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LYLES SCHOOL OF CIVIL ENGINEERING

ENGINEERING FOR HUMANITY

Groundbreaking 3D printing for infrastructure course challenges students to expand the discipline

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PURDUE UNIVERSITY

Lyles School of Civil Engineering

DAILY HAIR CARE ROUTINE MAY RELEASE LINGERING TOXIC CHEMICALS | PAGE 4

MESSAGE FROM THE HEAD

Something I am sure just about everyone in the civil engineering field can relate to — whether they are in research, industry or academia — is a desire to understand what the future of civil engineering will be.

As humanity's oldest engineering discipline, it would be only natural to think we would look to our past for valuable lessons. While learning from those who have come before us will always be an invaluable facet, civil engineering is a field that demands that we look forward, innovate, adapt and evolve.

From creating the very roads and bridges that first allowed people to safely connect to other communities to looking to the stars and planning how we will establish habitats in space, civil engineers quite literally have paved the way for humanity's progress throughout the ages.

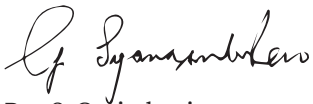
As the head of the Lyles School of Civil Engineering, I am especially privileged to see the strides toward the future being made every day in our laboratories and our classrooms. Whether it is the continuation of impactful research or the guidance of future civil engineering leaders, Purdue University serves as one of the world's greatest hubs for innovation.

This mindset also carries with it a tremendous sense of optimism and enthusiasm that is felt throughout the school. It is what helps us to preserve and to see ideas and ambitions become tangible realities — and in this edition, you will learn about some of those efforts that are coming to fruition.

Stories in this magazine include the development of a new undergraduate course on 3D printing as well as a number of undergraduate assisted research endeavors, including Purdue's continued research into establishing habitats on the moon, new findings on the air quality impact of haircare products and our work with NASA as we use satellite imaging to better monitor coastal erosion in the United States.

Whether it is planning for humanity's next giant leap to life on another planet or safeguarding life on this planet, Purdue civil engineers are persistently pursuing the best possible future.

All the best,



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

IN THIS ISSUE:

ON THE COVER

Students enrolled in 3D Printing for Infrastructure Applications, the first undergraduate course of its kind, learn how to harness the emerging technology that is the future of construction.

EA/EOU
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NEWS & EVENTS

GRADUATION

Congratulations to our Fall 2023 graduates! In December, the Lyles School of Civil Engineering saw nearly 100 students earn their degrees. We look forward to hearing about their future successes.

RANKINGS

The Lyles School of Civil Engineering is a top 5 civil engineering undergraduate program in the United States.

U.S. News & World Report has released its national rankings of undergraduate programs for 2024 with Purdue civil engineering ranked No. 4 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 was ranked No. 8 in the nation.

PURDUE UNIVERSITY | Lyles School of Civil Engineering

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HAZARDOUS HAIR CARE

RESEARCH INDICATES COMMON MORNING ROUTINE RELEASES LINGERING TOXIC CHEMICALS INTO THE AIR

The average morning routine for many Americans includes inhaling several milligrams of chemicals that may be harmful to their health, Purdue University researchers have found.

A research team, led by Nusrat Jung, assistant professor of civil engineering, discovered that many chemicals linger in the air after use. On average, Jung's team reports, a person can inhale a cumulative mass of 1-17 milligrams of potentially harmful chemicals in a single hair care session in their home.

"We found the results to be extremely alarming," Jung said. "We did not expect to see such significant emissions of volatile chemical mixtures from off-the-shelf hair care products during typical hair care routines that many people perform each and every day."

One of the most frequent — and most concerning — chemicals inhaled, Jung said, is decamethylcyclopentasiloxane (aka D5 siloxane). It is an organosilicon compound often listed first or second in the ingredient lists of many hair care products, indicating it can be among the most abundant ingredients. It has become a common ingredient over the past few decades in many personal care products due to its low surface tension, inertness, high thermal stability and smooth texture.

