna) — and two members of the School’s External Advisory Board: EMMY MONTANYE and MEG PIRKLE.

ANITA ATKINSON, P.E.
Vice President, Civil Engineering and Surveying; Patterson & Dewar Engineers, Inc. (BSCE 2000)

AMY DIAZ, P.E., PTOE
Development Services Manager, Cobb County Department of Transportation (MSCE 1998)

ANNIE GILLESPIE, P.E.
Director of Engineering, State Road and Tollway Authority (BSCE 2005, MS ENVE 2008)

LAURY JILL HODGES, P.E., CPESC
Senior Transportation Engineer, VHB (MSCE 1998)

KAREN JENKINS, P.E., AIA
Co-Founder and Managing Partner, Shear Structural (M ARCH 1992, MSCE 1993)

DAVEITTA JENKINS KNIGHT, P.E.
Georgia Transportation Operations Manager, Division Vice President; Jacobs Engineering Group (BCE 1994)

KARYN MATTHEWS, P.E.
Senior Transportation Engineer, Arcadis (BSCE 2002)

EMILY MEADOR, P.E.
Principal, Kimley-Horn (BSCE 1999)

EMMY MONTANYE, P.E., LEED AP
Senior Vice President, Kimley-Horn (BCE 1982)

CATHERINE OWENS, P.E., LEED AP
Interim Director of Program Management & Principal Engineer, Atlanta BeltLine, Inc. (BSCE 2001)

MARGARET “MEG” PIRKLE, P.E.
Chief Engineer, Georgia Department of Transportation (MSCE 1997)

BETH ANN SCHWARTZ, P.E.
Senior Associate, Manager of Roadway Design; Michael Baker Corporation (BCE 1994)

JEAN YU, P.E.
Practice Area Leader, Transportation/Local Government; Wolverton (BSCE 2004, BSIE 2004)
Kenneth Hyatt
Distinguished Alumni
Leadership Speaker Series

OUR 2019-2020 SPEAKERS

FALL 2019

JOHN HUFF
BCE 1969
CHAIRMAN
OCEANEERING INTERNATIONAL, INC.

SPRING 2020

BILL HIGGINBOTHAM
BCE 1976
PRESIDENT AND CEO
ET ENVIRONMENTAL CORPORATION

The Hyatt Distinguished Alumni Leadership Speaker Series taps the School's broad alumni base to bring a distinguished leader to campus each fall and spring who can share wisdom and insight with the School's students and the wider Georgia Tech community. It is made possible by the generous support of Kenneth Hyatt, BCE 1962, MSIM 1966.
Wassim Selman did a little bit of time traveling in his presentation to School of Civil and Environmental Engineering students, faculty and alumni in October.

Selman pulled lessons into the present day that echoed along the Mason Building’s walls when he was a student more than 30 years ago, sitting in Peter Parsonson’s undergraduate class on transportation — lessons that still echo for him today.

“[Parsonson] stressed, quite a bit, the relationship between the highway, the driver and the car. He always talked about how you have to create the right balance,” said Selman, president of the infrastructure business line in North America for Arcadis and the fall 2018 speaker in the Kenneth Hyatt Distinguished Alumni Leadership Speaker Series.

“You understand the natural and built environment. … You will need to consider the third part of the puzzle, and that is the human element,” Selman said. “It could one person, it could be a group, it could be a community, it could be a city, it could be our global humanity.”

Those lessons about keeping people in the equation have been key in defining his approach to engineering and leadership, Selman said. He recalled several examples of projects he worked on where clients said the biggest challenges were not technical or engineering; rather, they were challenges of building support for a project or convincing taxpayers to pay for it.

“Regardless of what you do, being able to understand and work with people will be key to your success.”

He said that all starts with each individual.

“When we talk about people, the most critical person that you need to think about in that equation is you. That’s where it all starts,” he said. “The more you learn about yourself, the more you take that into consideration, and the more you actually think about where your passions are, the more successful you will be.”

WASSIM SELMAN
KENNETH HYATT DISTINGUISHED ALUMNI LEADERSHIP SPEAKER

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- Year Round Postings of Jobs and Internships
- Hosting an Information Session
- Invitation to Networking Events with CEE Alumni, Professors and Students
- Participation in GOLD Mentoring Program

2018-2019 Partners

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The newest members of the School of Civil and Environmental Engineering External Advisory Board exhibit a decidedly entrepreneurial streak.

