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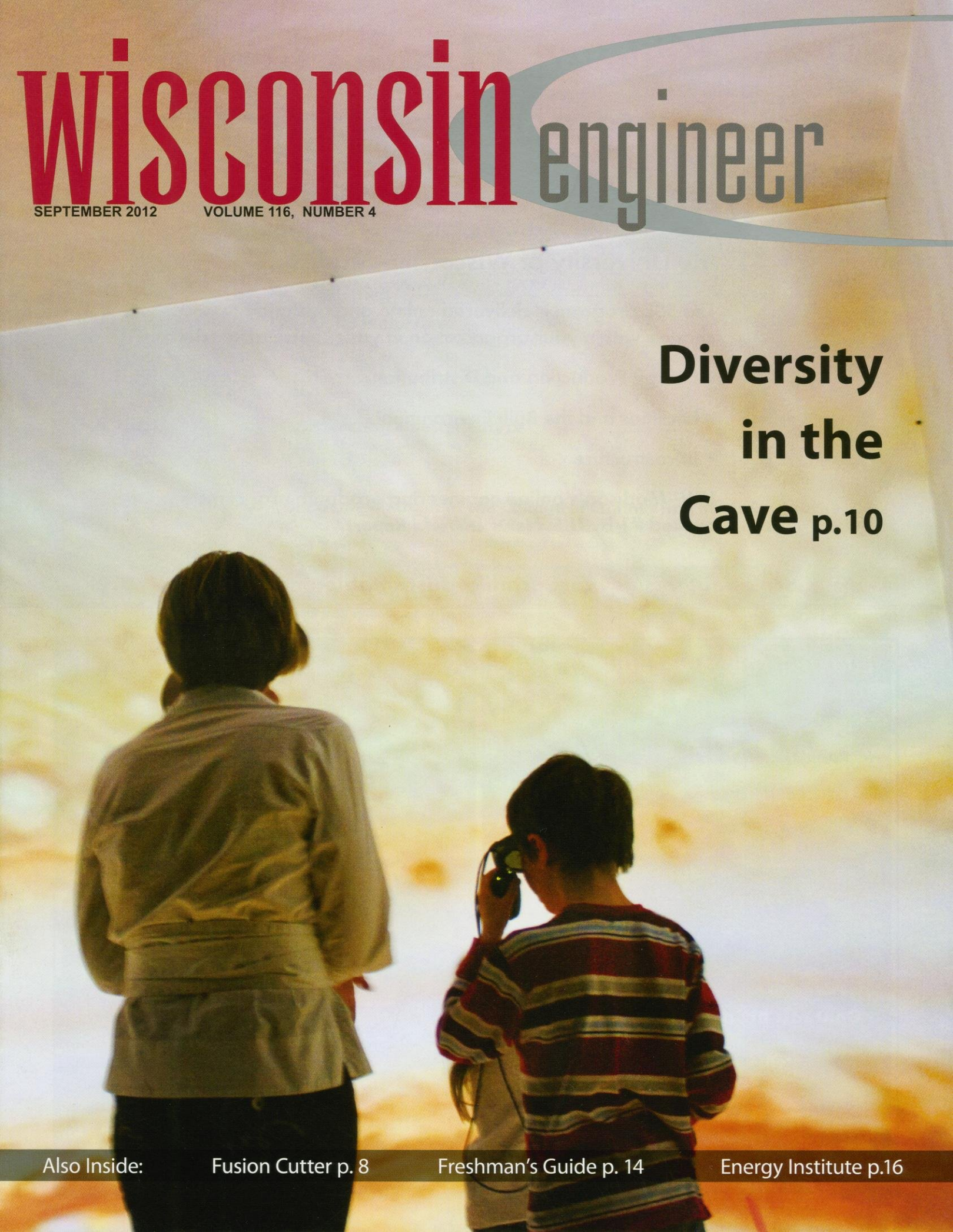
wisconsin engineer
SEPTEMBER 2012 VOLUME 116, NUMBER 4

Diversity in the Cave p.10



wisconsin engineer

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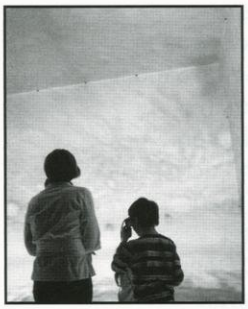
Feature

General



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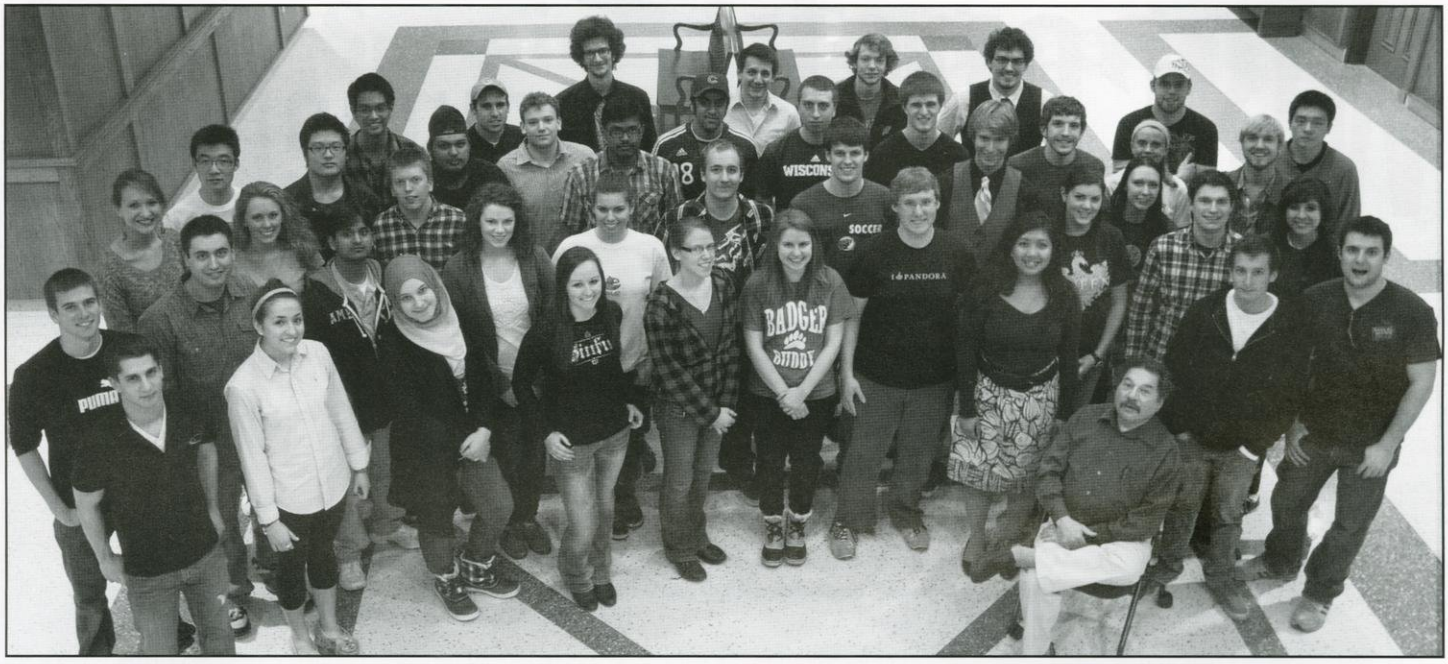
Jake Rohrig