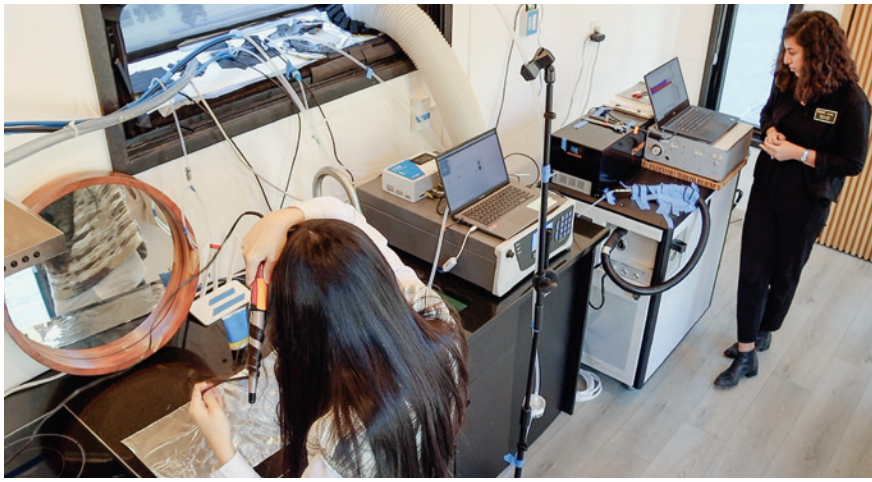
"There has not been much in-depth research into this, so we really have no idea the extent of the threat these chemicals pose when inhaled over a long period of time," Jung said. "There have been tests into wash-off products like shampoos, but almost none for leave-on products such as hair gels, oils, creams, waxes and sprays."

According to the European Chemicals Agency, D5 siloxane is classified as "very persistent, very bioaccumulative." And while the test results on laboratory animals is already concerning, Jung said, there is little information on its human impact.

Jung's research also noted that applying high heat to these chemicals, through the use of curling irons and hair straighteners, serves to further release the chemicals into the air. When met with temperatures of 410 degrees Fahrenheit, researchers found the chemical emissions from hair care products increased anywhere from 50% to 310%.

To make matters worse, Jung said, these airborne chemicals do not merely remain in a single room — or even just the home.

"Home ventilation is likely a major pathway of indoor-to-outdoor siloxane transport," Jung said. "In urban environments, this is especially significant as you will have hundreds — even thousands — of homes ventilating out potentially harmful chemicals into the urban atmosphere all in a short span of time as people get ready for work and school in the morning. These chemicals are then collectively piped back into buildings through ventilation systems. So even if using products with harmful chemicals is not part of your hair care routine, you will still be impacted due to your surroundings in an urban environment."



Purdue civil engineering PhD student and researcher Jinglin Jiang conducts her hair care routine while Nusrat Jung, assistant professor of civil engineering, observes data inputs during hair care routine emissions experiments conducted in the Purdue zero Energy Design Guidance for Engineers (zEDGE) Tiny House.

GATHERING THE DATA

Jung's experimental research was conducted in a residential architectural engineering laboratory: the Purdue zero Energy Design Guidance for Engineers (zEDGE) Tiny House.

"The work being done here has been just the start as we look toward the effects of other chemicals introduced into the air and environment," said undergraduate researcher Grayson Wittbrod.

The hair care routine emission experiments were conducted during a measurement campaign in zEDGE over a period of several months. The process included three experiment types: realistic hair care experiments that replicate actual hair care routines in the home environment; hot plate emission experiments that explore the relationship between the temperature of the hair care tools and volatile organic compound emissions; and surface area emission experiments that investigate how hair surface area impacts volatile organic compound emissions during hair care events.

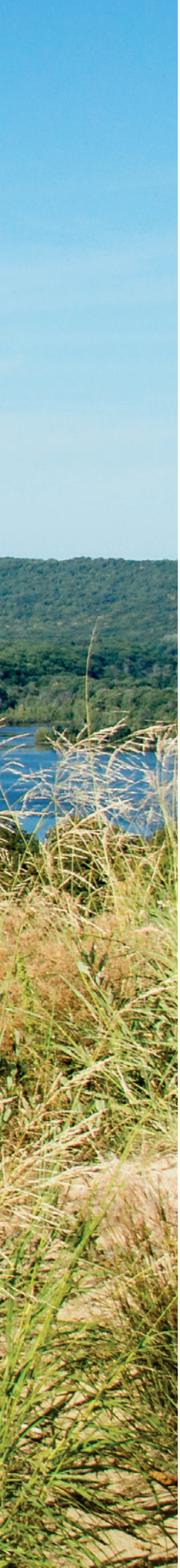
For the realistic hair care routine emission experiments, participants were asked to bring their own hair care products and hair styling tools to replicate their routines in zEDGE. Prior to each experiment, participants were instructed to separate their hair into four sections. The hair length of each participant was categorized as long hair (below the shoulder) or short hair (above the shoulder). The sequence of each experiment consisted of four periods, to replicate a real-life routine.

