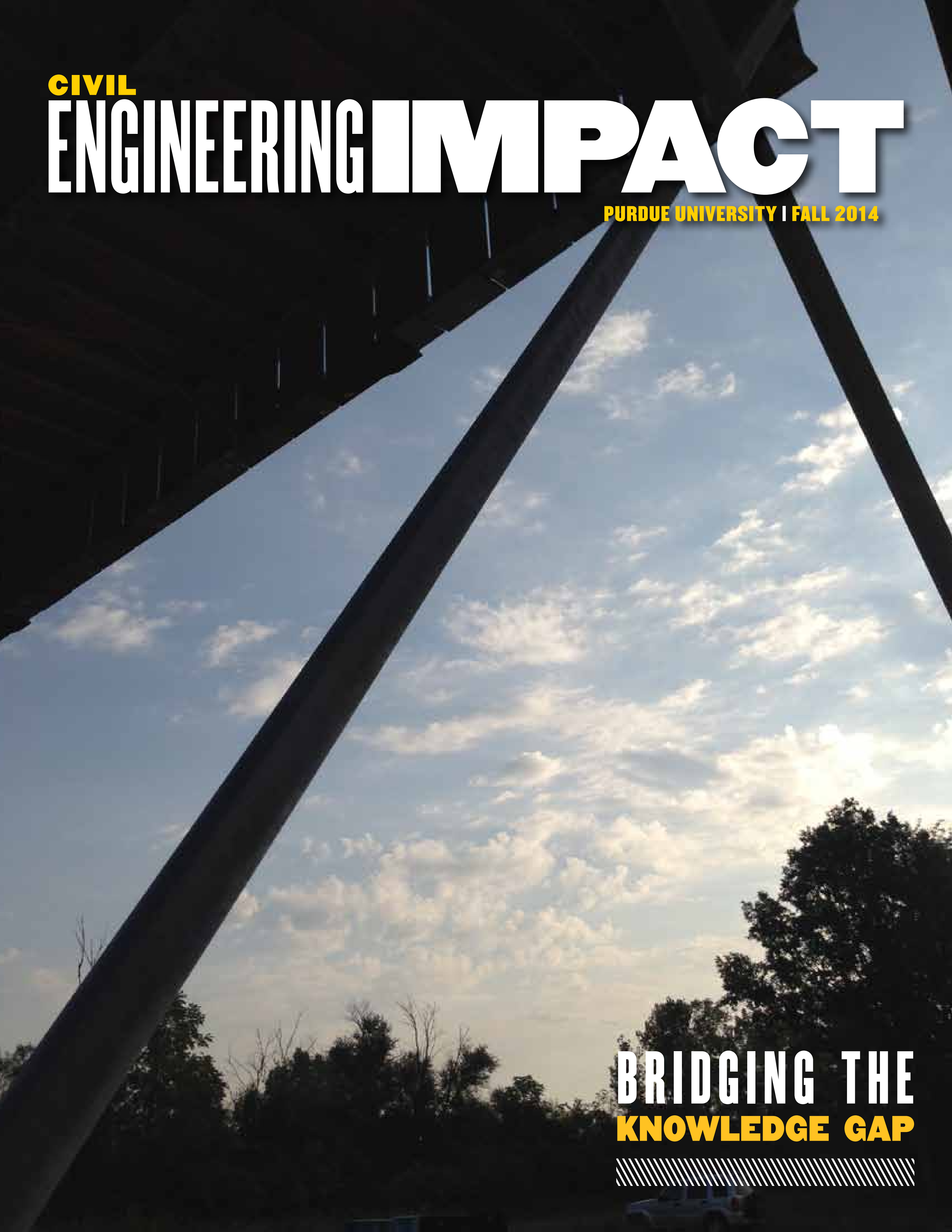
CIVIL ENGINEERING IMPACT

PURDUE UNIVERSITY | FALL 2014



BRIDGING THE KNOWLEDGE GAP


Photo by Steven Yang

We at the Lyles School of Civil Engineering at Purdue University believe enormous challenges can bring about remarkable solutions.

Take for example our cover story. The American Society of Civil Engineers estimates that an investment of $3.6 trillion is needed by 2020 to deal with our nation's aging infrastructure. As more and more engineers and inspectors retire, they take with them the knowledge of how bridges and other critical infrastructure were built decades — even a century — ago.

Robert Connor, associate professor and director of the new Center for Aging Infrastructure (CAI), and a team of researchers, including Jason Weiss, the Jack and Kay Hockema Professor of Civil Engineering, are assembling a "museum" filled with full-scale examples of fractured and failed bridge and other infrastructure parts. This center will allow current students to see firsthand how these structures were built and what it will take to maintain this aged inventory while they learn the latest techniques for building new structures.