Commentary

Wisconsin Engineer Staff



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Every new school year starts more subtly than the last. In kindergarten you get your Lion King backpack, brand new shoes with the curly shoelaces, a bright new hair scrunchie and a 36 box of crayons. If you're lucky you'll get the box with the sharpener. You make a ton of friends and run home to tell your parents everything you learned on the first day. First grade rolls around and you get another new box of crayons, but you still have to use your backpack from last year and there's no naptime anymore. When you reach third-grade you aren't coloring or doing addition anymore, so you need real supplies, notebooks, folders, pencils and most importantly – gel pens. At this point you also have to find out how to hide your Tomagachi because if your teacher confiscates it your digital friend would certainly die during the day. Pretty soon you reach middle school and you start hitting it off with musical instruments and new languages. Although exciting, at this point in your life the most important language seems to be instant messaging; you'll figure out Spanish and German later. You are also more concerned with concealing your phone in class than with learning every country and its capital in geography.

As you continue on to high school, the first day is exhilarating but it's also a lot more frightening than kindergarten was. You have no idea what you're getting into and if your first week goes poorly it could set the stage for all four years. Your newest tool is the graphing calculator. It's more than just a calculator, it has games, a periodic table and you can write notes to pass to friends when they borrow your calculator because they "forgot theirs". Then you realize that your most exciting first-day-of-school tool was a calculator. What happened to the scrunchies, crayons and new shoes?

College comes along and you start all over. Freshman year is analogous to kindergarten where everything is new, exciting, you want to meet everyone and have a million best friends. Sophomore year comes and it's similar to middle school. You're really excited to see your friends, but have no interest in your classes. Junior year rolls around and you're back in high school. Every decision you make is going to affect your ENTIRE future. One bombed exam may mean that you never find a job. By senior year, you finally start to balance everything out. Don't worry, it only took 15 years of schooling, but you did it. It's thrilling to be back at school to see your friends, but you are able to reach out and make new friends too. You know education is important and you study hard but you don't sweat one bad exam, you'll just have to make it up on the next one.

I was always told not to rush through college and to take advantage of everything there is; up until now I thought that was exactly what I was doing. What I have come to realize is that college would not have gone so smoothly for me if I had started the same way I left off senior year of high school rather than going back to the mentality of kindergarten. I believe that each step has been a very important part of my journey. The good news is that the third giant leap gets easier. Whether going on to graduate school, traveling or beginning a job in the real world, by the end of our college careers we will be experienced at fresh starts. We've finally figured out at least the basics of how life works, even though there is so much left to learn. For those of you moving toward graduation this December or next May, The Wisconsin Engineer Magazine wishes you the best of luck (and don't forget to buy a subscription from us!). For those just starting out here at UW-Madison, we truly wish that you enjoy reliving the thrills of kindergarten, middle school and high school all over. Hopefully everything goes just how you want it this time around, and if it doesn't, the third time's a charm. WE

Correction: It has come to the attention of the Wisconsin Engineer Magazine of a misprint in the story short "Think. Before you stick" in Volume 116, Number 3, where "Singapore, China" was published instead of solely "Singapore." We appreciate the feedback from our readers.

Constructing a Better Future

The term "build a better future" can be associated with a lot these days. Most associations cannot fit this term in both the literal and figurative sense of the phrase, but the UW-Madison Construction Club Banquet fits this term to the core. This banquet brings together students and industry leaders to celebrate progress in Construction Engineering and Management (CEM). It brings together a rare combination of both the leaders and aspiring students of an industry to focus on building a better future.

The Construction Club's history has been vital to its success today. The club began long ago in the College of Agriculture and Life Sciences. In the fall of 1997, the club was moved to the College of Civil and Environmental Engineering. Professor Awad S. Hanna led the club. The founding members included Julie Heinrich and Chris Kirkwood. In the spring of 1998, the first Construction Club banquet was held. This was the first major event that the Construction Club had put on and with 215 attendees they deemed it a success. The club has continued to grow and now hosts about 300 people at each banquet. In 1998, there were about 40 paying members. Since then, further development included the opening of student chapters of the Associated General Contractors of Wisconsin (AGC), the Mechanical Contractors Association of Wisconsin (MCA) and the National Electrical Contractors Association (NECA). These chapters have also aided the Club in gaining national attention in the construction community. These organizations are always working to make it easier for students to get involved and will grant funds to students to attend their national conventions when available. Today, the club is still expanding and gaining attention.

This year's Construction Club Banquet took place on Friday, March 23rd. Both students and industry professionals attended in high numbers. This business-casual night offers the chance for students to share an evening with leaders in the construction engineering and management fields. The evening allows for students to talk to professionals in a more formal setting. On top of that, a booklet full of the students' resumes is sent home with every employer. Many employers and students take advantage of this great opportunity.