After hair styling, the participants had two minutes to collect the tools and leave zEDGE; this was followed by a 60-minute concentration decay period, in which zEDGE was unoccupied, and the high-resolution proton-transfer-reaction time-of-flight mass spectrometer monitored the decay in indoor volatile organic compound concentrations. The experiments and subsequent analysis focused on indoor volatile organic compound concentrations and emissions during and after active hair care routine periods.

This research was funded and supported by Purdue University, the Alfred P. Sloan Foundation and the National Science Foundation. Jung's team plans to investigate the many other chemicals detected in these experiments that were not reported in this study.

DOCUMENTING ERODING SHORELINES

NOVEL DETECTION MODEL MAY INFORM THE ENGINEERING OF MORE RESILIENT COASTS



As shorelines around the world continue to erode while sea levels rise, a Purdue University professor is developing a new process using satellite imagery to improve understanding of these changes and better predict their environmental and societal impacts.

Cary Troy, associate professor of civil engineering, leads a research team that has been studying coastal processes around the Great Lakes for more than a decade. Through the use of coastal mapping via satellite and lidar imagery, his team has cataloged a continual erosion of the Great Lakes coast that has, in some areas, eaten away the adjacent beaches almost entirely.

The shoreline detection model that Troy's research team developed applies imagery from high-resolution satellites and is validated to have subpixel accuracy using beach survey data that were collected from the Lake Michigan shoreline using a novel backpack-based lidar system. The backpack system was developed by Ayman Habib, the Thomas A. Page Professor of Civil Engineering and one of Troy's collaborators. The model was also compared to 132 satellite images of a Lake Michigan beach over a three-year period and detected the shoreline accurately with a more than 99% success rate.

The model also outperformed other existing shoreline detection algorithms based on different water indices and clustering techniques. The resulting shoreline position time series is the first satellite image-extracted dataset of its kind in terms of its high spatial and temporal resolution. The results pave the road to obtaining other high-temporal-resolution datasets to refine models of beaches worldwide.

The findings from their research, Troy said, have been concerning.

"What we've been seeing since we started documenting the Great Lakes' coastal erosion is effectively a tug of war occurring between evaporation and precipitation — both of which show increasing trends," Troy said. "This competition between offsetting hydrologic effects has resulted in dramatically increased frequency in water level extremes across all of the Great Lakes, and in turn, erosion."

Undergraduate researcher Sophia Ung said the mosaic of satellite imagery the team is compiling paints a rather dire picture.

"The data indicates there has been pretty significant erosion along the Great Lakes," Sophia said. "Right now, we're working on determining the most vulnerable stretches of shoreline."

Between 2013 and 2020, Troy said, the Lake Michigan-Huron water level increased nearly two meters, breaking century-old low- and high-water level records in the span of only seven years. The growing consensus among Great Lakes hydrologists is that future water levels are highly uncertain, but that more extreme water levels — both highs and lows — are likely to persist for decades to come.

"These rapid oscillations between extreme water levels wreak havoc on Great Lakes coastlines and the communities that live along them," Troy said.

Based on research collected by Troy's team, ocean coastal effects are felt in response to the steady sea level rise of around 3 millimeters per year. In the Great Lakes, sustained lake level rise rates of almost 300 millimeters per year over nearly a decade led to devastating effects on property, infrastructure, public lands and industry. In recent years, this damage was felt across all five Great Lakes as water level records of one type or another were broken during a recent high-water period.

"The ability to detect and quantify these changes is essential for the development and refinement of models that can predict such shoreline changes, in turn guiding the design and management of coastal areas that are more resilient to ever-increasing coastal hazards," Troy said.

Undergraduate researcher Sophia Ung and graduate research assistant Hazem Abdelhady examine satellite imagery data.

The shoreline detection algorithm has now been applied at nine additional Lake Michigan beaches, and results from this work are expected to be published later this year.

To further aid in this research, NASA announced in the fall that it would help fund Troy's continued efforts with the possibility of expanding his work from the Lake Michigan test sites to shorelines in all five Great Lakes. The NASA project, funded by the Commercial Smallsat Data Scientific Analysis Program, seeks to leverage the technology not only to detect shoreline changes across the Great Lakes, but to use this data to train a Great Lakes-specific shoreline model that can help area coastal communities prepare for future conditions.

