DEPARTMENT OF
Civil and
Environmental Engineering
UNIVERSITY OF WISCONSIN–MADISON

WINTER 2016
www.engr.wisc.edu/cee

Fiber-reinforced concrete developed in part by UW-Madison engineers protects The Lincoln Square Expansion in Bellevue, Washington, against frequent earthquake activity.
Photo courtesy of Cary Kopczynski & Co.

Wisconsin concrete innovation makes Seattle skyscraper stable

A UW-Madison engineer's solution for streamlining the construction of skyscrapers is having a skyscraper moment in one of the most seismically active regions of the country.

All coupling beams in the 1.5 million-square-foot Lincoln Square Expansion—which includes luxury condos, a hotel, dining, retail and office space in two 450-foot towers in the heart of Seattle suburb Bellevue, Washington—are made of fiber-reinforced concrete using a unique design co-developed by C.K. Wang Professor of Structural Engineering Gustavo Parra-Montesinos.

These concrete coupling beams span doorways and windows, helping walls with such openings in them to function as a single structural unit, while bolstering the building as a whole against earthquakes.

Traditionally, coupling beams are reinforced with a labyrinth of rebar, adding a great deal of time, cost and complexity to the construction process. "Placement of the rebar in these link beams can sometimes control the construction schedule," says Cary Kopczynski, whose Seattle-based firm is the structural engineering company for the project. "Most of the west coast of the U.S., of course, is a highly seismic area, so when you're building concrete structures, they require a lot of intricate rebar to carry the seismic loads."

As an alternative to excessive amounts of rebar, Parra-Montesinos' solution incorporates steel fibers into the concrete mix, and he and University of Michigan collaborator James Wight engineered that approach to create beams that equal or exceed the performance of cumbersome rebar designs, yet simplify and speed up the construction process.

The first real-world implementation of the coupling beam solution occurred a few years back. Kopczynski incorporated the fiber-reinforced coupling beams into a portion of The Martin, a 255-foot, 23-story apartment building completed in Seattle in 2013.

Kopczynski credits The Martin's owner and developer for taking a chance on a technology grounded in research, simulation and laboratory-scale testing, but not yet implemented in the field. "They were very interested in being innovative and embracing new technologies," Kopczynski says. "That project was viewed as being a huge success because it reduced the level of uncertainty that existed prior to actually using it." *(Continued, back page)*

David Noyce

Greetings from beautiful Madison, Wisconsin! I am pleased to share with you the many successes of our world-class faculty, staff and students in the Department of Civil and Environmental Engineering. In collaboration with our Geological Engineering Program partners, we continue on our mission to transform society through the creation, application and transfer of engineering knowledge. Our faculty continue to implement new and innovative methods to educate and inspire our students and create future leaders in our profession, community, state, nation and world.

As I reflect on the recent accomplishments of our department, I once again face the wonderful dilemma of having too many topics to mention in a single newsletter. Nevertheless, here are a few highlights. Faculty research awards are at an all-time high, supporting an extremely strong graduate program of more than 120 students. Our research contributions and leadership are impacting all areas of the world, including current activities in Africa, South America, Asia, Europe, and throughout North America. Our faculty are leading efforts to develop our nation's workforce, improve Wisconsin's transportation infrastructure, and identify new applications for recycled materials, and are on the cutting edge of the burgeoning developments in transportation as the world moves toward connected and autonomous vehicles.

We welcomed nearly 330 undergraduate students this academic year and student interest in CEE continues to grow. Our students continue to be active in the American Society of Civil Engineers, and are perennial finalists in the Concrete Canoe and Steel Bridge competitions. Our Construction Club hosts many professional speakers throughout the year and holds its wildly popular annual banquet in which we recognize construction industry leaders for their lifetime achievements. We continue to lead the nation in the percentage of students who successfully pass the Fundamentals of Engineering exam on their way to professional licensure. Thanks to the generous support of our alumni and friends, we awarded more than $120,000 in scholarships this academic year to support our undergraduate students.

