SPRING 25

IMPACT

LYLES SCHOOL OF CIVIL AND CONSTRUCTION ENGINEERING

INNOVATING FOR STABILITY

A novel fix for strengthening older concrete structures against earthquake damage

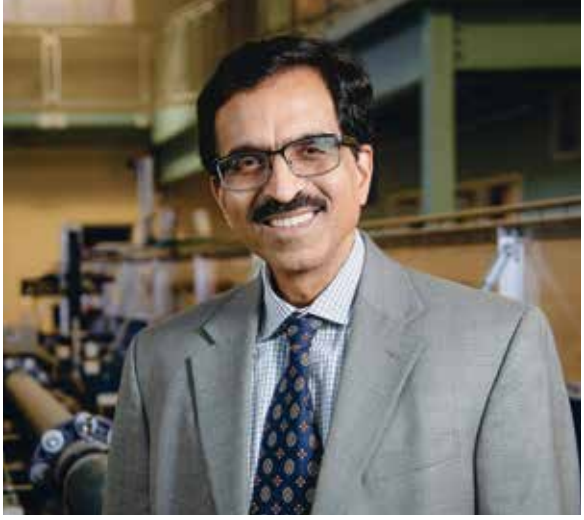
PAGE 6

PURDUE UNIVERSITY

Lyles School of Civil and Construction Engineering

BIKE PACK COLLECTS DATA TO CREATE DIGITAL TWIN OF THE ENVIRONMENT | PAGE 10

MESSAGE FROM THE HEAD



To say these past 12 months have been eventful would truly be an understatement — and I am proud to say the Lyles School of Civil and Construction Engineering has only become stronger over the past year.

Hands down the biggest development was our merger with the Division of Construction Engineering and Management, a move that has brought about a new, incredible era for our school — and especially for our students. With this merger, 116 new students joined our program, bringing our total student roster up to 763 undergrads and 430 graduate students.

The fall semester marked the beginning of this new era for our school, and the overwhelmingly positive response — both internally and externally — exceeded our expectations. From the eager reactions of our students to the enthusiastic encouragement from our industry partners, the merger between such strong programs was seen as something both necessary and forward-thinking.

Overall, the merger has enabled new opportunities for research, education and experiential learning for our students, faculty and staff. It has also allowed us to better answer industry demands — both nationally and internationally — that call for graduates who have a greater understanding of the civil and construction engineering fields.

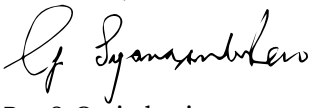
I am confident that benefits from this merger will continue to grow, and I look forward to sharing these stories in future messages.

Of course, that is not all that has been taking place at the Lyles School of Civil and Construction Engineering — and we are very excited to share some of the latest developments and innovations in education and research in this edition of Impact Magazine.

Stories in this edition feature undergraduate student-assisted research that could positively impact both communities and environments around the world. This impactful research includes the innovation in structure retrofitting that will make buildings in developing nations significantly more resilient, the creation of a new hazardous material rapid-response method and innovations in urban forest management.

These are just a few of the global-impact endeavors taking place at our school. Even more stories can be found in the news section of our website, which I encourage you to visit to keep up on all the latest developments and innovations at the Lyles School of Civil and Construction Engineering.

All the best,



Rao S. Govindaraju
Bowen Engineering Head of Civil and Construction Engineering and
Christopher B. and Susan S. Burke Distinguished Professor of Civil Engineering

IN THIS ISSUE:

ON THE COVER

Erin Plocinski, a junior from Indianapolis who is specializing in structural engineering, is one of the undergraduate students working in the research group led by Akanshu Sharma, the Jack and Kay Hockema Associate Professor in Civil Engineering.

ADMINISTRATION

RAO S. GOVINDARAJU
Head, Lyles School of Civil and Construction Engineering

AYHAN IRFANOGLU
Associate Head, Lyles School of Civil and Construction Engineering

HUBO CAI
Associate Head, Construction Engineering Undergraduate Program

STAFF

BRANDON FULK
Walsh Director of Internships

DREW STONE
Director of Marketing and Communications

JAIMEE BARR
Program Administration Manager

PURDUE FOR LIFE FOUNDATION

ERIC PUTMAN
Executive Director of Development, College of Engineering

L. SCOTT HINKEL
Senior Director of Development

CONTRIBUTORS

THE ESC PLAN
Art direction, writing, editing, photography

KARYSSA GRAHAM
Writing

CCE Impact is published biannually for alumni and friends of the Lyles School of Civil and Construction Engineering. We welcome your comments, opinions and questions.

Lyles School of Civil and Construction Engineering
Delon and Elizabeth Hampton Hall of Civil Engineering
550 Stadium Mall Drive
West Lafayette, IN 47907-2051
765-494-2166
engineering.purdue.edu/CCE

PURDUE UNIVERSITY

Lyles School of Civil and Construction Engineering

CIVIL AND CONSTRUCTION ENGINEERING

ADVISORY COUNCIL

MARK CVETKOVICH, CO-CHAIR
BSCNE '05
Project Manager
Bowen Engineering Corporation

STEVE FEHRIBACH, CO-CHAIR
BSCE '84
President/Owner
A&F Engineering Co. LLC

CLAYTON FORCE, CO-CHAIR
BSCE '02 MSCE '03
President & CEO
Force Construction Co. Inc.