BUILDING FOR THE FUTURE

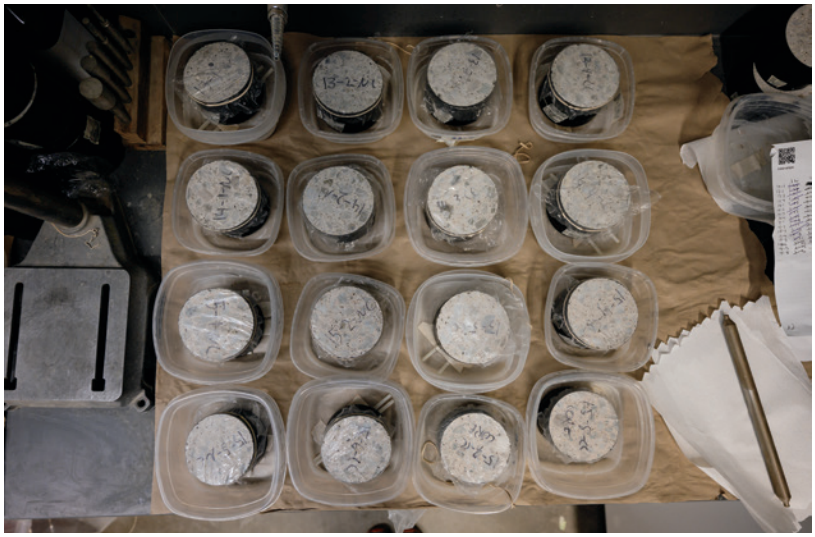
GROUNDBREAKING COURSE INCORPORATES INTERDISCIPLINARY APPROACH TO 3D PRINTING FOR INFRASTRUCTURE

A decade ago, 3D concrete printing was still an emerging technology. It's now one of the most rapidly growing sectors in the construction industry, projected to reach $40 billion by 2028. A new course offered in the Lyles School of Civil Engineering will equip tomorrow's engineers with the knowledge and skills necessary to thrive in this new market.

What began as a one-credit class popular with first-year engineering students has now developed into a 400 level course integrated into the curriculum. Beginning this semester, 3D Printing for Infrastructure Applications was offered to engineering and technology students across campus.

"Civil engineering has evolved exponentially in the digital age," said Pablo Zavattieri, the Jerry M. and Lynda T. Engelhardt Professor in Civil Engineering. "Modern techniques require the use of robots and solving present-day challenges demands out-of-the-box thinking. This course combines design, materials, mechanics, processing and a little bit of chemistry. We've taken an interdisciplinary approach to prepare our students to tackle some of the world's most-pressing needs."

The course is co-led by Zavattieri; Jan Olek, the James H. and Carol H. Cure Professor in Civil Engineering; Jeffrey Youngblood, professor of materials engineering; Yu Wang, a civil engineering PhD student and Lyles Teaching Fellow; and AlaEddin Douba, a Lillian Gilbreth postdoctoral fellow in civil engineering.



In 3D Printing for Infrastructure Applications, students develop concrete mixtures and work with polymers, metals, cement, mortar and concrete to fabricate structures of their own design.

ENGINEERING FOR HUMANITY

The 3D Printing for Infrastructure Applications course aligns with the Lyles School of Civil Engineering's vision to center engineering for humanity as the cornerstone of the school's identity.

"Finding solutions to large-scale problems requires civil engineers to focus on societal impact," Zavattieri said. "We also must expand our discipline by embracing robotic technology and considering space applications. We are not limited. As we look toward the future, we must harness the pioneering technology and expertise available to us to train tomorrow's civil engineers to create sustainable, resilient and inclusive communities that harmonize with the natural and built environment."

In the course, students work with polymers, metals, cement, mortar and concrete as they design and execute intricate 3D printed models. They will also conduct experiments and develop concrete mixtures to meet the specific requirements and constraints of 3D printing. Guest speakers from industry, national and government labs and other universities visit the course to conduct interactive discussions with the class and present their own projects and case studies that successfully navigated these constraints.

"We have had speakers from some of the leading construction printing companies in the world, such as COBOD, based in Denmark, and ICON, based in Austin, Texas," Zavattieri said. "We've also invited representatives from RCAM Technologies, a climate tech startup that's developing 3D printed concrete solutions for offshore renewable energy. These speakers provide real-world insights into engineering design challenges."