Three of the five new members have started companies — two remain involved in running the businesses — and a fourth runs the company his Tech-alumnus father started.

Their paths to entrepreneurship, however, couldn’t be more different.

Raul Delgado always knew he wanted to return to his native Peru and start a consulting company. He used a scholarship from the Fulbright Commission to earn his master’s degree in civil engineering at Georgia Tech, graduating in 1968 and working for a few years at Bechtel.

“I love my country, I love Peru. And I just said to myself, if God Almighty made me born there, it’s because He wanted me there,” Delgado said after his first advisory board meeting in October. “And, obviously, I love to work on big engineering projects.”

Delgado continues to serve as founder and CEO of CESEL Engineers, which focuses on those big projects, like subways, airports, roads and other big infrastructure. He credited his engineering courses and his minor in economics at Tech for helping him run the nearly 40-year-old company.

“I didn't realize how much that would serve me in the future. I don't think I would've been able to do what I've done, what I've accomplished, without having that minor combined with my core engineering knowledge,” he said.

The School’s advisory board is a group of 30 alumni and industry leaders who counsel the School’s leadership on everything from curriculum to alumni outreach. Delgado joined the board this fall along with Fred Carlson, Murray Griffin, Rebecca Nease and Art Williams.

For Murray Griffin, the idea of starting his own firm came after he’d already been a practicing engineer for nearly 30 years. He partnered with another Georgia Tech-educated engineer in the early 2000s and formed Atlantic Coast Consulting, where Griffin is still chairman.

“We jumped out. Were we prepared, engineering-wise? Yes. Business-wise? You know, we've learned a lot, and I've learned a lot, over the 13-plus years we've been in business,” said Griffin, who graduated with his civil engineering bachelor’s in 1979.

He credited his mentor, Charlie Jones, who ran the firm where Griffin worked for years before striking out on his own: “I had a good model to go after. Pretty much everything that we did, I modeled after what Charlie Jones had done [at Jordan, Jones & Goulding].”

Now that he has stepped back somewhat from day-to-day leadership, Griffin said he wanted to see what he can do for the School.

“I love Tech; I’ve gotten a lot out of Tech. So I look forward to trying to give back.”

Likewise, Rebecca Nease is looking forward to staying busy with the board now that she’s retired from the U.S. Nuclear Regulatory Commission, where she was a branch chief and oversaw the inspectors who examine nuclear fuel facilities.

“My engineering degree from Georgia Tech has opened many doors for me — and still does,” said Nease, who finished her Bachelor in Civil Engineering in 1979.

Those are doors that may not have opened, had Nease not taken a community college course on engineering.

“I had always high scores in math and science, so my high school adviser suggested I become a math or science teacher — she didn’t mention engineering,” Nease recalled. “Not knowing what I wanted to do, I took random classes at a community college near my home and was lucky enough to take an introductory class in engineering. At the end of the class, the professor suggested I go into engineering. The rest is history.”

Fred Carlson knew he wanted to be an engineer from the time he was in eighth grade.

“It was having that tangible [project], that you’re actually building something that’s going to be there for the long term and that would be impacting communities and people. It always was that,” said...
Carlson, a 2001 civil engineering graduate. It didn’t hurt that his father was a Georgia Tech civil engineer who exposed him to the road construction industry. Carlson did the same for a while, but then returned to Tech to earn an MBA and thought he’d end up in real estate development.

Along the way, an opportunity came up to partner with his dad and with farmers in South Georgia on an automated bagged-ice machine. Together, they founded Ice House USA in 2003 and ultimately sold to outside investors in 2010.

Now Carlson is vice president for construction cleaning at Triad Cleaning Solutions in Tampa, where he works with contractors to clean up projects before they’re turned over to the owner.

“Every day, I’m poring through building plans. I wouldn’t want to not be involved in some way with civil engineering and construction,” Carlson said. “It’s fun to work with all the different business owners that we deal with.”

Solving problems and “building stuff” is what attracted Art Williams to civil engineering and, ultimately, the family business. Williams continues the business venture — and Tech tradition — his father started in 1960. He’s president of Virginia-based Williams Steel Erection Company, one of the family firms he now runs with his brother.