As we move into 2016, our goal remains the same: to be recognized as one of the top departments of civil and environmental engineering in the world. Many areas of engineering are experiencing a renaissance as technology and societal needs rapidly change. Our faculty are at the core of this change, and are leading discoveries that cross disciplinary boundaries. We continue to enhance our curriculum, improve our nationally recognized capstone experience for our seniors, introduce makerspace facilities for collaborative learning and expand experiential learning opportunities.

The success of the research, teaching and service missions of our department is not achieved without the support of our excellent staff. Every day our team completes the many tasks necessary to keep all of us moving forward and I am thankful for all of the contributions they make. Additionally, we are fortunate for a wonderful group of adjunct faculty, commonly referred to as our "Professors of Practice." Not only does this group participate in our capstone and teaching efforts, they are a tremendous asset in helping our department understand critical needs in our profession. In times of limited resources, their voluntary contributions are priceless. I also look forward to working with our department's advisory board members during our meetings in April and November. Their support and advice allow us to build on the successes and strengths of our programs and department.

I will end by again thanking our generous alumni, emeritus faculty, and friends for your support, with which we continue to expand our global presence in critical national and international research. We created three new professorships, a broader array of scholarships, and support for ambitious renovations of our structures testing laboratory. Under the leadership of our director of development, Rob Herrick, we will explore new opportunities and support for our proposed water resources laboratory, student fellowships, professorships, and research innovation funds. Together, we empower our faculty and students to pursue some of society's most pressing grand challenges—and will ensure the Department of Civil and Environmental Engineering continues to remain among the best.

Hoping for your success in 2016 and ON, WISCONSIN!

David Noyce, Chair
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TWO CEE alums receive top college honor

On Oct. 16, 2015, during a daylong celebration of engineers, alumni Norman Doll and Malcolm Theobald were among 12 influential engineering alumni to earn accolades from the College of Engineering for their outstanding professional accomplishments.

NORMAN DOLL
(BSCE '77)
Chairman emeritus
Pieper Electric

Retirement as the chairman of an electrical and mechanical services contracting company hasn't slowed Doll down. Rather, it affords him even greater opportunities to apply his expertise in multiple service activities and to develop people in his community and around the world.

READ MORE:
go.wisc.edu/Doll-award

MALCOLM THEOBALD
(BSMineEngr '83)
Vice president, bits and advanced technologies
Schlumberger

After graduating in 1983, Theobald embarked on a long and diverse career with Schlumberger. In multiple roles, he worked on projects in places as close as Louisiana and as far away as Norway and the North Sea. In his current role, he oversees more than 3,000 employees and the development of sophisticated drilling technologies for some of the most challenging operations in the oil and gas industry.

READ MORE:
go.wisc.edu/Theobald-award

She's got drive:

CEE student athlete succeeds as civil engineer

Jacki Gulczynski, formerly No. 35 on the UW-Madison women's basketball team, spent the first four years of her education balancing the daunting schoolwork of a civil engineer and the dedication of a Badger athlete. "There's no room in the day for wasted time. That's the biggest benefit of being an athlete: learning to use your time effectively," she says.

At 6 feet, 2 inches tall, she stands out, sporting full-on Badger garb. She has an optimistic, relaxed demeanor and a confident, laid-back gait.

Gulczynski, who is from Carol Stream, Illinois, was recruited to UW-Madison the summer before her senior year of high school. She had no doubt in her mind that UW-Madison was the school for her. "When I came to visit, I knew right away that I wanted to come here," she says. "It had everything that I wanted. The engineering program had amazing facilities, there were good coaches, a good team, the university is beautiful. I was able to check off everything on my list, so it was an easy yes."

Gulczynski wrapped up her basketball career early in 2015 when her eligibility ran out after four years of playing. The highlights of her career are many. Among them: She was the first UW-Madison women's player to be honored as player of the week in all four seasons. She ranks fifth at the university for consecutive games played, at 114, and she played and started all 29 games in the 2014-15 season.