Such challenges include balancing design aesthetics with structural integrity or managing cost-effectiveness while ensuring sustainability. As the students develop their own projects, they are encouraged to showcase their creativity and problem-solving by experimenting with novel materials, structural designs and construction methods.

"Purdue is one of the first universities in the world to offer an undergraduate course on 3D printing for infrastructure," said Wang, who earned his master's at Northwestern University. "The persistent pursuit of innovation is ingrained at Purdue. It's one of the things that motivated me to pursue my PhD studies here. We are leading the nation in 3D concrete printing research. Through this course, we bring together the top minds in the field to pass that knowledge down to our undergraduates."

AlEddin Douba, a Lillian Gilbreth postdoctoral fellow in civil engineering, explains the characteristics of a specific concrete mixture to students in the 3D Printing for Infrastructure Applications course.

Although conventional building methods still have their place, 3D infrastructure printing is quickly becoming the construction technology of the future.

"In this course, students are exploring more than just 3D printing, they're also studying nature-inspired materials and solutions and imagining how to leverage this technology to establish habitats in outer space," Zavattieri said. "That's what makes the interdisciplinary approach so critical. We believe the field of 3D printing for infrastructure will be led by civil engineers, but to design these solutions, we need engineers from other disciplines as well — electrical engineers, data engineers and aerospace engineers, among others.

"Purdue has the faculty expertise, the facilities and the technology to develop future leaders of this industry."

THE ROAD TO INDUSTRY

Institute of Transportation Engineers readies undergraduate students through professional development and networking opportunities

Two years ago, Lauren Jenkins had never heard of the Institute of Transportation Engineers. In August 2023, the senior from Tallahassee, Florida, attended the organization's annual meeting and accepted the Best Student Chapter Award on behalf of the Purdue University student chapter of ITE. It was the second year in a row Purdue's chapter earned this top recognition.

"I was honored to represent Purdue during the ITE Annual Meeting and Exhibition," said Jenkins, who served as the chapter's first undergraduate deputy during the 2022-23 school year. "It was wonderful to meet transportation professionals and fellow students from all over the globe."

Jenkins, who's now the group's webmaster, first learned about ITE from employees at the Tallahassee HNTB office during her summer internship there in 2022. It motivated her to seek out the Purdue student chapter which was formed in 1977 but historically maintained a primarily graduate student membership. In recent years, the organization has amped up its advertising and provided scholarship assistance to recruit more undergraduate student members.

"In ITE, undergraduates benefit from learning what the field of transportation has to offer," Jenkins said. "A lot of people think it's just roads, but there's a lot more to it than that. You also make connections with academic researchers and industry professionals. ITE helped me figure out what I want to do as I progressed in civil engineering."

One way Purdue's ITE student chapter is expanding opportunities to undergraduates is by offering the Jack V. Skillman Award. The award provides financial support for qualified undergraduate students to attend the Transportation Research Board's annual meeting in Washington, D.C. Jenkins was named a recipient in 2023 and 2024. After she completes her degree this May, she plans to return to the Tallahassee HNTB office as a full-time employee.

Haydn Malackowski (BSCE'22), a second-year master's student, was a recipient of the award in 2022. This year, he served as the Purdue ITE chapter's TRB coordinator, managing travel and housing logistics for the Purdue group that attended the meeting in January.

"Support from the Skillman Award allowed me to attend the TRB meeting as an undergraduate," Malackowski said. "I saw Purdue's impact on the field first-hand. We're fortunate to learn from professors who are recognized worldwide. Seeing the various presentations and networking with professionals from all over the world made me realize I wanted to pursue a graduate degree at Purdue."

Whether students opt to go directly into the workforce or advance their education, membership in ITE helps undergraduates navigate the options available to them.

Students clean up trash along a two-mile section of a country road the ITE chapter maintains as part of Tippecanoe County's Adopt-a-Road program.

ITE students meet with alumni and industry professionals during a Purdue Road School Transportation Conference and Expo networking dinner.

The Purdue ITE chapter arranges field trips and technical tours for its members, such as this outing to Subaru of Indiana Automotive in Lafayette.

Top: A site visit to May Mobility where students learned about the company's autonomous vehicle technology. Bottom: Scenes from the Transportation Research Board's annual meeting in Washington, D.C.