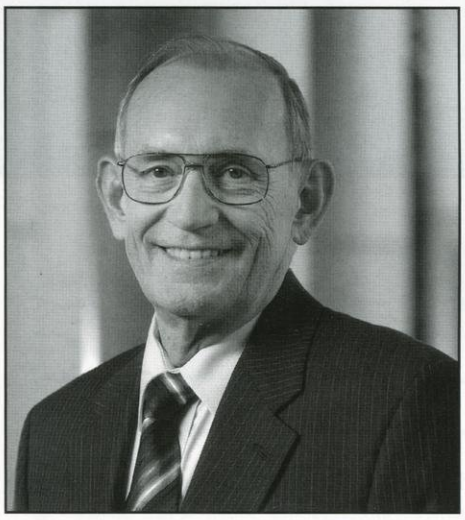
The night begins with a presentation of lifetime achievement awards. This year, four lifetime achievement awards were given to Jeffery S. Russell, Curt Hastings, Dr. Refaat Abdel-Malek and Richard Pearson. Also, there was a keynote speech from Philip Bernstein on Technology Innovation Beyond Building Information Modeling (BIM). Within the closing words of the banquet, the 2012 Construction Club Banquet was deemed another success.

Together, the students of the Construction Club and the professionals who attend the banquet can build a better future. The success and credibility of the Construction Club today is because of the students, many of whom go on to hold jobs with the companies that are in attendance at the banquet. In truth, this banquet is more than just a night out; it is a great resource for employers and students. WE

Written by: Patrick O'Donnell
Photography by: Sommer Ahmad
Design by: Songkhun Nillasithanukroh

The Game Changer of the College of Engineering Steps Down

Our years as undergraduate college students are some of the most influential times of our young lives. This is when we really determine our career path, push our capacity to study and work, and learn how to burn the midnight oil longer every semester. At this point in our lives, we need leaders ensuring that our hard work is producing the best possible education. In the UW-Madison College of Engineering (COE), Dean Paul S. Peercy has been doing just that for the past thirteen years.



Dean Peercy has worked diligently to create an atmosphere in which each student can succeed. Through fundraising and expansion, he has created a college where engineers, especially as undergraduates, can thrive and grow into their professional careers. Dean Peercy, who announced in spring 2012 he would retire following a national search for his replacement, will leave behind a legacy of advanced programs and improved resources for students and faculty to enjoy for years to come.

Dean Peercy's success stems from following through on a clear vision for the college. In an interview with The Badger Herald, he said that one must "set a well defined strategy and [have] a clear vision of what you want accomplish." According to Professor and Associate Dean for Academic Affairs Steven M. Cramer, Dean Peercy has effectively shared his vision with the college's alumni and industrial partners, leading to stronger relationships and consistent investments back into the college.

Dean Peercy has been a champion of academic innovation, leading years of reform efforts through the popular "Engineering Beyond Boundaries" initiative, which has funded more than 50 teaching and learning projects. He also supported the transformation of the fourth floor of Wendt Library into the Wendt Commons Teaching and Learning Center. This addition allows students to feel like they are in a more open environment, rather than having to sit in back corners among the bookshelves. It also serves as a group study floor, which now also houses the Student Tutor and Supplementary Instruction Center. The center has become not only a tool for those who are struggling in a class, but a resource for all students, even if they have one homework question or want something explained differently.

Under Dean Peercy's leadership, attitudes about tutoring have changed in a positive manner. The renovated fourth floor of Wendt has not only become an excellent place for engineering students to receive help and study in groups, but it has encouraged non-engineering majors to enter 'this side of campus.' This encourages students from multiple disciplines to interact, which has been another goal that Dean Peercy has sought over his term here.

In addition to changing College of Engineering's internal workings, the Dean collaborated with other highly ranked colleges within UW-Madison. According to Professor Molly Carnes from the Department of Medicine, "Dean Peercy has been a champion at working with schools across campus." Professor Carnes has worked with Dean Peercy on projects between the two schools and has overseen different projects with other schools such as the School of Nursing and the School of Pharmacy. To name a few "cross campus" projects, the Engineering Physics department is working with the UW-Medical School to create advanced forms of radiation treatments. Another involved the Department of Industrial and Systems Engineering, where researchers worked to improve safety of various medical products produced at UW-Madison. With these projects and Dean Peercy's continuous efforts to break down barriers between departments and colleges, UW-Madison was one of seven sites nationally awarded the Interdisciplinary Training Program Grant.

Dean Peercy has worked hard to improve some of the core outcomes of the College of Engineering. Besides turning sentiments around about tutoring and removing barriers between other colleges, our dean has also been working to improve student retention rates. When Dean Peercy first arrived at UW-Madison, students would immediately go into their chosen branch of engineering in their first year, making it more difficult to change majors down the road. This resulted in students switching to other majors rather than staying with engineering. Dean Peercy advocated curriculum changes that led to a common first-year academic experience across all departments, allowing engineers to switch if they so choose. As there are multiple majors within the COE that many students haven't even heard of when starting college, this opportunity is extremely important.

It has been comforting for students to know we have a dean who is constantly working to ensure that we have the best education possible. He has encouraged continual change to ensure the college stays up to date and current in this ever-changing world. Through expanding COE resources and improving some college core outcomes, Dean Peercy has left his mark and will not be forgotten.

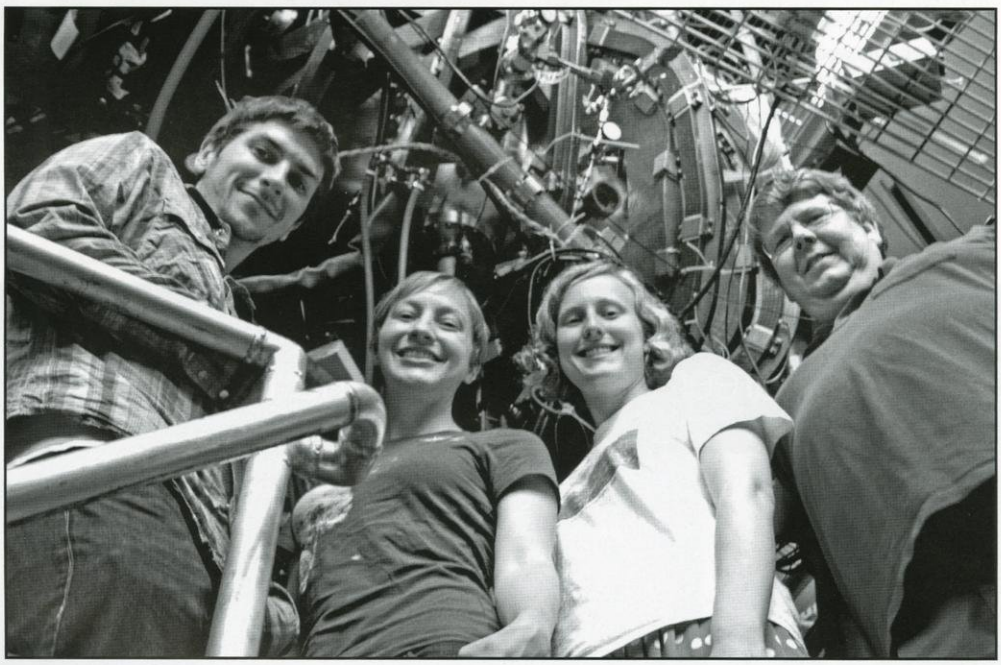
A search committee was assembled in spring 2012 to choose a new dean, and the committee is expected to identify a group of finalists during the fall semester. We all look forward to seeing who will have the opportunity to carry on what Dean Peercy started. Thanks to Dean Peercy for his extraordinary leadership for the past thirteen years. WE