She's taken her fifth year at UW-Madison to focus on her experiences as a student, and to plan for a future career in transportation engineering. The summer of 2015 was the first summer when she wasn't training heavily with the basketball team, so after a weeklong interview process she accepted an internship with Kittelson and Associates Inc., a transportation engineering company, in Bend, Oregon, which Gulczynski refers to as the most beautiful place she's ever been. The company approached the internship like an entry-level position, and Gulczynski worked with other engineers in her office on different documents for design work, safety audits, and roundabout analysis, collaborating with people from across the country on various projects.

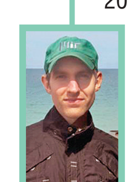
She realized that Kittelson also would be the right long-term fit for her as well. "It's a company that takes great care of their people, and that is more important than anything else. After going to their 30th year anniversary celebration, I could see how family-oriented this firm was, and that's really important to me," she says. She will be starting her career full time with the company in August 2016, after graduating in May of 2016.

For Gulczynski, her last academic year has been a much-needed growing experience. "I have had more time to dedicate myself to the future, and more time to just enjoy being here and being a student, just soaking it all in," she says. "I want to take in every single moment of these last couple of months before I graduate. You're only in college once, and going through basketball, things go by so fast that you kind of miss things. Now I can kind of just sit back and enjoy it all, watching from a distance instead of being on board."

Although she misses being out on the floor and playing, the past year as a normal student has given her much needed perspective on her future. As a result, she has developed her passion for the field of transportation and better prepared herself for future endeavors.

"In transportation, I feel like you can really make a difference. If you can make a road safer, you're benefitting society. It's not sitting in a computer lab all day; it's getting out, meeting with clients, meeting with the public and really making a difference in the community."

Young alum makes ENR top-20 list in NYC



Architect Steve Preston (BSCE '04, MSCE '06) is among 20 promising young professionals under age 40 cited by *Engineering News Record New York* for the impact they are making in their developing careers. A junior architect with GLUCK+, Preston worked on the first LEED Gold high-rise residential project in Philadelphia. He also volunteers with the Leukemia and Lymphoma Society, to Big Brothers and Sisters of America, and with the East Harlem School, where he is a tutor.

Multidisciplinary team draws on campus building to study challenges in geothermal

In the morning hours of early October 2015, graduate students Christian Herrera and Adam McDaniel could be spotted in an excavated area outside of the Wisconsin Institutes for Discovery (WID) Building on campus, wearing construction hats and maneuvering what appeared to be a high-tech fishing pole.

McDaniel, a graduate student in geological engineering, and Herrera, a graduate student in mechanical engineering, are investigating recent issues with the WID geothermal system. A geothermal system is an innovative, energy-efficient way of heating and cooling a building that pushes heat from the building into the ground during the summertime and absorbs heat from the ground during the winter using a mechanical system referred to as a "heat pump." The heat exchange with the ground is enabled by a "geofield" and at WID, the geofield consists of a network of deep wells.

Shortly after the building was completed, the UW-Madison campus district cooling system went down. And despite the fact that the WID heat pumps were sized to carry only a fraction of the building's overall heating and cooling load, at that point, the pumps cooled the entire building.

However, they also sent an excessive amount of heat into the ground, causing temperatures in the ground to spike. Since then, it has taken an unusually long time for that ground temperature to return to normal, and the graduate students are part of a team studying the functionality of the system, as well as the geological conditions of the ground surrounding the building.

Christian Herrera and Adam McDaniel

The students' "fishing pole" was actually a thermal probe that measures temperature at different sections underground. During a two-week period in early October, crews unearthed a portion of the geofield to enable the students and their faculty mentors to perform a battery of tests to gather data that may help explain the field's sluggish response.

Among a list of data collected by the students was the ground temperature profile throughout two of the geofield's excavated bores. "We found that it's hot in the middle, and also at the very bottom of the two bores we measured. Each bore seemed to cool down faster at the top," says McDaniel. "We're planning on using this data as part of a model of the WID's geofield."