"We host presentations by practicing professionals with great technical experience who can share their career trajectory and speak to our students about their own goals," said chapter advisor Darcy Bullock, the Lyles Family Professor of Civil Engineering and director of the Joint Transportation Research Program. "These conversations help students identify their career aspirations and develop networking skills. Whether it's the commissioner for the Indiana Department of Transportation or a recent Purdue graduate who's now consulting in Chicago, students are eager to learn from professionals in the field."

ITE members are also encouraged to participate in the Purdue Road School Transportation Conference and Expo, an annual event that convenes 3,000 transportation professional representatives from state and local agencies, industry and academia. Student poster sessions allow students to share their research and engage with transportation colleagues from across the state.

"The community of transportation professionals is close-knit," Malackowski said. "Everyone knows each other in the industry so the earlier you make those connections, the better off you'll be launching your career. Purdue's ITE student chapter is a great place to start."

Lauren Jenkins and Rajat Verma accept the 2023 Best Student Chapter Award during the ITE Annual Meeting in August.

BRINGING HOME THE HARDWARE

Purdue's transportation engineers are consistently recognized at regional and national levels.

2023 Best Student Chapter Award
ITE Annual Meeting

2023 Outstanding Chapter Award
Great Lakes ITE District Annual Meeting

2023 First Place in Student Design Competition
Great Lakes ITE District Annual Meeting

2023 Second Place in Traffic Bowl Competition
Great Lakes ITE District Annual Meeting

2022 Best Student Chapter Award
ITE Annual Meeting

2022 Outstanding Chapter Award
Great Lakes ITE District Annual Meeting

2022 ITE Wilbur S. Smith Distinguished Transportation Educator Award
Presented to Professor Darcy Bullock

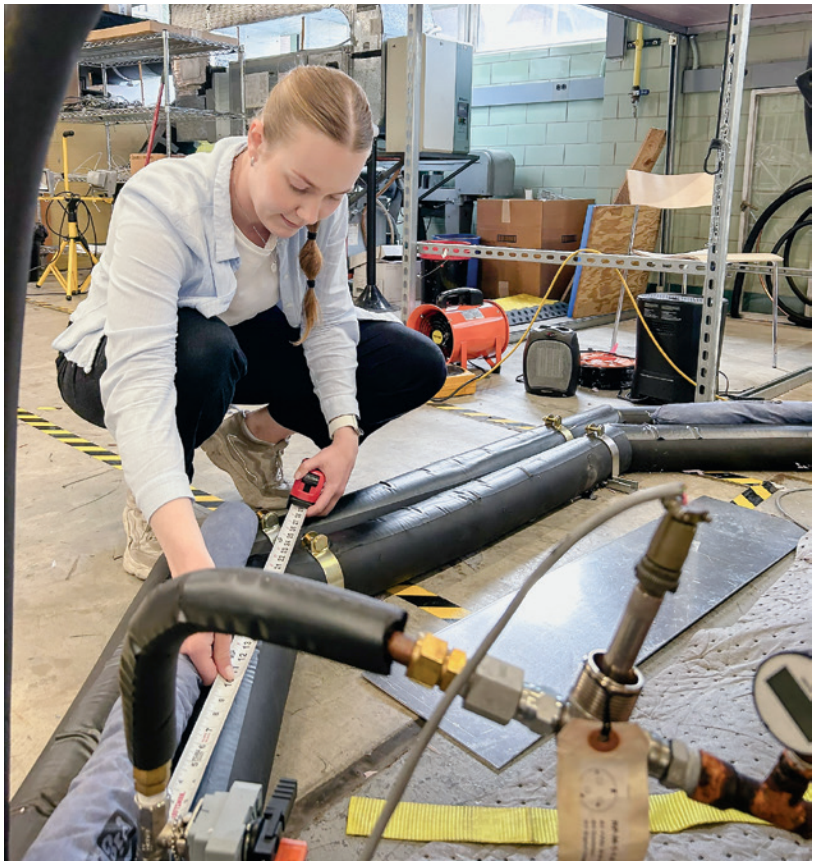
LIFE IN OUTER SPACE

Establishment of Resilient ExtraTerrestrial Habitats may occur sooner than we think

A habitat on the moon — something once only depicted in science fiction — is potentially just a few years away from becoming a reality, according to Purdue University researchers.