AUGIE ZICCARELLI, CO-CHAIR
BSCNE '81
Project Director
Pepper Construction

COREY BAUGH
BSCNE '01
Vice President
Milestone Contractors

KELLY POWERS BARIA
BSCE '98
Vice President
Powers & Sons Construction

STEVE BESTARD
BSCNE '91
Sr. Vice President & CCO
Messer Construction Co.

ROBERT L. BOWEN
BSCE '62, HDR '07
Chairman/CEO
Bowen Engineering Corporation

CHRISTOPHER B. BURKE
BSCE '77, MSCE '79, PhD '83 HDR '10
President
Christopher B. Burke Engineering Ltd.

JOHN CASSIDY
BSCNE '88
Construction Manager
Bechtel Oil, Gas & Chemicals GBU

RICK CONNER
BSCE '76
President
American Structurepoint Inc.

JAMES CURE
BSCE '75
President Emeritus
Advanced Technology Group

MARK DONAHUE
BSCNE '94
Sr. Vice President, General Manager
Mortenson Construction

DREW EMERSON
BSCNE '95
Vice President
JE Dunn Construction

JAN EVERETT
BSCE '76, MSCE '78
Vice President, Transportation, Florida, AECOM

KEVIN FITZPATRICK
BSCE '85
President/CEO
Alfred Benesch & Company

ERIN FLANIGAN
BSCE '87
Principal, Transportation Operations & Safety
Applied Research Associates

ERIC GRUNDKE
BSCNE '90
Renewables Execution Manager
Kiewit Corporation

CLAUDIA GUNSCH
BSCE '98
Professor
Duke University

HALEY HASSLER
BSCNE '07
Director of Strategic Development
Barton Malow Company

ROBERT HOLDEN
BSCE '90, MSCE '92, PhD '99
Vice President
Wessler Engineering Inc.

JARVIS JOINTER
BSCE '04
Founder/President
JQOL Inc.

VICKY KERAMIDA
MSCE '76, PhD '79
CEO and Chief Technical Officer
Keramida Environmental Inc.

CECILIA KUCHARSKI
BSCNE '95
Vice President
Webcor

JEFFREY LEMNA
BSCNE '88
Director of Career Development
The Walsh Group

DARREN LUEKING
BSCNE '93
Pursuit Manager
Traylor Bros. Inc.

WILLIAM M. LYLES IV
BSCE '81
Senior Vice President
Lyles Diversified Incorporated

MATT MEUNIER
BSCNE '00
Construction Manager
PCL Construction Services Inc.

DOREEN MITCHELL
BSCE '81
VP, Facility Asset Management
Walt Disney World Company

JACK MOLLENKOPF
BSCNE '95
CEO
Pankow Builders Ltd.

SHANNA MORRETT
MSCGT '08
Senior Manager, HR
Holder Construction

PEGGY NEWQUIST
BSCNE '86
Director of Learning and Development
Clune Construction Company

JOSH NIXON
BSCE '01
Professional Engineer
Kimley-Horn & Associates Inc.

STEVEN P. OSBORN
BSCE '78
Founder, President and CEO
CE Solutions Inc.

ERSAL OZDEMIR
BSCE '97
Chairman/CEO
Keystone Construction Corporation

MARK PERNICONI
BSCE '74, MSCE '76
Executive Director, Retired
Charles Pankow Foundation

JIM ROWINGS
BSCE '75, MSCE '79, PhD '82
Vice President
Peter Kiewit Sons Inc.

KEVIN SCHMOK
BSCNE '91
Executive Vice President
Trammell Crow Company

BART SHIVELY
BSCNE '83
Chief Strategy Officer
MATT Construction

JULIA SPADACCINI
MSCNE '05
Permian GHG Program Manager
ExxonMobil

TOM SPORS
BSCNE '01
Project Manager
BMWC Constructors Inc.

MICHAEL STEWART
BSCE '96
Manager of Infrastructure Planning and Development Group
Bechtel Infrastructure Corp.

MARK WHITSON
BSCNE '01
President
DPR Construction

RAO S. "G.S." GOVINDARAJU
Head of Civil and Construction Engineering

NADIA GKRITZA
Professor of Civil and Construction Engineering, Transportation

ROBERT B. JACKO
Professor of Civil and Construction Engineering, Environmental

MOVING? SEND CHANGE OF ADDRESS TO:

Lyles School of Civil and Construction Engineering
Delon and Elizabeth Hampton Hall
550 Stadium Mall Drive
West Lafayette, IN 47907-2051
jimaddox@purdue.edu

NEWS & EVENTS

LSCCE UNDERGRADUATE PROGRAM RANKED NO. 3 IN THE NATION

U.S. News & World Report has released its national rankings of undergraduate programs for 2025 with Purdue University LSCCE ranked No. 3 in the nation. The rankings are computed from the responses to a survey sent to deans, heads and selected senior faculty.

Overall, Purdue University's College of Engineering undergraduate program is ranked No. 8 in the nation.

PURDUE TO HOST CIB WORLD BUILDING CONGRESS

Purdue University will host the 23rd World Building Congress (CIB) in May 2025. This is the first time the conference will be held at Purdue and only the third time in the United States.

The title of the conference is "Sustainable Built Environment — The Role of the Construction Community in Meeting the UN sustainable development goals." Sustainable development goals include industry, innovation and infrastructure; responsible consumption and products; sustainable cities and communities; and decent work and economic growth, to name just a few.