CAI, the first-of-its-kind large-scale facility, will also provide advanced training for Department of Transportation inspectors to enhance their skills in detecting problems before they become catastrophic. Importantly, it will serve as a test bed for research leading to new and improved infrastructure.

Amit Varma, professor of civil engineering, and his research team are conducting vital research at the Robert L. and Terry L. Bowen Laboratory for Large-Scale Civil Engineering Research, a 66,000-square-foot research facility that provides the space and technical capability needed to investigate the behavior of large structural models and elements subjected to loads representing extreme events, such as earthquakes, blasts, and impact, so that future structures will be designed to better withstand these extreme events.

Professor Varma and his graduate research assistants are examining how seismic and fire events affect structural stability of nuclear plants and large-scale structures using events such as the collapse of the World Trade Center towers in New York City on 9/11 and the failure caused by an earthquake and tsunami hitting the Fukushima Daiichi nuclear power plant in Japan.

Associate Professor Pablo Zavattieri and his research team study mollusks, crustaceans, etc., to draw inspiration from nature and design advanced lightweight materials with extraordinary toughness and strength. Venkatesh Merwade, associate professor, and a team of researchers are developing tools that allow users to collaborate and integrate multiple georeferenced data sets on the Web for users to probe the data in multiple ways and conduct experiments.

Mamon Powers Jr., a civil engineering alumnus and former Purdue trustee, is president and CEO of Powers and Sons Construction Co. Inc., with offices in Gary, Indianapolis and Chicago. He has more than 40 years of construction experience managing projects as a general contractor, construction manager, design builder and owner's representative. He credits his success to always putting the customer first.

As we expand to meet the goals of the College of Engineering's Strategic Growth Initiative to increase by 30 percent key faculty positions within the college, the Lyles School of Civil Engineering welcomes several new faculty members this fall. Ayman Habib brings extensive knowledge of geomatics engineering. Mohammad Jahanshahi and Sukru Guzey will add to our strengths in the Structures area. In addition, we have three new faculty with joint appointments in civil engineering and environmental and ecological engineering. Amisha Shah is interested in chemical and physical processes in water; Andrew Whelton works on infrastructure, environment and public health; and Zhi (George) Zhou seeks microbial solutions to environmental challenges. We are very excited to have them all in our ranks.

And finally, like many aspiring civil engineers, Doreen Mitchell (BSCE '81) planned on building big city skyscrapers, but a professional twist of fate sent her to Orlando to help build one of the original pavilions at Epcot. Nearly three decades later, Mitchell shares how she uses the problem-solving skills she learned as a Purdue Civil Engineering student to enhance the "Disney experience."

Thank you for being a part of an exciting future for the school.

G. Govindaraju

RAO S. GOVINDARAJU
Bowen Engineering Head of Civil Engineering and Christopher B. and Susan S. Burke Professor of Civil Engineering

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PURDUE UNIVERSITY
LYLES SCHOOL OF CIVIL ENGINEERING

TOP HONORS
FOR CIVIL ENGINEERING FACULTY

Two Civil Engineering faculty members have received prestigious awards that recognize their contributions to innovations in student engagement. To learn more about these award-winning faculty members, visit the websites listed below.

JASON WEISS, the Jack and Kay Hockema Professor of Civil Engineering, received a 2014 Charles B. Murphy Outstanding Undergraduate Teaching Award, the University's highest undergraduate teaching honor. He was recognized for his keen knack for explaining complex topics in relatable, easily digestible ways.

http://www.purdue.edu/newsroom/purduetoday/releases/2014/Q2/murphy-award-winner-jason-weiss.html

CARY TROY, assistant professor of civil engineering, received a 2014 Exceptional Early Career Award for his enthusiasm for teaching and engaging with his students. Troy constantly looks for ways to enhance his teaching by creating a student-centered, active-learning environment.

http://www.purdue.edu/newsroom/purduetoday/releases/2014/Q2/exceptional-early-career-award-winner-cary-troy.html

BRIDGING THE KNOWLEDGE GAP

■ BY DELLA PACHECO

The CAI research team (from left to right): Undergraduate student Kyle Konz, graduate students Julie Whitehead and Luke Snyder, research engineer Tom Bradt, Professor Robert Connor, and research engineer Jason Lloyd. Purdue University photo/Steven Yang.

When most people think of a museum collection, images of Old Masters' works by Michelangelo, Rembrandt or other great artists come to mind. Robert Connor, associate professor of civil engineering, has a different vision.

Connor's vision would feature masterful works like a 1890s railroad bridge covered in rust. A portion of the collapsed I-35 bridge from Minnesota showing a failure. Fractured bridge girders. Cracked full-scale bridge decks.