Purdue's NASA-funded Resilient ExtraTerrestrial Habitats Institute (RETHi) was established in 2019 with the mission of developing the techniques and technologies needed to establish safe and resilient habitats in the extreme environments of space. Now, just five years later, the institute's director believes such a habitat could be established on the moon within a decade.

"We'll probably have a habitat on the surface of the moon in about a decade," said Shirley Dyke, RETH Institute director and professor of mechanical engineering and civil engineering. "The world is ready to take the next giant leap."



Hafdís Magnúsdóttir, an undergraduate student researcher, is assisting with cyberphysical testing through the RETH Institute.

The RETH Institute is a multidisciplinary NASA-funded center that integrates engineering faculty and researchers from Purdue (lead institution), Harvard, the University of Connecticut, the University of Texas at San Antonio and Mississippi State. In the years since its inception, Dyke said, its focus has progressed from overall viability, such as characterizing the many hazards including moonquakes, radiation and dust to cyber-physical testing for exploration.

The RETHi team is providing NASA with techniques to design and operate deep space habitats that are resilient, defined as being able to adapt, absorb and rapidly recover from disruptions. The institute leverages the vast amount of expertise in constructing civil infrastructure with evolving methods in system health management, autonomy, artificial intelligence and cyber-physical testing.

"The people involved are some the best researchers in the world and we all share a goal of seeing our work come to life," Dyke said. "To see the work come to fruition — from the formation of the RETH Institute to where we are now — is incredibly motivating."

The RETH Institute team has a space habitat testbed that includes a dome that would protect the occupants of the lunar habitat. In addition to protecting its inhabitants from the harsh and inhospitable environmental conditions, the habitat also needs to withstand micrometeorite strikes. Once a strike occurs, information about the damage propagation in the structure and to the subsystems inside must be extracted so that critical repairs can be made.

Hafdís Magnúsdóttir, an undergraduate researcher on the team, is assisting with the cyber-physical testbed. Magnúsdóttir is contributing to the design and 3D modeling of the dome — something she never expected to have the opportunity to do when she came to Purdue.

"To be part of something like this and see where the research is going has been a wonderful opportunity," Magnúsdóttir said. "The amazing research being done, the concepts I've been exposed to and experience I've gained have all been incredible."

Dyke said in parallel to the cyber-physical testing, the research includes development of a digital twin of the interconnected systems in the habitat for system health management.

WATER SCARCITY IN INDIA

WINTER STUDY ABROAD COURSE CREATES UNFORGETTABLE EXPERIENCE FOR UNDERGRADUATES

Civil engineers are often tasked to solve environmental issues — and sometimes the best way to prepare students to tackle these challenges is through experiential learning.

For the past two years, Venkatesh Merwade, professor of civil engineering, has led a winter study abroad course in India. There, Purdue University and University of Iowa engineering students travel through the country to learn how water conservation projects are having positive impacts on rural communities in the states of Haryana and Rajasthan. The Sehgal Foundation, an Indian NGO focused on rural development, is leading these water conservation projects and partnering with both universities.

"This course serves as a great opportunity for students to see, up close, how engineers can directly impact entire communities for the better," Merwade said. "Many of the students have never traveled abroad, so to not only see the needs people in other countries have and the obstacles they face, but also to experience a different culture is invaluable."

As part of the program, students shadowed members of the Sehgal Foundation and followed them from their call center to their projects in the field. One of the main projects students learned about was a recharge well that injects harvested rainwater into the saline-heavy groundwater to create a freshwater pocket.

"Soil and water obstacles like these are something I never really put a lot of thought into and it's eye-opening to see the work being done and how much of a positive impact the project is having for an entire community," Purdue student Dawson Baxter said. "And to see how grateful the people are to see us was really special."

Fellow Purdue student Tommy Richards said the warm welcome they received and learning about how these communities have been changed for the better was both inspiring and motivating.

"We learn a lot about how important civil engineers are to improving communities and lives, but to see it up close and how people's lives have been changed for the better was something I will never forget," Richards said.

In addition to taking water samples and working with and visiting communities in rural India, students also toured some of the world's civil engineering marvels, such as the Taj Mahal, Agra Fort, Amer Fort and Qutub Minar.

Overall, Purdue student Quentin Lovejoy said, the cultural and educational experience gained over the winter will stick with him for the rest of his life.

"It was a special experience and I am so glad I decided to do it," Lovejoy said. "It was so much more than I expected to see. How we can change the lives and futures for people — and create landmarks that people all over the world come to see — is so unique to civil engineering."