“Our whole family was Georgia Tech-involved,” Williams said. “I always knew I liked solving problems. Engineers solve problems, so I think it was just a natural fit.”

Williams and his brother earned civil engineering degrees at Georgia Tech, just like their father. Now they share responsibility for Williams Industries and its subsidiaries. He said joining the advisory board is an opportunity to give back in more ways than donating money.

“It’s an opportunity to be more involved in the School and an opportunity to give back to the School that’s helped me get where I am.”

"My degree from Georgia Tech has opened many doors for me — and still does."

Rebecca Nease

"It’s an opportunity to be more involved in the School and an opportunity to give back to the School that’s helped me get where I am.”

Art Williams

"It’s an opportunity to be more involved in the School and an opportunity to give back to the School that’s helped me get where I am.”

Fred Carlson
BSCE 2001

Raul Delgado
MSCE 1968

Murray Griffin
BCE 1979

Rebecca Nease
BCE 1979

Art Williams
BCE 1983
External Advisory Board

Jim V. Anderson  
Chief Executive Officer, SocialFlow  
BCE 1998, MSCE 1989

Fred Carlson  
Vice President of Construction Cleaning, Triad Cleaning Solutions  
BSCE 2001, MBA 2004

Raul J. Delgado  
Founder and CEO  
CESEL Engineers  
MSCE 1968

Rick L. Garcia  
Retired, Delta Airlines  
BCE 1973

Murray K. Griffin, P.E.  
Chairman  
Atlantic Coast Consulting, Inc.  
BCE 1979

Bill Higginbotham, P.E.  
Advisory Board Chair  
President and CEO  
ET Environmental Corporation  
BCE 1976

Michael F. Houlihan, P.E.  
Principal Engineer and Vice President  
Geosyntec Consultants  
BCE 1985, MSCE 1987

John U. Huffman  
Retired President and CEO  
Pepco Energy Services  
BCE 1981

Richard H. Hummel II  
Founder, Commodore Investments LLC  
Co-Founder, Federal Holdings, Inc.  
BCE 1989

John M. Kelley  
Partner and Senior Vice President of Commercial Development  
North American Properties  
BCE 1992

Todd I. Long  
Chief Operating Officer  
Moreland Altobelli Associates, LLC  
BCE 1989, MSCE 1990

Silvio J. Lopez  
Senior Vice President  
Banco Popular  
BCE 1979, MSCE 1981

Orlando R. Mendez, P.E.  
Chief Executive Officer  
Dorado Beach Resort  
BCE 1991, MSCE 1992

Edward Metzger  
National Accounts Manager  
Trane Inc.  
BCE 1980

Emmy Montanye, P.E.  
Advisory Board Vice Chair  
Senior Vice President  
Kimley-Horn and Associates, Inc.  
BCE 1982

Stephen P. Mulva, Ph.D.  
Director, Construction Industry Institute  
University of Texas at Austin  
Ph.D. 2004

Rebecca Nease  
Retired Branch Chief  
U.S. Nuclear Regulatory Commission  
BCE 1979

Christopher D. Pappas  
Special Adviser to the CEO  
Trinseo  
BCE 1978

Donald W. Paul  
Retired, Georgia Pacific  
BCE 1980

Meg Pirkle, P.E.  
Chief Engineer  
Georgia Department of Transportation  
MSCE 1997

Josh Rowan, P.E.  
General Manager  
Renew Atlanta Infrastructure Improvement Program  
City of Atlanta  
BCE 1996

Franklin Rucker, P.E.  
Chief of Capital Programs, Expansion and Innovation, Metropolitan Atlanta Rapid Transit Authority  
BCE 1979

I.J. Scott III  
President and CEO  
Scott Bridge Company  
BCE 1974

Wassim A. Selman, Ph.D., P.E.  
President, Infrastructure – North America, Arcadis  

S. Paul Shailendra  
President, SG Property Services  
BSCE 2001

Stacie Sire  
Director of Structures Engineering, Boeing Commercial Airplanes  
BCE 1996

Deborah K. Staudinger  
Partner, Hogan Lovells  
BCE 1978

Damian K. Taylor  
Senior Vice President  
Arch Street Capital Advisors  
BSCE 2001

Michael R. Van Epp  
Principal, EnvironCaptial  
BSCE 2003

H. Arthur Williams  
President  
Williams Steel Erection Company, Inc.  
BCE 1983

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