The researchers now know, based on initial ground thermal connectivity tests, that the problem isn't as much the performance of the various heat pumps or the system design, but of the geofield itself. Yet understandably, it's not an easy feat to dig up the field every time they need to perform a new test. So during the excavation, the researchers also installed new valves and piping that will give them permanent access to the geofield in the future. This unique feature will enable current and future researchers to investigate a wide range of aspects of this type of geothermal system.

The project has prompted both the geological engineers and the mechanical engineers to puzzle the big question: Why is the high ground temperature persisting?

Douglas Reindl, a professor of mechanical engineering and engineering professional development and Herrera's mentor, speculates the high temperature has something to do with the innate characteristics of the campus geology, since the geothermal system itself seems to be mechanically sound. UW-Madison sits on an isthmus between two lakes, and the location may have unique ground properties that may work against a geothermal system.

"In collaborating with geologists on the team, one possible explanation of the slow rate of ground temperature recovery is the presence of a huge amount of subsurface perched water that was initially heated up during a period of intense heat pump operation," Reindl says. "Once a perched reservoir is heated up, it just takes a long time for the absorbed heat to dissipate."

Now, the researchers are analyzing the geofield with a thermal response test (TRT) rig with a fiber-optic probe attachment, which will yield a much more complete temperature profile of the field.

In addition to Reindl, the research team includes geothermal expert Jim Tinjum, an associate professor of geological engineering and engineering professional development, and John Nelson, an adjunct professor of civil and environmental engineering. Kristin Murray and Erin Badger of the Wisconsin Alumni Research Foundation (WARF), and Todd Kiley from the campus facilities planning and management unit, provided essential support of the research team. WARF also provided funding for the fieldwork

Harrington offers primer on energy usage and drinking water

In January 2015, the U.S. Environmental Protection Agency (EPA) estimated that a staggering $2.6 billion worth of treated drinking water is lost each year due to leaking water mains and approximately 240,000 main breaks. To address this problem, the agency proposed that more than $600 billion be invested in water infrastructure improvements over the next 20 years.

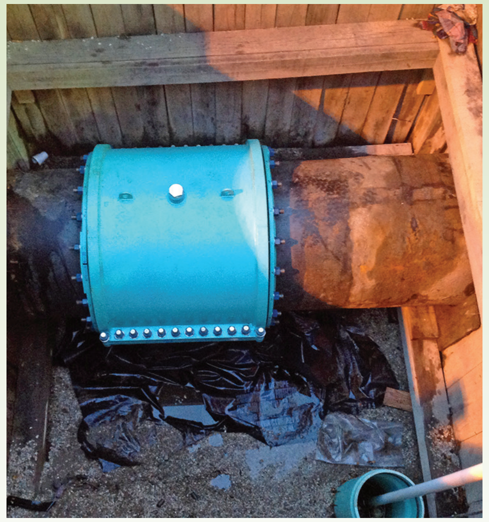
These numbers don't surprise Professor Greg Harrington, who is an expert on our drinking water infrastructure. He knows better than most people the importance of the public water utility, and the tremendous role it plays in keeping everyone safe.

In 1993, more than 400,000 Milwaukee residents got sick from drinking their tap water due to an outbreak of the parasite *Cryptosporidium*. The largest known waterborne disease outbreak in U.S. history, this incident spurred an investment of $89 million in upgrading the city's water treatment plants during the next five years.

Harrington conducted research on new water treatment technologies in the aftermath of Milwaukee's *Cryptosporidium* outbreak, and says that "Wisconsin's water utilities became leaders in the nation in implementing new water treatment technologies."

But the EPA's concerns about infrastructure are also Harrington's. Water treatment technology is important, but upgrading the water delivery grid is equally as important, both for public health reasons and for conserving energy.

Many of the nation's water pipes were either installed more than a century ago or right after World War II. Leakages or water main breaks are one consequence of the deterioration, or corrosion, of these pipes since then. "The more corroded a pipe is, the more likely it is to break," Harrington says. "The material they used for pipes in the 1940s tends to break the most."