Leading the international event is Lyles School of Civil and Construction Engineering Professor and CIB President Makarand (Mark) Hastak, and co-chairs Željko Torbica and Bryan Hubbard, former heads of the School of Construction Management Technology at Purdue.

CONGRATULATIONS GRADUATES!

In December, the Lyles School of Civil and Construction Engineering saw 40 undergraduates and 60 graduate students earn their degrees. We are incredibly proud of their achievements and wish them the best of luck in their future endeavors.

Purdue researchers and Terran Robotics partners visit Bloomington, Indiana, showcasing natural material homes and 3D printed walls for ponds.

Purdue researchers collaborate with Terran Robotics to evaluate clay-based bricks tested at Purdue.

Coupling AI and 3D printing for sustainable, affordable and environmentally friendly homes

Through research at Purdue University, 3D printed homes are swiftly becoming a reality.

"There have been great advances in 3D printing technology over the years — and we expect improvements will keep coming for some time," said Pablo Zavattieri, the Jerry M. and Lynda T. Engelhardt Professor in Civil Engineering. "What we need to do now is to find the right materials to 3D print sustainable and affordable structures without negatively impacting the environment."

Leading the research effort at Purdue to perfect functional, life-size, 3D-printed buildings are Zavattieri; Jan Olek, the James H. and Carol H. Cure Professor in Civil Engineering; Marika Santagata, professor of civil and construction engineering; and Jeffrey Youngblood, professor of materials engineering.

Partnering with Purdue in this research is Terran Robotics, a company that specializes in constructing affordable, sustainable homes by leveraging artificial intelligence and robotics. Their approach utilizes natural materials to create high-quality, environmentally friendly homes, addressing the housing crisis by improving construction efficiency with AI-driven technology.

The material currently being tested by Purdue researchers is known as cob — a mix of clay, sand, water and straw. It is a low-carbon building material that has shown to test well for compression strength and durability while incurring lower carbon emissions during its manufacturing than concrete.

"Currently, we're testing various mixtures to find the strongest set of materials," said PhD student researcher Yu Wang. "Our focus right now is to find the ideal mixture and moisture content to make the strongest, most resilient material possible."

Assisting in the research were undergraduate students Ilene Trach and Case Vandevelde. Trach said she developed an interest and wanted to join the research team after taking a new course, 3D Printing for Infrastructure Applications.

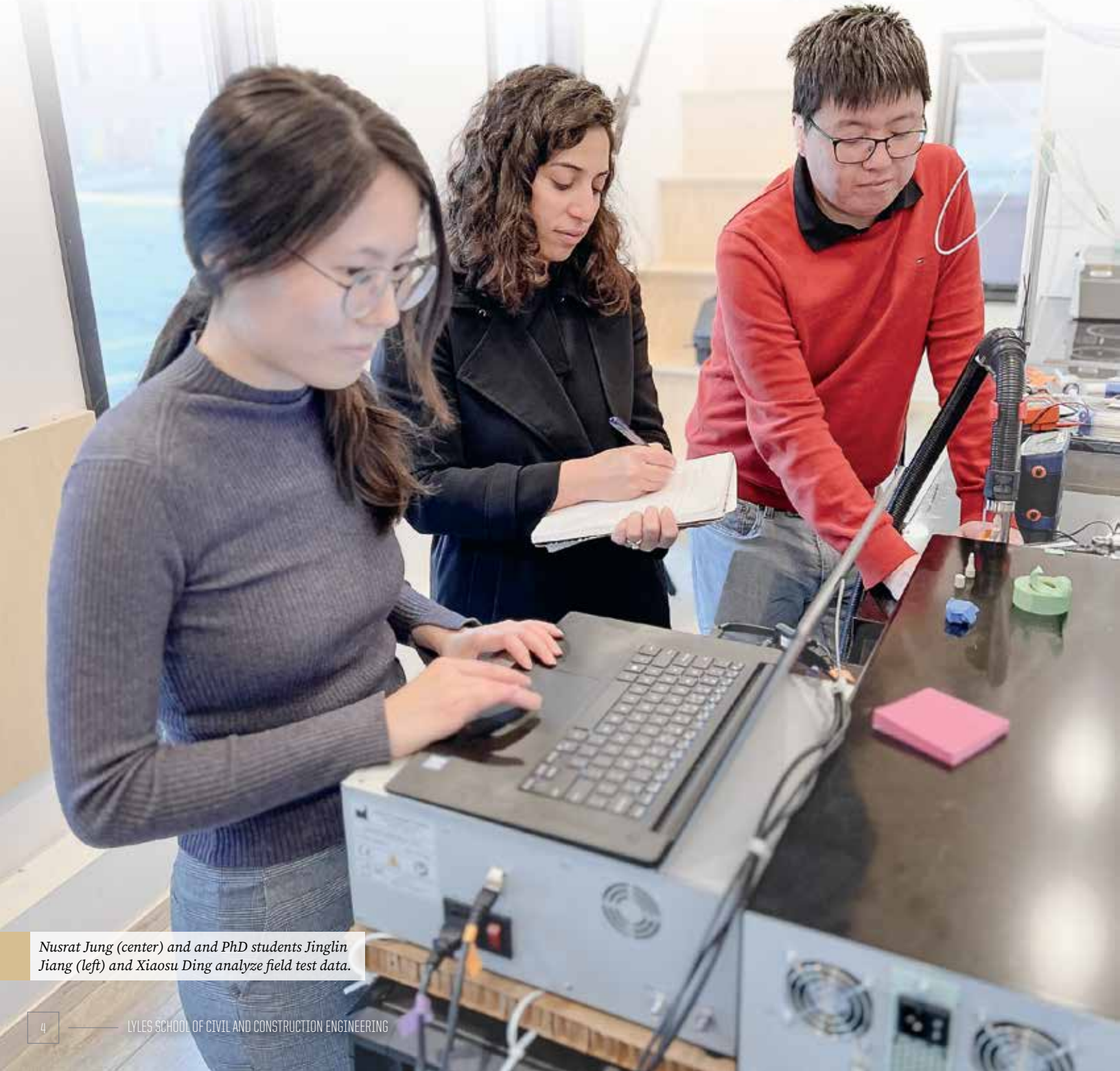
"When I saw the potential applications for 3D printing in the future, I wanted to learn and experience even more," Trach said. "Getting the opportunity to record data and participate in research like this was a valuable experience."