Written by: Mitul Patel
Photography by: Chen Liu
Design by: Tom Bernath

Congress' Fusion Cutter

Though few people think about it in such terms, nuclear fusion is the source for all life and energy on Earth. I am referring of course to that bright, shiny ball in the sky we lovingly call the Sun. Every second over 600 metric tons of hydrogen are fused into helium and the energy released radiates across the solar system. Nuclear reactions of any type produce millions of times more energy than chemical reactions such as the burning of fossil fuels. Moreover, fusion reactions are several times more energetic (per unit of mass) than their cousin, fission reactions. Research into harnessing this energy for public use, i.e. power plants, has been going on since the 1950s… "So what's the hold up?" you may ask, which I did – here is what I discovered.

I began my search to find out why fusion power has not taken off right here on campus. Unbeknownst to many, UW - Madison houses cutting edge research in the field of plasma physics. Of particular note is the world renowned Helically Symmetric eXperiment (HSX) which is an innovative design for plasma confinement devices (PCD). I met with the father of HSX, Professor David Anderson, and a few of his graduate students to discuss the details of their experiment and its role in the development of fusion power generation.

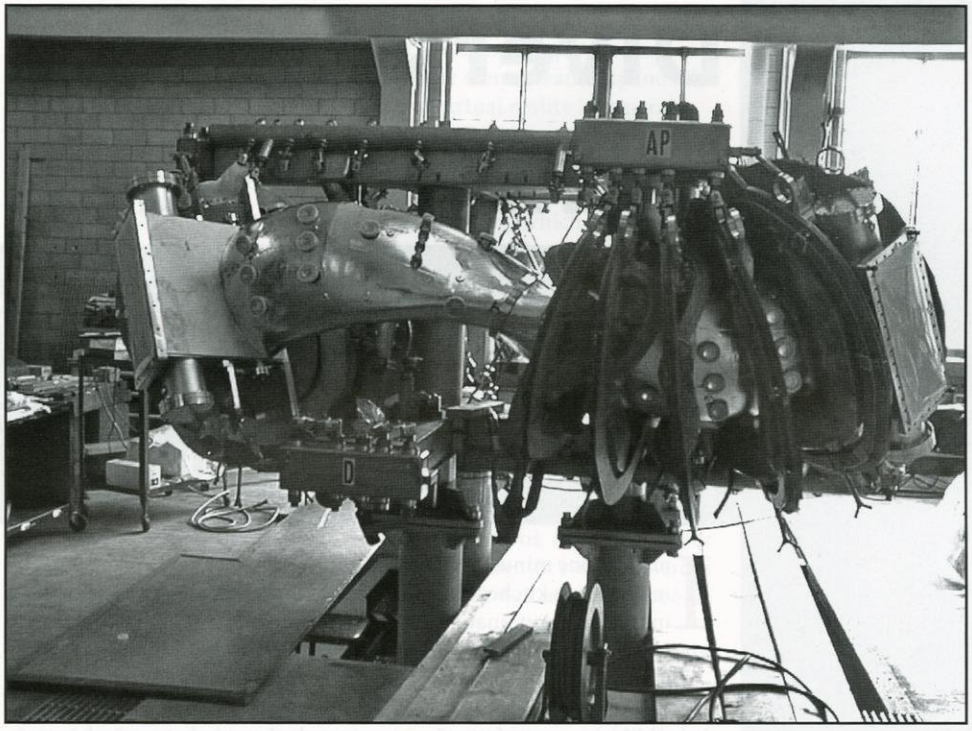


Pictured here (from right to left) is Professor Anderson with his graduate students Laurie S., Alexis B., and Gavin W.

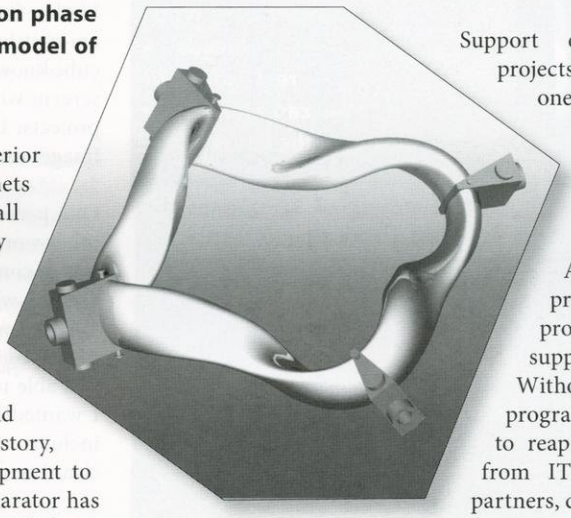
The first thing they wanted to assure me of was the safety of these devices. "At any given time you only have maybe five seconds worth of fuel in the reactor so if something happens to the reactor it's benign. You don't have any latent heat… like in Fukushima, you know how they had to dump water on that for months," says Anderson, "[Also], you don't have radioactive byproducts." The reactions involved are very complex and require extremely specific operating conditions. However when these conditions go awry there is no devastating meltdown or cataclysmic explosion—the reaction just stops. This makes fusion reactions immeasurably safer than fission reactions.

In order to actually harness these reactions for electrical power generation, however, burning plasma must be created and then confined. This hot plasma is confined through use of external magnetic fields which attempt to control the path of the highly energetic particles within the plasma. One of the most distinctive characteristics about the HSX is its unique geometry and how this is used to lengthen confinement times. While most PCDs today are tokamaks, the HSX is a stellarator. What does that mean? Tokamaks are the more prevalent today because by driving a current through the plasma itself, they have historically achieved longer confinement times than stellarators. As a result they have seen more development and have demonstrated the best performance to date, getting them much more attention. Stellarators, on the other

"Recent talks of funding cuts for fusion research in the U.S. have sparked a heated debate both in Congress and around the country."