Problems with Milwaukee's aging water infrastructure became more apparent in the severe winter of 2013/14 when MWW repaired a record number of 724 water main breaks.—

Courtesy of Mid City Plumbing & Heating Inc.

Courtesy of Milwaukee Water Works

Professor Gregory Harrington's research helped Milwaukee Water Works (MWW) develop cutting-edge drinking water treatment technology after the city's 1993 Cryptosporidium *outbreak. MWW treats Lake Michigan surface water at its Linnwood and Howard Avenue plants.*

But another consequence involves public health: Even if old pipes don't break, they might contaminate the water they carry.

Up until the 1950s, lead was a commonly used material for service lines, or pipe sections that connect the water main to a consumer's home. The corrosion of these lead service lines may result in dangerous levels of lead leaching into drinking water, which can cause irreversible brain damage in children.

Many utilities have employed chemical corrosion control to reduce lead leaching, but Harrington says the best long-term solution to this problem is replacing all lead service lines with newer pipes made of plastic or copper.

Since both water treatment and water pumping require substantial energy, one of the best ways for water utilities to conserve energy is to minimize water loss by upgrading the water delivery grid.

But Harrington also emphasizes that a utility's energy use for water quality assurance and infrastructure maintenance is a fixed expense unrelated to the amount of water delivered to a home. Since this expense has to be recovered from monthly water bills, a 50 percent decrease in a customer's water use may not translate to a 50 percent decrease in their water bill.

"There is a lot of customer education that has to take place," Harrington says.

Ethiopians look to Madison to reclaim bicycle-friendly culture

Yimer Degu Ayicheh, a researcher from Bahir Dar University, visited Madison to experience its bicycle culture as Bahir Dar works with UW-Madison researchers to reclaim its bicycling culture.

When the city of Bahir Dar, Ethiopia, looked for a way to reclaim its bicycling culture, it looked to UW-Madison, an institution located in the midst of a bike-friendly city, and found a dedicated bike enthusiast to lead the charge.

"Bicycling is a historic culture for Bahir Dar city," says Genet Gebreegziabher, director general of regional urban planning for the Amhara region that includes Bahir Dar. She and several university and government officials visited Madison recently to meet with city and university representatives.

UW-Madison Global Health Institute (GHI) Director Jonathan Patz, the John P. Holton Chair in Health and the Environment and an international authority on biking's health benefits for people and the planet, has been a champion for the project. Patz and Assistant Scientist Jason Vargo from GHI and the Nelson Institute for Environmental Studies, are working with the Department of Civil and Environmental Engineering and leaders from Bahir Dar University (BDU), Bahir Dar and the Amhara Region to develop a bicycling plan for the city.

Bahir Dar is a lot like Madison—a university city on a lake, where children, students and young professionals are ready to ride bikes to school, to work and for pleasure. Eight years ago, 30,000 people rode their bikes regularly. That number has dropped to 10,000 with the arrival of bajajs, three-wheeled, motorized taxis that clog city streets and zig and zag through traffic, causing accidents.

What Bahir Dar doesn't have—but is looking toward–is roads made safe for bikes, bike-sharing programs and a bike industry."Most people want to bike, but they fear accidents, so they lost this habit. This project will help us continue this habit for the city and protect our environment," says Gebreegziabher.

Getting it all right the first time

Bahir Dar represents an opportunity for planners to make existing roads safer and plan new routes that accommodate all forms of transportation before they lay any asphalt, "Cities in Europe and America are seeing that designing cities for only motor vehicles is short-sighted," Patz says. "Why did we give up bicycles? We're trying to get back to building streets the right way, which is not just for motorized vehicles.

"(Bahir Dar) is an opportunity to design the city expansion right the first time. This used to be a bike-friendly city. There's a demand to reclaim that."