Trach and Vandevelde joined the Purdue research team through the university's Summer Undergraduate Research Fellowships (SURF) — an 11-week summer program that includes team research experience, professional development seminars, the presentation of research discoveries at the SURF symposium and social activities with other members.

"The SURF program has been an indispensable resource for us to find engaged students who want to further their studies and experience," Zavattieri said. "It is impactful for the students and helps further our research."

As for the next step in the research, Zavattieri said that they will continue to test and refine materials and aim to print a full-sized structure in the near future.

FASTER SOLUTION FOR SPILLS



Nusrat Jung (center) and and PhD students Jinglin Jiang (left) and Xiaosu Ding analyze field test data.

CUTTING-EDGE METHOD ACCELERATES HAZARD RESPONSE

When responding to a hazardous spill, every second counts — and Purdue researchers have found a way to optimally use that time.

A research team led by Nusrat Jung, an assistant professor in the Lyles School of Civil and Construction Engineering, has developed a new rapid screening method to test for volatile chemicals. This test can be used in a variety of hazardous spill scenarios to provide responders faster results when checking for chemicals in the soil, water and air.

"The most crucial time after a hazardous spill are the moments immediately following the incident," Jung said. "Our team developed a method that could provide first responders and researchers a swift and accurate assessment so that they may form a faster plan of action to better contain the spill and protect the surrounding communities and the environment."

In the United States, hazardous chemical incidents — including fires, explosions and chemical releases — are a common occurrence. On average, these incidents occur once every two days. Between 2004 and 2014, there were approximately 172,000 chemical spills that affected water bodies. Over the past 20 years, hundreds of thousands of chemical incidents have impacted drinking water sources.

"The increasing prevalence of hazardous chemical incidents in the United States necessitates the implementation of analytically robust, rapid and reliable screening techniques for toxicant mixture analysis to understand short- and long-term health impacts of environmental exposures," Jung said. "In disaster situations like these, every extra second saved is invaluable."

To provide time-sensitive exposure data for emergency response, Jung's team outlined a novel methodology for rapid characterization of chemical contamination of environmental media to support disaster response efforts. Undergraduate researcher Grayson Wittbrod contributed to the research.

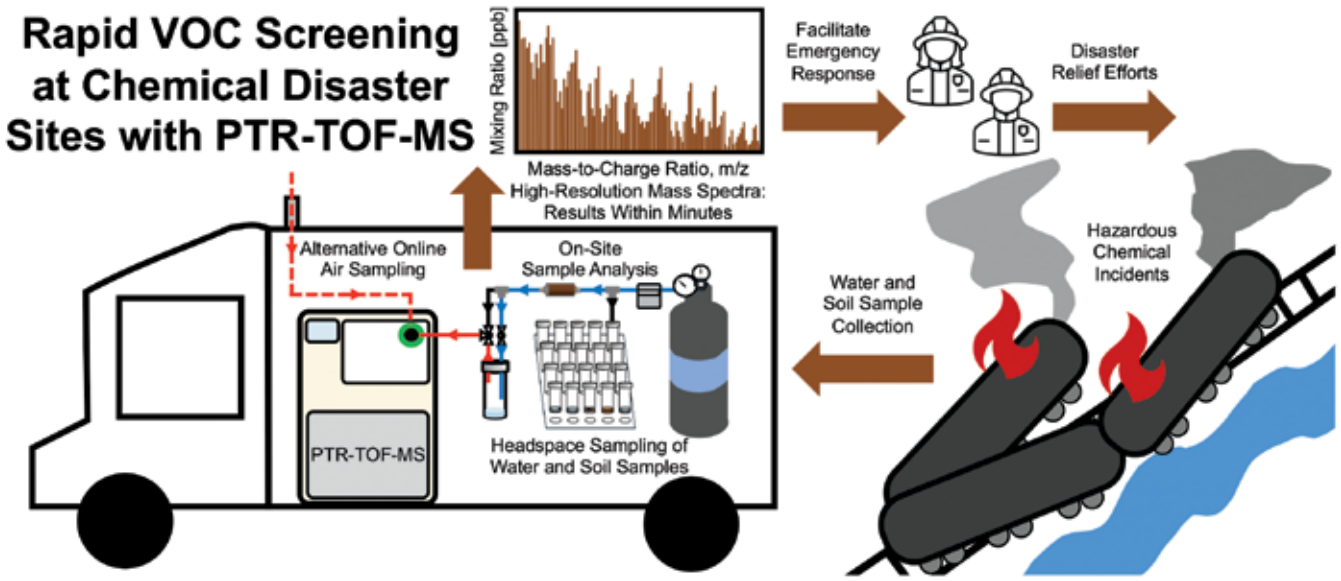
"A faster, accurate response is absolutely necessary to protect both the people and the surrounding environment," Wittbrod said. "The work being done here is just the start of what I hope is an overall improvement to hazardous material testing."