The structure of the HSX was designed to optimize the magnetic field produced. Above: HSX in the initial construction phase with a segment of coils removed. Right: Computer model of the HSX confinement vessel.



hand, have received less recognition but exhibit several superior characteristics. The HSX, with its uniquely-designed magnets and the helically-symmetric field they produce, possess all these characteristics while offering the confinement capability of a tokamak. In fact, a primary goal of researchers in this field has been to demonstrate that with current computer modeling technologies such a design was possible.

Another reason tokamaks have received more attention historically is that they are significantly cheaper to build because of their simpler geometries. This is not the end of the story, however. "The tokamak takes a lot of very expensive equipment to control it, and also to heat it and operate it. Whereas the stellarator has got a higher capital cost, it's a little more expensive to build, but it's cheap to operate. So where do you want to put your money?" says Anderson. Since tokamaks require extremely large currents to confine their plasma, operating costs add up quickly. Another drawback is if they lose control of this current it is large enough to fry electronics and cause ruptures in the containment vessel, seriously damaging your investment. Anderson goes on to say, "Bottom line is stellarators are ready to advance, and they are advancing [in Europe and Japan]. But here [in the U.S.] we don't have anything. It's always money; if you wanted to invest we're ready for the next big step."

From what I learned, this seems to be a reoccurring theme in the field of fusion research here. The U.S. was once the leader in the field, but with constant cuts to funding we are quickly losing our title as 'king of the hill.' "You'll hear the joke 'fusion's 40 years away; always has been, always will be'. What's really been the problem is we said it was 40 years away when we looked at the funding level that was going on in the 60s and 70s when they were on track. But then you get political figures [that] aren't seeing the progress that's going to get recognition right away so they don't maintain the funding level. This sets back fusion and sort of mothballs things and slows down the programs…" says Alexis Briesemeister, one of the graduate students working on HSX.

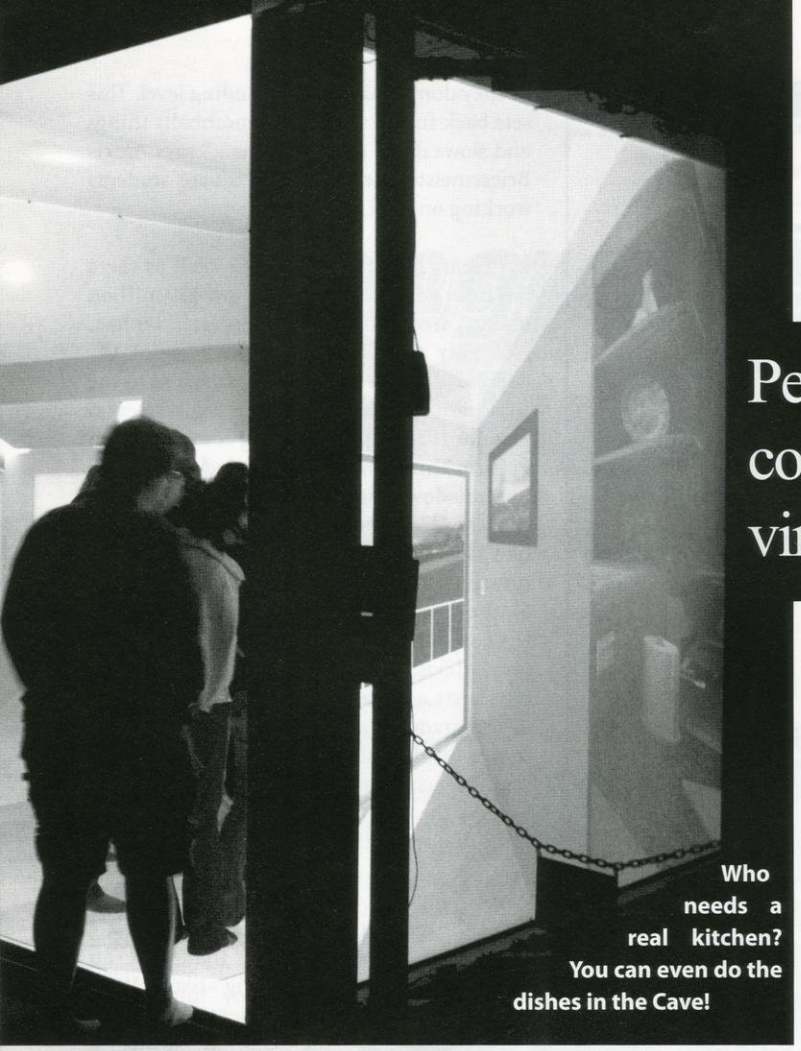
It appears history is repeating itself as there has been a recent proposal to cut $50 million dollars from the fusion research budget. Not only that, but larger portions of the decreased budget have been promised to the International Thermonuclear Experimental Reactor (ITER) project being constructed in France. This combination has led to the need to shut down domestic research programs like the Alcator C-Mod over at MIT. Cuts like this have many concerned about the future of domestic fusion research. "Some of the best scientists end up leaving [the U.S.] because they can't count on support" says Alexis. This is a real fear that many physicists are starting to face. I asked a few of the graduate students at HSX what their stance on the subject was. The reaction was unanimous; though none were overly eager to leave the U.S. for work abroad they would if the opportunities were not present here.