Those pieces and more are part of the new Center for Aging Infrastructure (CAI), a first-of-its-kind center that will become the leading education, training, research and engineering center related to all aspects affecting the nation's infrastructure, Connor says. It is located on over 20 acres owned by Purdue just off South River Road in West Lafayette near the Purdue University Airport.

CAI includes the Steel Bridge Research, Inspection, Training, and Engineering Center (S-BRITE), which focuses on existing steel highway bridges. As part of S-BRITE, a Distributed Expertise Network (DEN) will bring together a group of highly specialized technical experts from across the country who will be " on call" to assist state departments of transportation as needed.

BACK TO THE FUTURE

The American Society of Civil Engineers' 2013 Report Card for America's Infrastructure gives the U.S. an overall D+ grade when it comes to addressing aging infrastructure. The report card gives a C+ for aging steel bridges. Of the more than 607,000 bridges in the U.S., one in nine is rated as structurally deficient. The average age of these bridges is 42 years.

Jason Lloyd, a research engineer working with Connor, says that many of the engineers that were around when most of the nation's bridges were built have retired or moved on from Department of Transportation positions.

"New engineers are not trained in the materials and methods of the old bridges," Lloyd says. "That causes a gap in expertise that can make it difficult for DOTs to manage their infrastructure. Many of the bridges are old enough now that they are causing problems."

To maintain the existing steel bridge inventory, expertise is needed in the areas of deterioration, fatigue, fracture, corrosion, coatings, riveting, welding, fabrication and more.

The idea for the center, Connor says, came to him about 10 years ago, but was reignited after a serious problem that occurred with the Sherman-Minton Bridge connecting New Albany, Indiana, to Louisville, Kentucky. INDOT inspectors discovered cracks in the load-carrying element of the bridge, which carries nearly 80,000 cars and trucks every day.

Connor says INDOT was being proactive in asking him how to make sure this didn't happen again.

"I identified areas where we could help them with professional training, research and general outreach while adding to our own students' knowledge," he says. "Say a bridge structure is being removed because of some type of damage. We take photos and show them in class, but I thought why not ask if DOTs would donate those pieces, the idea being to create a bridge component 'gallery' where we could display specific components with damage, repairs or even something that may not be damaged. Being able to get your hands on a real specimen can't be compared to looking at photographs, especially for our students."

INNOVATION LEADS TO IMPROVED PERFORMANCE

Jason Weiss, the Jack and Kay Hockema Professor of Civil Engineering, also sees many benefits for faculty and student researchers at the new center.

Three of his ongoing research projects will be expanded to include full-scale tests at CAI.

One project is evaluating the long-term performance of a new type of concrete called internally cured concrete. It has the potential to provide high performance, is long-lasting and is more durable and resistant to cracking than conventional concrete. Research started in the lab and funded by the Federal Highway Administration, Expanded Shale and Clay Institute, Indiana Local Technical Assistance Program and multinational company Lafarge is now being moved to full-scale testing at CAI.

In research sponsored by INDOT, samples that mimic bridge decks will be prepared at CAI to evaluate long-term durability to provide a link between laboratory tests and ongoing evaluations on bridges throughout the state. This work is garnering significant national attention and is pivotal to developing the "rule book" on when it makes sense to consider using internal curing.

The second project that began a few years ago in collaboration with Bernie Tao, professor of agricultural and biological engineering, is being done with support from the Indiana Soy Alliance, which has resulted in a Purdue patent. Weiss' team is developing a soy-based sealer that is spread onto the surface of concrete to make it more durable. "The soy-based sealer is made of soy products, it is biodegradable, contains no VOCs," he says.

The third project, in collaboration with Pablo Zavattieri, associate professor of civil engineering, Jeff Youngblood and Robert Moon, both associate professors of materials engineering, with support from the National Science Foundation, is evaluating the use of cellulose nano crystals to improve the strength and durability of concrete. Preliminary work has shown increase in flexural strength of 30 percent. While still in its infancy, this research has great potential to improve performance by modifying the nanostructure of concrete.

The challenge with conventional research is being able to monitor degradation of life-sized structural materials over time. CAI will eliminate this limitation to a large degree.

"We will also have unlimited access to the site for the design and monitoring of experiments," Weiss explains. "When you do something on a major Interstate, you can't just run out and see how the experiment is performing. Further, while we are fortunate to have many test sections with cities and towns through LTAP and on highways with INDOT, we cannot always push the limits on the material use to evaluate different failure limits. With CAI we have the potential to evaluate the materials to and through failure."

BY THE NUMBERS

The American Society of Civil Engineers in its 2013 Report Card for America's Infrastructure gave a C+ grade for the condition and performance of the nation's bridges.