A controlled static headspace sampling system, in conjunction with a high-resolution proton transfer reaction time-of-flight mass spectrometer, was developed to characterize volatile organic compounds (VOCs) in surface water samples collected near the East Palestine train derailment site.

"Rapid evaluation of air, water and soil contamination and human exposure risks is critical to decision-making," Jung said. "This helps officials minimize population exposures and environmental harm. An effective and reliable approach to assess air, water and soil contamination, and subsequent human exposures, is urgently needed."

Jung's team utilized novel online mass spectrometry for rapid characterization of the chemical contamination of surface water samples. Specifically, proton transfer reaction time-of-flight mass spectrometry with hydronium as the reagent ion was used — a form of chemical ionization mass spectrometry that has been used for online monitoring of VOC concentrations in outdoor and indoor atmospheric environments.

Jung's report — along with her new testing methods — will be released publicly so that future response teams can gather samples more quickly and efficiently.



Through a newly-developed rapid screening method, spill responders will be able to more quickly and precisely test for volatile chemicals. This test can be used in a number of hazardous spill scenarios to provide responders faster results when checking for volatility in the soil, water, and air.

Akanshu Sharma (left), the Jack and Kay Hockema Associate Professor in Civil Engineering, leads a team investigating a new technique to reinforce concrete structures and protect them against earthquake damage.

The team includes PhD candidate and lead project engineer Margaritis Tonidis (center) and undergraduate researcher Erin Plocinski.

Improving Earthquake Resilience

RESEARCHERS TEST LOW-COST SOLUTION TO REINFORCE AGING CONCRETE STRUCTURES

Concrete structures of the past weren't built to withstand the fury of an earthquake but a groundbreaking solution from researchers in the Lyles School of Civil and Construction Engineering could change that.

A research team led by Akanshu Sharma, the Jack and Kay Hockema Associate Professor in Civil Engineering and an expert in structural engineering hazard solutions, is testing a cost-effective, minimally invasive technique to fortify older concrete buildings against earthquakes, potentially saving lives and preserving structures worldwide. Their secret weapon? Using adhesive anchors to install metal braces — a simple yet ingenious retrofitting that could revolutionize how we protect our built environment from seismic disasters.

"Most of the techniques that currently exist in the field require some part of the existing structure to be demolished to access critical areas, which is very invasive and requires parts of the building to be closed for several months," Sharma said. "We wanted to develop a minimally invasive solution that can be applied without disruption to the use of the building."

The team's novel approach involves installing haunches — metal triangular braces —to reinforce beam-column joints. The haunches are attached with post-installed adhesive anchors secured with epoxy mortar, so material cost is relatively low. There's an additional indirect cost-savings by keeping the building's functionality intact during installation of the haunches.

"Many solutions work well in the lab scale, but they are not practical enough to be applied in real life," Sharma said. "I've been developing this method for the past 15 years and have finally reached a stage where it can be implemented in real life."

To test the solution, the team erected a life-size, two-story structure in the Bowen Laboratory for Large-Scale Civil Engineering Research. This first structure, without haunches, represents an older concrete building with connecting columns and beams that have not been reinforced to withstand seismic activity.

Using the strong wall in Bowen Lab, the team applied cyclical loads to the structure, mimicking the stresses and deformations in the frame members typically caused by an earthquake. The researchers then evaluated the behavior of various structural elements, such as the columns and beams, and measured the effects of the applied stress. This data can be used to verify available models in the field of research to predict the structural behavior of older buildings against lateral loads.

"The initial phase of testing involves an analysis of the vulnerability of existing reinforced concrete structures against joint shear failure," said Margaritis Tonidis, a PhD candidate in the Lyles School of Civil and Construction Engineering at Purdue and the lead engineer on the project. "Beam-column joints are critical regions when it comes to lateral loading. In previous earthquakes, buildings have collapsed mainly due to joint shear failure."

To test how well the haunches and anchors perform, the team plans to create a second two-story structure, identical to the first. Construction of a second building is necessary because this technique isn't designed to repair and strengthen an earthquake-damaged building, but to reinforce structures that could be susceptible to earthquakes in the future.

This time, the concrete beam-column joints will be strengthened with steel haunches. The post-installed anchors being used to secure the haunches are manufactured by Fischer, a global supplier of anchors and structural strengthening solutions and funder of the project.

Margaritis Tonidis, lead project engineer, takes measurements on the life-size concrete structure built inside Bowen Lab.

"The effectiveness of the technique is dependent on many parameters, but the most important one is the performance of the anchors," Tonidis said. "Different companies produce different products and different products mean different performance. We must understand the characteristics of this specific anchor we are using. Its strength, stiffness, behavior when intercepted by cracks in the concrete — these are all important considerations."

The same quasistatic lateral loading procedure will be applied to the retrofitted concrete structure, and the same measurements will be taken. By comparing the two sets of data, the researchers will be able to determine the effectiveness of the haunches and anchors with respect to the seismic performance of the structure. If successful, the technique could be applied on a global scale, saving not only structures but the people who dwell and work within them.