Support of international fusion projects at the expense of domestic ones is more than just an 'outsourcing' issue. With many scientists leaving, the U.S. is losing a valuable knowledge base and source of experience. Additionally, domestic programs are essential for providing training and even supporting projects like ITER. Without a healthy national program we will not be able to reap as many of the benefits from ITER as our international partners, despite our heavy monetary commitment. In order to prevent further funding cuts it is imperative that fusion research begins to gain public interest. With so many benefits over conventional forms of power generation and so few negatives, nuclear fusion research should be on the top of our list, not the bottom. WE

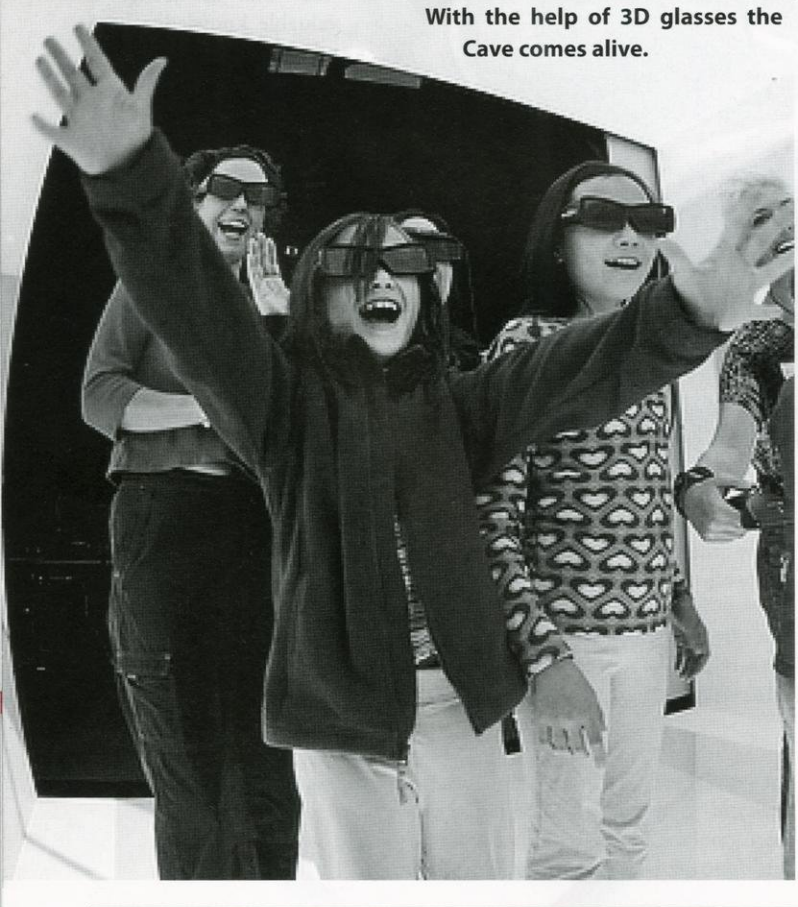
Written by: Nathan Rogers
Photography by: Tyler Van Fossen
Design by: Ryan Krull

Diversity in the CAVE

People from diverse backgrounds come together to create an amazing virtual reality environment.



Who needs a real kitchen? You can even do the dishes in the Cave!



With the help of 3D glasses the Cave comes alive.

Imagine one minute standing on top of Jupiter, and the next standing in your own kitchen. In reality, of course this is impossible; however, in the Cave Automatic Virtual Environment (CAVE), virtual reality gives you the power to be in many locations within minutes.

In the Wisconsin Institute for Discovery, the Living Environments Lab (LEL) is one of five primary research themes that were chosen to set the intellectual direction of the institute. The LEL, led by Patricia Flatley Brennan, (Professor, Industrial and Systems Engineering), is an interdisciplinary team that is working on a six-sided virtual reality cube known as the CAVE. The cube consists of six 9'6" by 9'6" projection screens which are used to simulate a variety of environments for research projects; behind each screen are two projectors that produce the 3D images on each wall.

One person controls the navigation through a given environment; in other words, the scenes are dependent on the user's viewpoint. When I was in control, I wore 3D glasses and held a wand, similar to a Wii game control, which contained tracking sensors that communicated with the CAVE. I was able to travel through the galaxy and the images that were displayed changed as my eyes scanned from the floor to the ceiling. I was able to fly through the galaxy and stand on top of any planet that I wanted! Some of the other environments that have been developed include an interactive kitchen, a bathroom with different levels of cleanliness and an interactive operating room with a patient.

How is the CAVE useful in simulating environments for different types of research? As described by Kendra Jacobsen, Associate Director of the LEL, when you take something out of context, such as a ventilator in an intensive care unit, you are missing critical information about how that device is used, how people interact with that device and with other people, and how decision making about that device takes place. To fully understand how something works or how it is used, you need the entire context together in one package. Designing a ventilator in a factory and presenting it in a conference room will have completely different results creating the design in a simulated intensive care unit where all of the noise and other devices associated with that unit are present. The CAVE allows you to bring that context into any kind of process or device design, without actually spending the money to create it.

The LEL has attracted a wide range of faculty who want to collaborate with the CAVE. One of the current projects in the LEL involves library and information science research on whether people in a house would eat healthier meals if the nutrition information of each item in the refrigerator was displayed upon opening. People involved in other

CAVE projects have backgrounds in industrial and systems engineering, computer science, nursing and biomedical engineering. Allowing new ideas and collaborators to be brought into the scene greatly expands the possibilities for the future of the CAVE and virtual reality in general.