OVER 200 MILLION TRIPS DAILY ACROSS DEFICIENT BRIDGES IN 102 LARGEST METROPOLITAN REGIONS

1 IN 9 BRIDGES ARE RATED STRUCTURALLY DEFICIENT

42 YEARS AVERAGE AGE OF THE 607,380 BRIDGES IN THE UNITED STATES

An important benefit also is the ability to correlate research findings from small-scale, accelerated tests with full-scale specimens to evaluate long-term durability of coatings and materials. Numerical models are being developed to make these correlations, and CAI provides the test bed to evaluate these predictions.

"In the case of internally cured concrete, we can dramatically extend the life of bridge decks," Weiss says. "Instead of replacing a bridge every 25 years, we might extend that to every 75 years. While the initial cost is slightly higher, there is a big payoff in savings, minimizing disruption to the travelling public, and safety." The site can be used for training on damage identification with visual or non-destructive techniques since several full scale models can be erected and be available for research and education.

ASSEMBLING THE COLLECTION

Part of Lloyd's duties is working with DOTs to identify, ship and stage pieces and oversee coordination and construction of research pads at the site.

The majority of the funding, about $900,000, is being provided by the Joint Transportation Research Program, a partnership between INDOT and Purdue. Another $400,000 in funding is being provided by the Federal Highway Administration and five additional DOTs — Kansas, Minnesota, South Dakota, Illinois and Iowa. The center is now in its beginning stages. Donated materials include a 65-foot span railroad bridge that was transported free of charge from Pueblo, Colorado, by CSX and BNSF railroads. Twelve-foot deep fractured steel girder pieces were delivered from Minnesota.

In addition, Steel Dynamics in Fort Wayne provided the steel to build a test bridge, and AZZ Galvanizing in Plymouth, Indiana, donated the steel galvanizing. This test bridge is part of the first research project at the site called

Researchers at the Center for Aging Infrastructure will cast sections of concrete, like those depicted here in the field, to evaluate the long-term performance of similar mixtures exposed to severe elements. This process can be used in model development and can be compared with field performance to better predict long-term performance. Photo provided.

the Probability of Detection Study. Graduate students Julie Whitehead and Luke Snyder are conducting research through the S-BRITE Center.

“We are looking at the probability of detection on steel bridge inspections,” Whitehead says. “We are looking only at visual inspections and collecting data on what inspectors are able to see — what size and type of cracks — and what kind of corrosion is present to determine how good they are at finding the damage.” She has developed a test that will be administered to inspectors on-site.

Snyder’s portion focuses on taking bridge details and introducing cracks and other flaws before assembling the details to create a bridge.

“By creating the cracks ourselves, we will have the ‘answer key’ as to the location of those cracks,” he says. “The answer key will provide us with helpful ways to identify where inspectors can look for cracks and what details to watch for.”

The goal is to assess where inspection is right now, change protocol and improve training so that inspectors are much better prepared to do their jobs in the field.

Connor says inspectors are told to look for fatigue cracks but they may have never seen them or know how to assess the extent of the crack.

“I look at them every day and do testing but they don’t,” he says. “If I wanted to show inspectors something on an active bridge on the Interstate, such as I-65, we would have to go there, close a lane, get lift equipment and expose participants to risks of working in traffic. By having a realistic model at S-BRITE, we can provide a realistic experience for the inspectors while enhancing their knowledge.”

“The girder pieces are suspended on the steel test bridge so that it is like a real bridge inspection in the field,” Whitehead says. “The inspectors will be out there in a man-lift, bouncing around in the wind like on a real inspection. At the site, inspections can be done at any time of the day or year — mimicking what inspectors typically encounter.”

Connor and his team worked with INDOT and the partner states to identify factors that cause problems for their inspectors in the field, and include those in the training modules. The first group of inspectors just completed training and additional groups will participate throughout the fall semester.

LONG-TERM GOALS

CAI will serve as a test bed for conducting research on aging infrastructure — encompassing design, development, and testing leading to new and improved infrastructure components. While the S-BRITE Center continues to assess and train today’s bridge inspectors, a long-term goal is to create the next generation of bridge engineers and inspectors who are properly educated to be effective stewards of the existing aging steel bridge inventory.

To that end, Connor hopes Purdue will offer a new minor or certificate in the area of transportation structures. High-quality short courses for professionals are being developed, implemented and are targeted for those individuals currently responsible for the existing infrastructure. The courses would go beyond the current National Highway Institute course level.

Plans include collaborating with external technical schools to develop a new area of educational expertise — the steel bridge infrastructure specialist. Connor says both one- and two-year degree programs are envisioned and would involve the development of several new courses within existing degree programs. ■

Efforts are underway to raise $200,000 in private support from industry leaders, foundations, alumni and friends to be used for construction of a permanent training building at the CAI site.