"Around 50% of the reinforced concrete structures worldwide were designed without any seismic considerations," Sharma said. "It's as high as 90% in many developing countries. During earthquakes, these structures can be heavily damaged or collapse. It's not just a matter of capital losses; it's also the loss of human lives."

An estimated 55,000 people died in the Turkey-Syria earthquake in February 2023. With the installment of haunches on older concrete buildings in areas susceptible to earthquakes, deaths of that scale could be preventable when future natural disasters strike.

Interest in the research has been stoked by a blind prediction competition where engineers can submit their guess as to how well the haunch and anchor solution will perform, potentially qualifying for a cash prize.

"We've received interest from all over the world," Tonidis said. "We have submissions from Asia, Europe, South America — the implications of this research are far-reaching and the visibility of the project helps affirm Purdue's status as a leading institution for civil and construction engineering research."

The second phase of testing is slated to occur in May. Upon success of the experiment, Sharma hopes to commercialize the technology through Purdue Innovates and make it available to communities around the world.

"As civil engineers, we evaluate the aftermath of earthquake damage to assess what happened to the buildings," Sharma said. "That's the technical part of our work, but you cannot avoid seeing how people are affected. Earthquake disasters can have devastating effects. The aim of this study is to prevent that staggering level of loss. If the structures do not fail and people's lives are saved, that has a much bigger impact than anything else."

Erin Plocinski

FROM CLASSROOM THEORY TO LABORATORY IMPACT

The research has potential for worldwide impact, and it's an example of the type of projects that undergraduate researchers in the Lyles School of Civil and Construction Engineering can work on.

"This is my first time seeing a large-scale structure intentionally being broken," said Erin Plocinski, a junior from Indianapolis who is specializing in structural engineering. "It's cool to witness that in person, but it's even more interesting to see how the structural modifications we're implementing could help the industry long-term."

For Sharma, integrating undergraduate students into his research group is an essential part of the Purdue educational experience.

"In the classroom, we often look at lines and drawings and talk about how force is transferred," Sharma said. "But when you test a life-size structure in the lab, you can actually see the forces flowing and how the cracks are forming. Viewing something with your own eyes lends a different perspective to the application of theoretical concepts."

The opportunity for Plocinski to contribute to a project centered on structures retrofitted for earthquake resilience not only expands her understanding of the discipline, but also affirms her passion for her chosen specialty.

"One of the reasons I chose to study civil engineering is because of the impact your work can have on a community," she said. "I want to be able to create sustainable and safe buildings for people."

David Kopp (right) studied civil engineering at Purdue so that he could work to improve the public transportation experience for people with special needs.

ENGINEERING *ACCESSIBILITY*

Professor's unlikely skill helps blind student achieve his dream

A professor's unexpected crossing of career paths has led to a tremendous impact on the life of a blind student.

Lyles School of Civil and Construction Engineering undergraduate student David Kopp was born with a genetic eye disorder called aniridia that led to a gradual loss of eyesight. During surgery early in his junior year to correct a detached retina, he came out of the surgery totally blind. Undaunted, Kopp continued to pursue a degree and career in transportation engineering with a focus on accessibility.

"Accessibility is obviously really important to me, and I know just how vital it is for people with disabilities to get around," Kopp said. "And Purdue — especially my school — has been very accommodating."

One of the more remarkable accommodations came in his final semester. Robert Jacko, professor of civil and construction engineering and senior design instructor, just happens to be associated with the Miami Lighthouse for the Blind and Visually Impaired.

"My wife, Virginia, slowly lost her sight to Retinitis pimentosa near the end of her 24 years working at Purdue," Jacko said. "She is now the president and CEO of the Miami Lighthouse for the Blind and Visually Impaired. This familial connection led me to become familiar with the needs of the blind and I earned a braille machine advanced repair technician certificate in 2023.

"I was in a unique position to help my student who did not have a brailler conveniently available," Jacko said. "So, I went online to eBay and purchased the old reliable, cast aluminum bodied machine, totally disassembled it, cleaned it, repaired it."

This machine, Kopp said, is better than any other brailler he has ever used.

"It's true what they say about how 'they don't make them like they used to,'" Kopp said. "The brailler is big but it's incredibly well-made and more reliable than anything I've had before."

In addition to being a great help with his studies, Kopp said it has also provided practical uses.