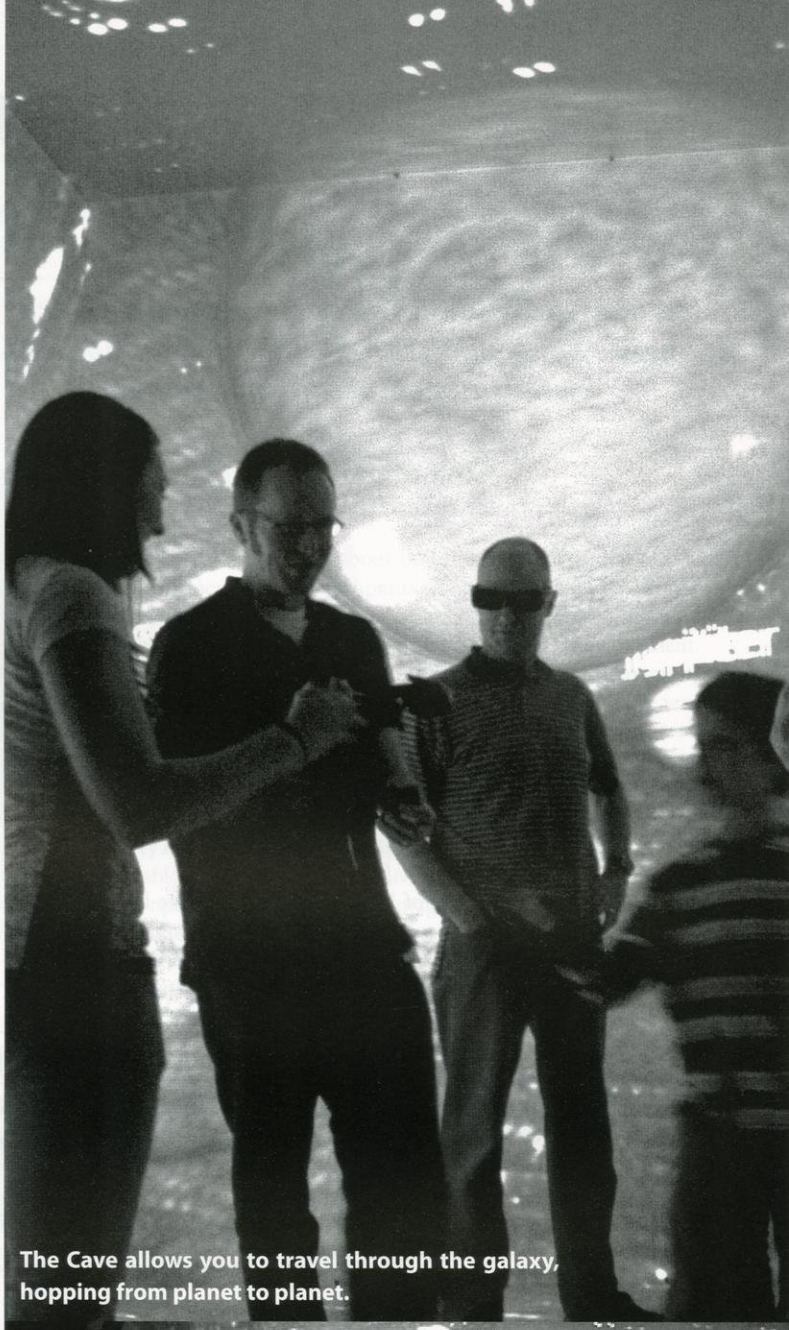
In terms of this technology becoming more widespread, the LEL team had a few predictions. Computer science post-doc researcher Kevin Ponto says, "I think the cost to do virtual reality, which is right now only accessible for universities and high end research and development departments for oil and aerospace, is going to come down to the point where it may be a consumer level technology; that's where you're probably going to see a huge boom in innovation." The possibilities of this technology may expand to industries such as architecture, genetics and even video gaming.

As researchers have been attracted to the CAVE from a variety of backgrounds, the challenges of interdisciplinary research has been brought to the forefront for the LEL. Brennan and her team chose to take these challenges head-on; "Because most of us realize that our work goes better with people who bring complementary skills, there is a natural synergy that really helps things to move well, and helps people appreciate each other."

Brennan has led interdisciplinary teams for over 25 years. Having a background in both nursing and industrial engineering has been one of the key factors in her success. She says, "I think being dual-trained in a health profession and in engineering provides a deeper knowledge of human function, health care delivery and engineering solutions." She goes on to say that although the two disciplines may use different models to augment human function, the fundamental principle of using technology to support human function remains constant.

Experiencing the CAVE was an incredible opportunity that truly showed me the level of innovation that Brennan and her team are capable of. Their research and developments will create a way to help all engineers understand how diverse everyday environments can be; which in turn will help them to build tools that will shape our lives. Albert Einstein said, "To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science," which is exactly what the team in the CAVE has accomplished. WE

Written by: Austin Kaiser
Photography by: Jake Rohrig and Jeff Miller, UW-Madison University Communications
Design by: Tom Bernath



The Cave allows you to travel through the galaxy, hopping from planet to planet.

Researchers in the Living Environments Laboratory work to enhance the understanding of human behavior and interactions in order to fuel innovation in design technologies. The 3D immersive environments are created by computer scientists using code which then allows researchers to conceptualize a variety of environments in an immersive context. The immersive capabilities of system allow researchers to explore a variety of environments interactively. The main goals maintained in the lab are to advance the science of virtual reality, advance art and science of design, and create innovative home care technology.

For more information on the Living Environments Laboratory and the CAVE, visit http://discovery.wisc.edu/home/wisconsin/research/living-environments-lab/. Public tours of the CAVE are held every month: check the schedule online for dates and how to make reservations.

Reallocation of the 700 MHz D Block
Bringing public safety up to speed

In 1973, Martin Cooper of Motorola took a minute before walking into a scheduled conference to make a quick phone call to one of his rivals at Bell Laboratories. Cooper said, "Joel, this is Marty. I'm calling you from a cell phone, a real, handheld, portable cell phone." Nearly 40 years after this historic event, over five billion people are subscribed to services that would allow them to make a similar taunt.

The digital revolution has irreversibly changed the way that we communicate with one another in today's world. Found inside of a growing majority of students' and professionals' pockets are cellular devices that continue to blur the line between telephones and personal computers. Many of these devices are equipped with processors of well over 1GHz, 8 megapixel cameras and high-resolution LED screens that allow streaming and viewing of live video over our country's vast wireless network.

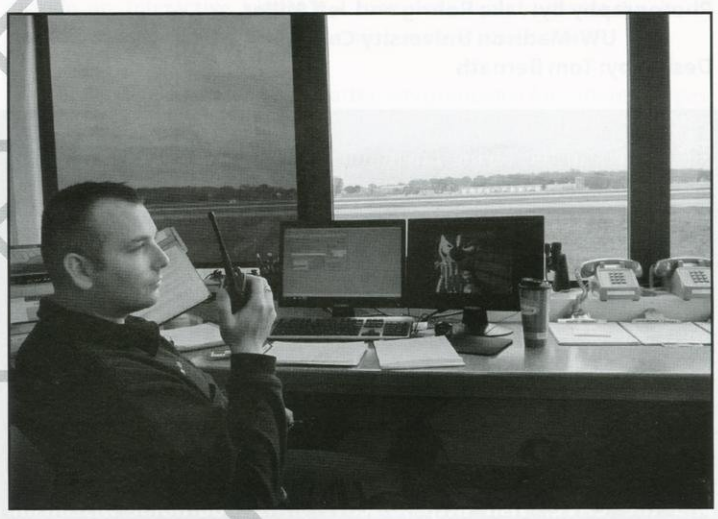
While civilians have enjoyed the technological progression at a rate typified by Moore's Law, our nation's public safety communications systems have evolved very little. Senior writer at Urgent Communications magazine, Donny Jackson, says, "While some public-safety services — primarily in metropolitan areas—are using 800 MHz trunked systems built in recent years, the vast majority still rely on UHF and VHF analog voice systems built with equipment installed in the 1970s."