Like Patz, CEE Professor David Noyce sees an opportunity to learn from what the United States did right—and wrong—as cities expanded in the '50s and '60s. "Civil and environmental engineering is at an interesting time," Noyce says. "When you look at the world's issues—water, transportation, energy—civil and environmental engineering is in the middle of it. This project is an opportunity to help shape the future of a developing country."

Patz and Vargo met in June with Bahir Dar's mayor, BDU's president, heads of urban development, roadway authorities and the president of the Amhara Region. They shared possible bike lane solutions with Noyce before they left and looked for his advice on a related bridge project.

In Ethiopia, they found the political will to move forward. "Imagine the (Wisconsin) governor coming to a meeting about improving the bicycle culture of Madison and saying, 'We have to do this,'" Vargo says.

That was what happened at the Bahir Dar meeting.

Checking out bike-friendly Madison

BDU's Yimer Degu Ayicheh had a chance to ride a bicycle again when he visited UW-Madison in October to plan a pilot bike lane project for Bahir Dar.

Bicycling was a way of life for Ayicheh, but he sold his bike because he feared accidents. The Bahir Dar University, Bahir Dar Institute of Technology, Faculty of Civil and Water Resources Engineering lecturer and former chair of geotechnical and highway engineering was on two wheels as he and Vargo toured Madison from the university to city hall to bicycle shops and to see former Madison Mayor Dave Cieslewicz, now executive director of the Wisconsin Bicycle Federation.

The bicyclists checked out commuter crossings, automated bike counters and how intersections are engineered to safely accommodate bicycles and motor vehicles. Ayicheh rode on Madison's bike lanes on busy and not so busy streets. "Now I can see it and feel it," he says. "(The bike lanes) are so good, and I feel safe."

He also used B-Cycle and would like to implement a bike sharing program in Bahir Dar, as well as establishing a bicycle factory.

Bahir Dar's terrain is flat, and the climate is temperate, perfect for biking. "If we make something protected and safe, definitely people will bike again," Ayicheh says.

ANDREA HICKS

As an industrial ecologist, Andrea Hicks specializes in quantifying the environmental impact of products and processes, using tools such as life cycle assessment. Enter the complex math of stochastic modeling, which is just one method of assessing a product's societal-level environmental impact throughout its whole lifecycle—from raw materials to use to the end of its life.

One area she's particularly interested in assessing is products of convenience—for example, single-serve coffee pods.

Hicks, who earned her PhD in civil engineering from the University of Illinois at Chicago, also studies the environmental impacts of various consumer products, such as fluorescent and LED light bulbs or products that incorporate nano-silver.

READ MORE:
go.wisc.edu/more-hicks

HIROKE SONE

While at Kyoto University, where he completed bachelor's and master's degrees in geology and mineralogy, Hiroki Sone studied the mechanics of a thrust fault in Taiwan linked to hazardous earthquakes. Later, while at Stanford University, Sone continued his research on fault mechanics as a PhD student, He also began doing experiments on shale gas reservoir rocks to characterize their basic qualities, particularly creep deformation.

Now, while Sone's research interests continue to include experimental rock mechanics and their application to both the understanding of earthquake-prone faults and of shale gas reservoirs, he is beginning to explore engineering problems like those posed by nuclear waste disposal.

Because clay-rich shales are less porous and have the ability to flow slightly, Sone says they have the ability to self-seal if fractured. Those same rocks also tend to adsorb excess moisture and contaminants that might otherwise leak through other rock types.

READ MORE:
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Environmental reunion!

Save the date for the 3rd International Reunion Conference on Environmental Engineering—**June 23-24, 2016.** All alumni and friends of CEE are invited to attend two days of presentations on all areas of environmental engineering. The reunion will also include a banquet, picnic, tours, and student poster sessions. Visit **go.wisc.edu/p8gon8** for more information as it becomes available.