RECORD-BREAKING CAREER FAIR

A record-breaking **200-plus employers** attended the annual Purdue Civil Engineering Student Advisory Council (CESAC) career fair. Held each fall, the fair is home to one of Purdue University's biggest on-campus hiring opportunities.

"Employers all over the country come here to find Purdue Civil Engineers," said Ava Curry, CESAC vice president. "Whether it's for full-time positions or internship and co-op opportunities, Purdue civil engineers have earned a reputation as some of the best recruits out there."

A CAREER TAKES FLIGHT

AVIATION CIVIL ENGINEER CONTRIBUTES TO PROJECTS AT AIRPORTS ACROSS THE COUNTRY

From an early age, Shannon Gunn set her eyes on the sky.

Gunn (BSCE 2017) grew up in New Orleans and San Antonio. Both places, she said, allowed her to explore different cultures and ways of life. Her love of airports came at a young age through family travel — and her passion for civil engineering stemmed from a fifth-grade class project.

"Growing up in New Orleans, hurricanes and hazardous storms were not all that uncommon," Gunn said. "For one project, my teacher had us design and lay out a neighborhood that would be resilient against such disasters. From then on, I only grew more and more interested in issues like these and how to solve them."

In addition to problem-solving, Gunn said what made her ultimately decide to pursue a civil engineering degree at Purdue University was the room for creativity.

"I love that you can be so creative in civil engineering," Gunn said. "The projects that we have, and the way that you have to problem solve and work with various stakeholders, it really allows you to approach issues from different angles." With Purdue offering a variety of concentrations within civil engineering, Gunn was able to pursue her passion in transportation.

While at Purdue, Gunn was heavily involved on campus and often took leadership roles within the Lyles School of Civil Engineering. She was the secretary of the Purdue chapter of the American Soci-

ety of Civil Engineers, secretary of Chi Epsilon, member of the Civil Engineering Student Advisory Council and vice president of finance for Sigma Kappa sorority.

Gunn was first exposed to aviation as a civil engineering career path during a college internship. After earning her degree, Gunn moved back to Texas and started work at CH2M (now Jacobs) as an aviation civil engineer-in-training. One of her more notable projects from Jacobs included working on the Runway 17C-35C Rehabilitation at Dallas Fort Worth International Airport.

"I've always wanted to do something that positively impacted communities, and it was through aviation engineering that I found my passion," Gunn said. "Being able to have a lasting positive impact on our infrastructure — and working on projects that are used widely — I find to be really fulfilling."

In 2019, Gunn started working for Kimley-Horn in Indianapolis as an aviation engineer. At Kimley-Horn, Gunn has designed runways and taxiways, inspected airfield pavement and contributed to projects at airports around the country.

One of her most notable projects is her current work on Runway 5R-23L and Taxiway D at the Indianapolis International Airport (IND).

"Runway 5R-23L is one of IND's two primary, parallel runways, and it's the runway that serves most of FedEx's traffic," Gunn said. "Indianapolis is FedEx's second largest hub in the world after Memphis, so the runway is a critical piece of infrastructure."

The project has been ongoing for nearly five years and is approaching its third and final year of construction. Runway 5R-23L is the first runway in the United States implementing carbon capture technology into the concrete mix for the aircraft-loaded pavement.

Looking back on her journey from Purdue to Kimley-Horn, Gunn said the late Professor Jon Fricker as well as her past and current colleagues, Johnny Jackson and Jenni Warnimont (BSCE 2011), were instrumental in shaping both her academic and professional careers.

"Learning from them how to not only be a good engineer, but how to carry yourself in public settings, industry settings and in the workplace has been so incredibly helpful to me," Gunn said. "The lessons and advice I've received from them I put into practice almost every single day."

Now, as she starts to become a person new engineers look to for guidance, Gunn said her advice to civil engineering students is: "Take initiative to investigate what you're interested in before interviewing with a company. It's impressive when students understand their own capabilities and how they can leverage those in an industry setting."

In her free time, Gunn said she spends time with her husband and fellow Purdue civil engineering alumnus and Kimley-Horn engineer Neil Kippenbrock (BSCE 2017). Together, they have a one-year-old son, Leo.

Top: Neil Kippenbrock (BSCE '17) and Shannon Gunn (BSCE '17) with their son, Leo. Bottom: Gunn on site at Runway 5R-23L project site at Indianapolis International Airport

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