HUMBLE LEADERSHIP

BY DELLA PACHECO

Success can be defined by the attainment of wealth, position or honors. By those measures, Mamon Powers Jr. has achieved great success. But to him, real success is derived from customer satisfaction and giving back to others.

Soft-spoken and unassuming, Powers, president and CEO of Powers and Sons Construction Co. Inc., says the first time someone referred to him as a successful businessman he was taken aback.

"This was about 30 years ago," he recalls. "I was probably wrestling with myriad challenges, which are typical for any business. It occurred to me that success is a relative term and it's the description that others put on you rather than yourself. We're all successful to someone in some manner."

He believes that whatever success he has achieved is because of the people surrounding him.

"Without the support of the people in our company, our wives, my church, none of this recognition or success would really happen," Powers says.

Powers and Sons was started by Powers' father in Gary, Indiana. The company currently has offices in Gary, Chicago and Indianapolis. The younger Powers says it was inevitable that he would move into construction.

"It was in my blood," Powers says. "My grandfather was a home builder and minister in Mississippi and my father built homes in Gary."

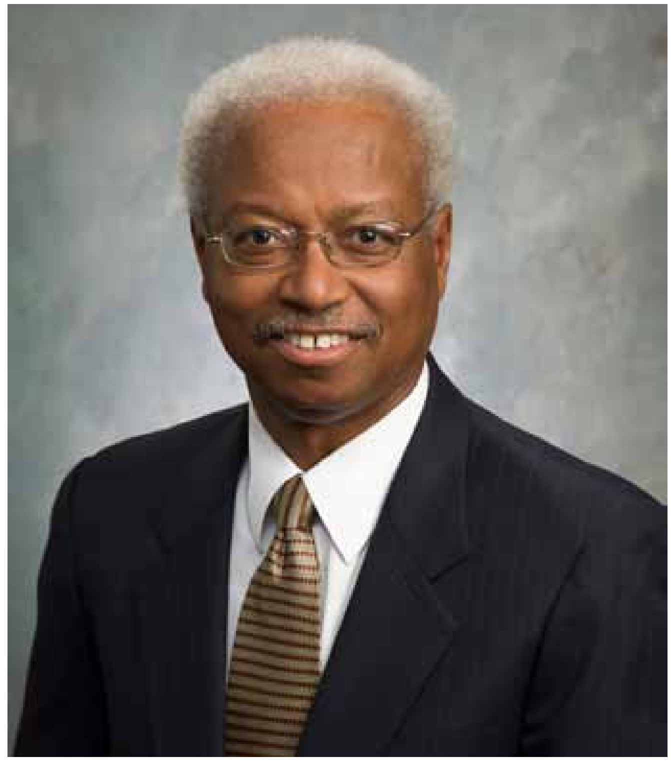
He began working for his father, Mamon Powers Sr., at the age of 11, first sweeping then later wielding a hammer on projects.

As he accompanied his father on building sites, he was able to see the correlation between mathematical principles he was learning in school and construction.

It was on a high school trip to Boys State at Indiana University that Powers realized the importance of equal access to the best education.

"In talking to students across the state, they asked us what high school we attended," Powers says. "It became apparent that they looked down on my Gary high school because we weren't receiving the same quality of education that other students were receiving."

When it came time to choose a college, Powers said he chose Purdue, a university respected worldwide.



Powers earned a BS in civil engineering in 1970. In 2002, he received the Purdue University Civil Engineering Alumni Achievement Award and a year later the Distinguished Engineering Alumnus Award from the College of Engineering. He received an honorary degree from the University this past May.

From 1996 to 2011, Powers served on the Purdue Board of Trustees. In his final term, he served as vice chairman of the board.

Earning Purdue degrees is a family affair. His brother, Claude, received a BS in building construction management; daughter, Kelly Powers Baria, obtained a degree in civil engineering; and son Mamon Powers III earned an MBA from the Krannert School of Management. All work with the firm.

Powers is often asked to speak to students about how to succeed in business. His message is clear: "Have passion and desire for your career. It's not how smart you are but how passionate you are about learning. And remember that the customer is always right."

He also points to the importance of supporting everyone within the company. "It's hard for me to say employee because it's not employer-employee. At Powers and Sons, we are team members. We believe we can do anything, and no obstacle is too large."

Several years ago, Powers spoke to a group of Krannert students. He teased them by saying, "I am going to share the latest and greatest new business technique."

"I got their attention," he says. "I paused and said, 'Do unto others as you would have them do unto you.' That says it all."

NUCLEAR KNOW-HOW

Research at Bowen Lab is furthering the next power generation.