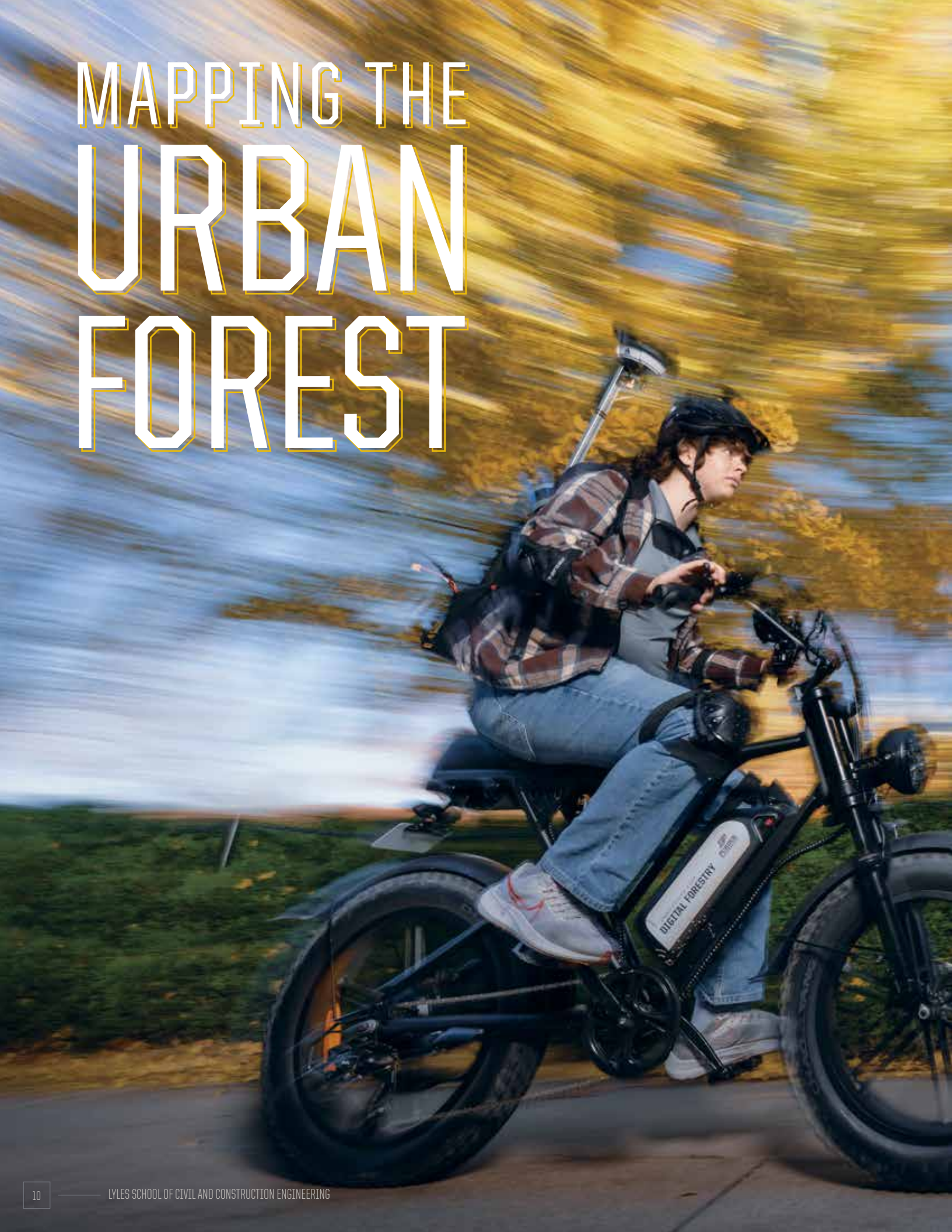
"Now that I am completely blind, I am more reliant than ever on labeling things, especially after I moved into a new apartment," Kopp said. "The brailler can make labels, which I use to help make the space more accessible as I get used to my surroundings."

Jacko insisted Kopp keep the brailler as a graduation gift, in hopes the machine will benefit Kopp as he begins his career as a civil engineer.

"When I signed up for the Perkins Braille Machine Repair Course, I would have never guessed it would be so critical in helping one of my civil engineering students toward graduation," Jacko said. "One never knows where the path will take them."

Kopp graduated in December 2024 with a bachelor's degree in civil engineering, having used braille notes during his final oral senior design presentation.

MAPPING THE URBAN FOREST



LIDAR-EQUIPPED BIKE PACK COLLECTS DATA TO CREATE DIGITAL TWIN OF THE ENVIRONMENT

Pedestrians walking around Purdue's West Lafayette campus gave Colton Gomoll some strange looks as he pedaled by on an e-bike last summer. What those passersby may not have known — Gomoll wasn't just cycling; he was conducting science.

"If you're trying not to look goofy, the bike pack system might not be for you," Gomoll said. "Not only was I wearing a high visibility vest, helmet, knee pads and elbow pads, but there's also a large antenna sticking up out of the backpack with a LiDAR scanner and an RGB camera attached."

As he cruised by on the e-bike, the bike pack platform collected LiDAR data that can be used to create a realistic digital representation of the environment. This digital twin enables precise spatial measurements of the landscape, streetscape, buildings and trees.

"Using remote sensing to gather data on the natural and built environment allows for more efficient planning and management of urban forests," Gomoll said.

Gomoll, a junior civil engineering major from St. Charles, Illinois, was part of a team of undergraduate researchers contributing to a project led by Ayman Habib, the Thomas A. Page Professor of Civil Engineering, and Songlin Fei, the dean's chair of remote sensing in the Department of Forestry and Natural Resources and founder of ArborMapper. Fei is also the director of Purdue's Institute for Digital Forestry and Habib serves as the institute's associate director.

"For this project, our primary focus was using LiDAR data collection to conduct an inventory of urban trees and infrastructure," Habib said. "This information is useful in monitoring the health and growth of trees. Understanding the relationship between buildings and trees plays an important role in reducing the heat island effect in urban environments. At the same time, we can gather information about the condition of infrastructure, such as sidewalks, and generate an as-built model of the environment."

The researchers are not only collecting data but processing it to provide information to end users. In previous LiDAR studies, Habib's team has provided information on infrastructure to transportation departments; mapped coastlines to evaluate the impact of water levels; and monitored agricultural fields for seed breeders and farmers.