ALUMNI NEWS

Alumnus honored at the White House for bridge invention

Habib Dagher (MSCE '82, MSEM '84, PhDCE '85) was honored at a White House ceremony in October 2015 for the composite arch bridge system he invented. He was recognized as a 2015 White House Transportation Champion of Change. The bridge system, also referred to as a "Bridge-in-a-Backpack," involves innovative arch bridge technology. Lightweight and corrosion-resistant, it uses composite arch tubes that are initially packed flat into a bag. They are transported, inflated and bent over a mold, and then infused with a resin, which cures in a matter of a few hours. The result is a lightweight curved hollow arch twice as strong as steel. Contractors fill it with concrete on site.The bridges have been installed in 18 locations in the United States and beyond.

Dagher is the founding director of the University of Maine's Advanced Structures and Composites Center, an effort that includes 180 faculty, staff and students. Dagher, who was nominated for the White House award by the American Society of Civil Engineers, is named on 24 patents and has eight patents pending.

CEE GOLF OUTING!

September's 19th Annual CEE Golf Outing and 19th Hole After-Party was a huge success. More than 200 alumni and friends of CEE came together to support our students and program. Thanks to this year's generous sponsors, we were able to raise almost $60,000. **Save the date for next year's outing, September 16, 2016**, which will mark the event's 20th year. We are planning a huge celebration and an even bigger after party. Check back to **www.golf.cee.wisc.edu** for updates.

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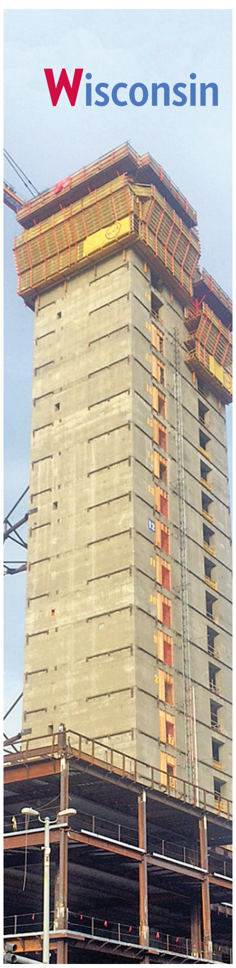

Wisconsin concrete innovation *(Continued from front page)*

This time around, the teams behind the Lincoln Square Expansion embraced the coupling beam technology because of the overwhelmingly positive feedback they received from crews who worked with it on The Martin project, says Kopczynski.

"The reason we're using the new coupling beams is that they're faster, less expensive, and reduce the potential for field mistakes," he says. "With traditional coupling beams, it's very common to have placing mistakes in the field because of all of the intricacy. Now, not only can we build the building faster and more simply, but we can reduce the potential for field errors."

Because the new technology is not yet included in the American Concrete Institute's building code—which sets the agenda for the concrete construction industry and its regulators—both buildings have had to pass muster with outside peer reviewers engaged by local officials.

Parra-Montesinos hopes it will be included in the next edition of the code, which is due out in 2019. "I think we've come up with a very robust design," he says. "We just need to be able to specify the minimum performance requirement for the fiber-reinforced concrete based on standard material tests."

Currently, with funding from the Charles Pankow Foundation and other industry partners, Parra-Montesinos and his students are studying other types of steel fibers incorporated into the concrete in various quantities.

"Ultimately, we expect to establish a link between material behavior and seismic performance of the coupling beam so that users are not required to use the same fiber and in the same amounts as we used in our past research," Parra-Montesinos says. "This is a required step to develop design provisions for the building code."

His research emphasizes large-scale physical testing, an approach that is helping the construction world catch up to the promise of fiber-reinforced concrete.

Para-Montesinos

Kopczynski recognizes that potential, and he looks forward to seeing the new coupling beams become more widely adopted in skyscraper construction.

However, he says, a greater payoff will occur when innovative structural engineers like Parra-Montesinos develop ways to incorporate fiber-reinforced concrete into other key building components. "Then, we could potentially start reducing the reinforcement-bar requirements throughout the entire core of the building, and that would have an impact in a very positive way on the way we build concrete buildings," Kopczynski says.