■ BY WILLIAM MEINERS

From the left: Research engineer Tom Bradt, graduate student Jake Bruhl, research engineers Kadir Senerand Jungil Seo, Professor Amit Varma, and graduate student Zhichao Lai. Purdue University photo/Mark Simons.

The world is increasingly becoming fueled by nuclear energy. That call to power requires hands-on expertise from many engineering circles. Amit Varma, professor of civil engineering and University Faculty Scholar, is leading efforts to create efficient designs for nuclear power plants that are not just disaster-resistant, but disaster-resilient.

"Nuclear power can be an effective and efficient solution for a lot of the developing countries," Varma says, "particularly given the fact that many manufacturing jobs have gone abroad."

Factories require energy, of course, and nuclear energy is a viable source in places where natural energy sources, i.e., hydroelectric, solar and wind, are not available or feasible. With work supported by the National Science Foundation, U.S. Department of Energy, U.S. Department of Commerce, American Institute of Steel Construction and Canadian Nuclear Safety Commission, Varma and his team test structures at full-scale size in one of the few places in the world big and equipped enough to do that — Purdue's Robert L. and Terry L. Bowen Laboratory for Large-Scale Civil Engineering Research.

BUILDING TO SCALE AND TO WITHSTAND

It's often a matter of size when it comes to generating nuclear power. Varma says there are two types of plants on the nuclear horizon. The small modular reactors, currently subsidized by federal funding, would produce at a capacity of 50 to 200 megawatts. The other option is to build big.

"If you want to have a plant that's going to generate more than 1,000 megawatts of power," Varma says, "the question becomes 'How do we build such a large plant?'"

With so much capital invested in simply building a power plant, Varma has a role in speeding up the construction schedule. "If the plant is being built for more than a decade, you're not generating energy while you're building it."

In addition to getting a power plant, large or small, up and running more quickly, the question of safety always comes into play. Many of the questions these days center on the damage and failures of Japan's Fukushima power plants amid a March 2011 tsunami.

"The Fukushima plants were old," Varma says. "The next generation of power plants are designed to have passive protection in them. That means there is no external intervention needed for them to shut and cool themselves down."

By leaving no stone unturned, Varma's group can simulate the most horrific of accidents, where a plant can be faced with overheating from a thermal event while withstanding an earthquake. "We examine the performance of the structure to demonstrate that not only can it withstand those combined events, but it can also safely shut itself down," Varma says. "It's quite a bit of engineering and quite a bit of disaster resistance and resilience that we provide."

It may also be a matter of scale in a disaster scenario. The researchers can test for worst-case scenarios, but they're also looking beyond those scenarios as well. "We actually consider that a design necessity," Varma says.

BOWEN BREAKTHROUGHS

Drawn to Purdue a decade ago, in part for the chance to work in Bowen Lab, Varma has made the most of the world-class facilities, which allow for experimental research on a truly large scale. He has been instrumental in helping identify specific failures of aging construction, including what happened to the steel in the World Trade Center collapse of 9/11, and he has helped in the discovery and testing of new types of composite structures that can withstand both man-made and natural disasters. One particular breakthrough came with the use of steel-concrete composite walls, which are resistant to extremely high temperatures, blast and missile impact.

As researchers simulate and test large-scale structures, Bowen Lab has become a haven for engineering breakthroughs. "Simulations are great, but one test is worth a thousand simulations," says Varma, who believes they may be the only group in the world to test for a nuclear disaster in this way.

Beyond delivering on the promise to improve civil and nuclear engineering, young researchers at Bowen Lab are securing bright futures of their own. Varma has worked with nearly a dozen doctoral students, all of whom, he says, are a hot commodity.

Kai Zang (PhD'14), now working at Westinghouse and directly involved in the design of nuclear power plants, returns to Bowen Lab as often as once a month to check in on the latest research findings.

From a teaching standpoint, Varma hopes his students take away an understanding of the importance of experimentation, analysis and design, with design reigning supreme for a structure's ability to absorb and deflect damage without failing.

"In order to create a good design, you need to understand from the laboratory how these things fail," Varma says. "And since you cannot test everything, you need to have a good simulation to understand how." ■

Bending behavior and ductility of composite SC walls.
Purdue University photo/Mark Simons.

INSPIRED BY NATURE

Research team designing lightweight, stronger intelligent materials

BY EMIL VENERE AND WILLIAM MEINERS

Associate Professor Pablo Zavattieri and a team of researchers from University of California and Northwestern University have received a $7.5 million Department of Defense Multidisciplinary University Research Initiative (MURI) grant to uncover fundamental design rules and develop simple and basic scientific foundations for the predictable design of lightweight, tough and strong advanced materials inspired by a wide diversity of structures from plants and animals, including the mantis shrimp, toucan and bamboo.