In this current project, Habib aims to create a complete digital twin of Purdue's West Lafayette campus. Such a model can be used by architects to evaluate the condition of the buildings, arborists to monitor tree health and grounds crews to assess safety of sidewalks — by identifying both places of deterioration and areas in need of more lighting.

"It's a single data collection with multiuse value," Habib said. "The payload we've designed can be mounted on several systems — an individual walking or riding a bicycle. It can also be mounted on crewed or uncrewed ground and aerial vehicles."

Purdue has plans to commercialize the technology which will make data acquisition faster, cheaper and more accurate. One of the goals for the Institute of Digital Forestry is to map every tree on the planet, and the LiDAR data collection and processing system developed by Habib's research team could help achieve that goal.

"Right now, metrics related to carbon credits or estimated timber production are not based on precise measurements," Habib said. "It is very easy to excessively overestimate or underestimate the amount of greenhouse gas emissions being reduced or potential board feet for harvesting. Using this technology to obtain accurate measurements of every tree in the forest could have huge economic value."

Involving undergraduates in the project gives students an opportunity to put theory into practice and to contribute to interdisciplinary research.

"Purdue is known for its expertise in engineering and agriculture and there is strong collaboration between the two colleges," Habib says. "I consider myself privileged to work with individuals in diverse fields."

ALUMNI SPOTLIGHT

COMMUNITY IMPACT

Passion for leadership fuels alum's interest in public works projects

Born and raised in Tegucigalpa, Honduras, Nelson Frech grew up in a family that emphasized the importance of hard work and education.

At 18, he moved to Indiana to attend Purdue. As an international student, he had to navigate the cultural adjustments while balancing a demanding academic schedule in the First-Year Engineering program and working at Harrison Grill.

"From an early age, I understood the importance of hard work and education, instilled by my parents, who were dedicated to giving my sister and me the opportunities they themselves never had," Frech said.

Pursuing a dual degree in construction engineering and political science merged his interests in construction and public policy. His time at Purdue enhanced his foundation and passion for leadership. He interned at Wilhelm Construction on life sciences projects and later at The Skillman Corporation where he initiated a COVID-19 safety plan.

"Throughout my career, I have focused on public works and projects that serve the community in the education, health care and municipal sectors," Frech said. "This focus began with early experiences at projects for Purdue University with Wilhelm Construction and continues today with health care, education and public safety projects at Skender."

Nelson, now a senior project manager and team leader at Skender, oversees renovation and new construction projects for higher education, municipal and health care clients. He serves on the board of Adelante Schools and mentors young professionals through the ACE Mentors Program. His work emphasizes growth and community impact, as he manages project execution, client relationships and team training, ultimately fostering the

Nelson S. Frech receives the 20 in Their Twenties Award from Samm Quinn, managing editor of the Indiana Business Journal, at the August 13, 2024, event at the Indiana Roof Ballroom. Photo courtesy of IBJ.

next generation of construction leaders. Mentoring young professionals brings him personal fulfillment and benefits his team and company.

Nelson is a committed leader in construction, focused on positively impacting his community. He holds an executive certificate in real estate from Cornell University and a JD and MBA from Indiana University. Inspired by early real estate projects in Tegucigalpa, he aims to create environments that foster learning and growth.

Nelson's time at Purdue strengthened his practical skills through hands-on projects and student organization connections. He values mentoring young professionals and returns annually as a guest lecturer. Being named to the Indiana Business Journal "20 in their Twenties" list reflects the support he's received in his career.

"My experience at Purdue University was nothing short of transformative. Academically, the programs were challenging but provided invaluable real-world experience," Frech said. "The hands-on projects, internships and opportunities for direct industry engagement allowed me to grow quickly and see the practical side of what we were learning in class."

Nelson S. Frech celebrates his graduation from the Indiana University's Robert H. McKinney School of Law in Indianapolis, surrounded by family and friends, May 8, 2024.

PURDUE ENGINEERING

38 BY 38

The Purdue Engineering 38 by 38 award is inspired by the legacy of alumnus Neil Armstrong, who was 38 years old when he became the first person to set foot on the moon. The annual award honors 38 Purdue College of Engineering alumni who are 38 years old and younger and have demonstrated an accelerated trajectory of professional success and made a significantly high impact in their field, organization, community or society as measured in units relative to their work.

The inaugural class of 38 by 38 was honored during a reception held October 17, 2024, as part of the College of Engineering's yearlong sesquicentennial celebration. Four alumni of the Lyles School of Civil and Construction Engineering were among the recipients:

Rachael Bisnett (MSCE '10)
Principal Engineer, Dam and Levee Subsector Lead
Stantec

Emily Foote
(BSCE'10, MSBCM'18)
Civil Engineering and Area Construction Manager, Main Fabrication Unit
Bechtel Corporation

John Kremer (BSCE'08)
Vice President of Corporate, Renewables, and Policy Strategy
Marathon Petroleum Corporation

Jeffrey Peters (MSCE'11)
Partner
IBEX Investors

PURDUE UNIVERSITY | Lyles School of Civil and Construction Engineering

Delon and Elizabeth Hampton Hall of Civil Engineering
550 Stadium Mall Drive
West Lafayette, IN 47907-2051

Non-Profit
Organization
U.S. Postage
PAID
Purdue University
Permit No. 221

CONNECT

WITH THE LYLES SCHOOL ON SOCIAL MEDIA!