The researchers will study more than 20 organisms, including mammals, reptiles, birds, fish, mollusks, crustaceans, insects and plants. Examples include lightweight, tough and durable materials with cellular structures such as the stem of bamboo; the beak of a toucan; layered structures from shells of marine snails and antlers from mammals; twisted plywood structures found in crustacean structures such as the club of mantis shrimp; and insect cuticles.

These structures are particularly interesting because they are composed of relatively simple biological materials such as keratin found in fingernails, yet display incredible mechanical performance. The team will also reach back in history, looking at dynamic evolutionary processes such as the structure of the extinct trilobite, which existed for more than 200 million years by adapting to its environment.

About nine years ago, Zavattieri began studying how shells, specially the nacreous layer of abalone shells, gain their toughness without sacrificing strength or stiffness.

"Materials in nature not only satisfy a structural function in many remarkable ways, but they also do more," Zavattieri says. "Materials can also sense, adapt and self-heal."

THE RESEARCH PROGRAM USES FOUR INTERWOVEN THRUSTS:

- the ultrastructural and mechanical investigation of these organisms.
- development of mathematical models of their structures and new design.
- fabrication of biomimetic structures that emulate features found in natural systems.
- theory-based designs in order to underpin their tough, strong structures.

Finally, the team will conduct comparative evolutionary analyses to pinpoint design principles that are unique and those which have arisen convergently.

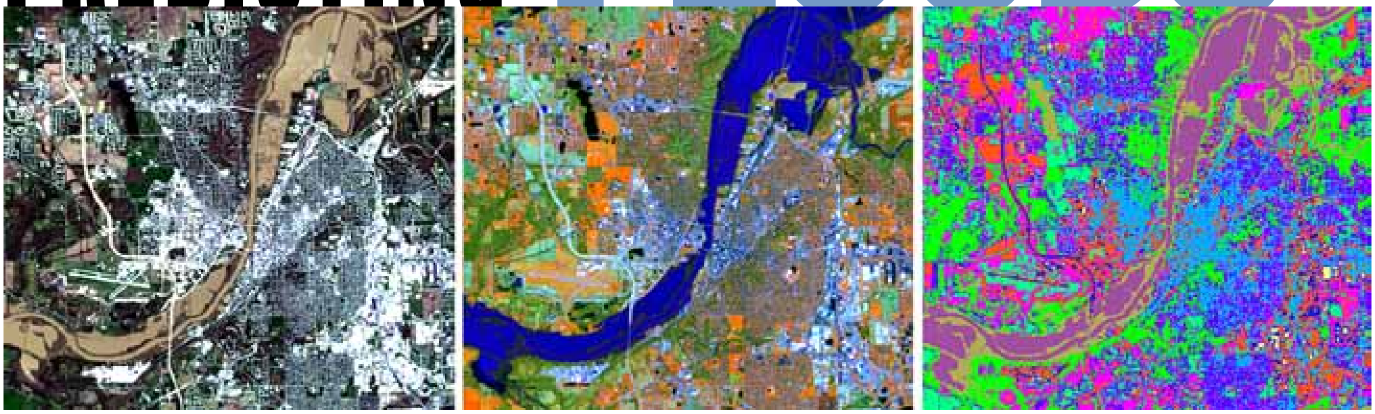
Zavattieri is providing multiscale modeling that offers unique insights into the deformation and failure modes within these structures and potential modifications for future designs.

> "INTELLIGENT MATERIALS AND STRUCTURES CAN SENSE DAMAGE AND EITHER ADAPT SO THAT THE LOAD PATH OF THE STRUCTURE CHANGES, OR SELF-HEAL, SO LIVES CAN BE SAVED."

He believes the materials we are seeing nowadays for our infrastructure won't look the same 20 years from now. In fact, he sees that "materials will have more functionality than just satisfying the structural purposes such as columns, beams and walls."

"Imagine a structure in danger of collapsing after an earthquake," he explains. "Intelligent materials and structures can sense damage and either adapt so that the load paths of the structures change, or self-heal, so lives can be saved. In those cases, only a few hours of structural integrity are needed until emergency responders can rescue people." ■

PREDICTING FLOODS



Geospatial research project opens significant data to people worldwide

BY GREG CLINE

A powerful Web-based system enabling people worldwide to better prepare for damaging floods and the potential effects of climate change is the goal of a $4.5 million, four-year National Science Foundation project.

The project will add geospatial data hosting, processing and sharing capabilities to Purdue's HUBzero, a platform for building feature-rich websites enabling research and education. This should open the way for easy development of a variety of Web-enabled tools for probing and presenting geospatial data in ways that can help address pressing issues in the United States and around the globe.

Geospatial data can include maps, aerial photos, satellite imagery, sensor outputs and almost anything able to be "georeferenced," or located on a map, from field-level crop yields and local population densities to regional weather and climatological records and the flow of trade in specific commodities across national borders.

"We want to have tools where people can integrate multiple data sets in the way they want and extract information based on these multiple data sets," says Venkatesh Merwade, associate professor of civil engineering and co-leader of the project.

Mapping such data, particularly in layers that integrate information on an array of factors and can show how they may interact, is a powerful way to glean new and improved knowledge from data collections and to explain the results to policymakers and the public.

The project should open geospatial data and sophisticated analysis tools — many of them common to a geographic information system (GIS) — to almost anyone, anywhere and allow ready sharing of data and results, as well as collaboration among users.

The geospatial data project stems from earlier, specialized projects involving HUBzero and focused on causes and effects of droughts, water resources, and agriculture, land use and the environment.

Additional co-leaders are Nelson Villoria and Purdue research scientist Larry Biehl. Villoria is an assistant research professor with the Center for Global Trade Analysis. Thomas Hertel, Distinguished Professor of Agricultural Economics and executive director of the center, is a project advisor.

Several partners, from K-12 educators to large NSF projects, have signed on to test the new geospatial tools as they become available. The Purdue researchers will work with the Geography Educators Network of Indiana (GENI) to provide school students with engaging online activities that improve comprehension of geography, GIS, remote sensing and other geospatially related topics.

Merwade's research involves building a hydrologic model of the entire Mississippi River Basin incorporating large amounts of data on weather, land use, topography, soil and more. On completion, the tool should allow users to generate stream flow projections and estimate when floods may occur anywhere in the Mississippi Basin, which encompasses all or parts of 31 U.S. states and two Canadian provinces between the Rocky and Appalachian mountains.

The new capabilities will be incorporated in the freely available open source version of HUBzero, making them accessible to current hub owners or those who want to build a hub.

A major HUBzero feature is its ability to make computational research tools, visualization capabilities and analysis of results easily available through a Web browser. The platform also offers data management and interactive database capabilities and simplified access to supercomputers and cloud computing. ■

MULTI-ENGINEERING MAGIC

Alumna helps to elevate the Disney experience

■ WILLIAM MEINERS

Like many aspiring civil engineers, Doreen Mitchell (BSCE '81) planned on building big city skyscrapers. But a professional twist of fate sent her to Orlando to help build one of the original pavilions at Epcot, which segued into nearly three decades of work at Walt Disney World.

Mitchell, who grew up in Addison, Illinois, says her skyscraper ambitions were on course when she accepted a job with a Chicago firm. The Florida assignment allowed her to work in the fast-paced, highly demanding world of Disney.

"I was thrown into things that I never expected to do right out of college," says Mitchell, who has been acting as Disney's vice president of Experience Development in the project management office for the past four years. "I was making schedules for a multi-million dollar project and managing change orders, which numbered in the thousands. Disney's desire to make things better and quick was a real challenge."

After helping to see the Epcot Imagination Pavilion to completion, Mitchell says, that drive for excellence, along with getting the "sand between her toes," put Disney in a very different light for her. She stayed in Florida and worked for some other contractors on Disney hotels. Learning the "Disney way" was instrumental in Mitchell's becoming a full-time employee, also known as a cast member, in the in-house engineering department in 1986.

"When I was in school, it was all about the technical details or construction schedules," Mitchell says. "As I grew through Disney, I found a lot of those things that work in engineering also work in leading an organization. Engineers want to make something better."

One recent effort to make things better revolved around the Disney experience. Launched this year, MyMagic+ is a major initiative designed to take the theme park experience to the next level. It extends throughout every aspect of a visit to Walt Disney World and encompasses the My Disney experience website and app and FastPass+, a way for guests to reserve select rides and shows in advance. Visitors can wear a MagicBand, which serves as a hotel key, ticket and access to FastPass+ selections. Walt Disney World Resort hotel guests can even leave their wallet behind and use it for in-store purchases.

Doreen Mitchell (BSCE '81)
Photo provided.

Mitchell led a team responsible for key deliverables. "It was an interesting time," she says, "especially with the software base and trying to understand how software development mirrors a construction schedule."

Mitchell's engineering education has served her well throughout her own Disney experiences. "It's those skills that engineers are ingrained with," she says. "There's a consistency of that problem-solving ability and methodology that helps us succeed."

To work for the company, admittedly not in her wildest imagination as a Purdue student, has become her dream job.

"Disney is a brand that you can respect not only as a cast member, but for what we represent for families," Mitchell says. "From a professional side, it's always been challenging. We continue to try and push the envelope and do something that nobody else has done before. It's also especially important in a place you've been for nearly 30 years to be able to continuously grow and reinvent yourself." ■