What this means is that most public-safety workers are communicating on more primitive, disparate systems that—while reliable—greatly limit the efficiency and amount of data that can be transmitted between agencies and across county lines. Inter-agency communications are often sluggish and their deficiencies have been illuminated by recent disasters.

A Joint Advisory Committee on Communications Capabilities report given to Congress in February 2008 stated, "On the fateful morning of September 11th, among the thousands of casualties was our communications infrastructure—hampering communications at the very time when emergency medical workers and public health-care facilities needed it most." According to the report, emergency medical services (EMS) were unable to speak to police, police were unable to communicate with firefighters, many two-way emergency medical radios failed and dispatchers routed victims to overcrowded hospitals while beds lay vacant in others because of insufficient occupant data. This generated a cry for a nationwide interoperable network.

"This is arguably one of the most significant events in U.S. public safety communications history."

- Donny Jackson, Urgent Communications



Public-safety workers will soon have an interoperable LTE wireless network for communicating and sharing data on scales several orders higher than previously possible.

Firefighters and fire trucks in urban areas outfitted with new public safety cellular devices would be able to receive valuable, real-time data about building blue prints, hazardous materials, sprinkler locations and occupants.

As engineers, we understand that mechanical failures due to natural disasters, miscalculations, erosion and sinister acts of terrorism are an inevitability of the world we inhabit. However, in a day and age when we can video conference with people from all corners of the earth at any hour from almost anywhere, it seems unacceptable that first-responders are often handicapped by technology most take for granted. Therefore, it has been the recommendation of the 9/11 Commission that Congress provide funds to create a nationwide, interoperable Long Term Evolution (LTE) network for public safety.

The issue with creating this unified network is rooted in the scarcity and expense of wireless spectrum. Spectrum is the medium over which data is transported; and the spectrum that devices are tuned to determines what other devices they can communicate with. While there is a wide amount of spectrum that communications devices can be built to utilize, not all spectrum is created equally. The best spectrum for wireless broadband falls in the 700MHz band (and bands are further broken down into blocks).

Fire Chief Jeff Johnson (Ret.) is one of public safety's most active advocates of a unified public safety network. Johnson says, "Spectrum is the one resource I know of that is more valuable than gold or oil." The prime 700 MHz band used to be inhabited by analog television broadcasting, but in 2009 all television broadcasters had to be switched to digital signals. In 2008, the Federal Communications Commission (FCC) auctioned off the vacated 700 MHz block to commercial wireless network providers to the tune of nearly $20 billion dollars. The only unsold spectrum in the 700 MHz band was the so-called "D Block," which had stipulations that any buyer must share it with public safety.

Most industry observers expected the D Block to be auctioned for commercial purposes. However, in a decision that seemed highly improbable only a couple years ago, on February 23rd, 2012, President Barack Obama signed into law legislation that reallocated the 700 MHz D Block spectrum to public safety and $7 billion dollars of federal money to begin construction of a nationwide LTE network. Jackson says, "This is arguably one of the most significant events in U.S. public safety communications history."

What does this mean for engineers? The reallocation of the D Block creates opportunities for engineers to bring public-safety communications into the 21st century. Soon, public-safety workers will have an interoperable LTE wireless network for communicating and sharing data on scales several orders of magnitude higher than previously possible. Engineers will be expected to produce innovative new technologies in the communications field to pair with the more mature technologies law enforcement, fire safety and EMS have experienced during the last 30 years.

As an example of what this network will allow, firefighters and fire trucks in urban areas outfitted with new public safety cellular devices would be able to receive valuable, real-time data about building blueprints, hazardous materials, sprinkler locations and occupants. These first responders would be able to remotely view traffic cameras that are already installed in many cities to determine the exact location and circumstances of an incident. Firefighters in rural areas would be able to view topological maps in addition to satellite and thermal imagery to choose the most effective way to handle a wildfire.

"It's one thing to get the technology, but then it's another thing for others to say how can we apply this and how can we make it better?"

- Fire Chief Gary Peck

At the International Wireless Communications Expo in Las Vegas, Motorola unveiled its first mission-critical handheld device to utilize the new public safety network, the LEX 700. Intended for law enforcement, this smart phone is able to access and control live video from security cameras, share real-time operational views, share images and video, view incident location history and even take finger prints.

The branch of public safety that may benefit the most from the new network is EMS. Following a traumatic incident, a victim's health is tied to the quickness of public safety's response and treatment. In the EMS community, this time period is referred to as the "golden hour"—the time immediately following an accident in which medical attention would give the highest probability to prevent death. EMS personnel outfitted with new LTE devices could share data about a victim's medical history, possible drug interactions and accident severity much more efficiently. Live video from first response units could be delivered to doctors at hospitals to give them additional time to prepare for an incoming victim.

The government's reallocation of the 700 MHz D Block and $7 billion in federal funding for the creation of a nationwide LTE network for first-response units is a monumental victory for first-responders. It lays the groundwork for a host of technological advances to bring their communications up to speed. Today's engineers will be expected to develop novel technologies, applications and procedures that create a rigorous and capable network to resolve the issues that have plagued public-safety communications in the past. WE

Writen by: Matthew Treske
Photography by: Sommer Ahmad
Design by: Matthew Treske

A Freshman's Guide to UW-Madison Engineering

How prospective student tours and SOAR acquaint potential students with UW-Madison

Imagine. Investigate. Innovate. Make a difference. Understand the impact of engineering solutions in a global, economic, environmental and societal context. Prepare yourself to solve modern engineering challenges and to create solutions that will shape the world in which we live. These are the challenges laid out for prospective students by the College of Engineering. With its culturally rich and globally diverse faculty and student body, UW-Madison provides an environment that stimulates teamwork and creative design. The College of Engineering does more than just teach students, they are immerse us in interdisciplinary activities, offer real-world design challenges and provide us with the technological tools and resources that will prepare us to meet 21st-century engineering needs. Is it right for you?

I sat down with Tanya Cutsforth, an advisor in the engineering office. "The prospective tour visits are both for students that have applied or planning to apply, in addition to the parents or guests that are also involved in the process. In the presentation, we talk a lot about the college in general, and some of the logistics, admission to UW-Madison very briefly, how the pre-engineering program works and applying for the department. While that is important information, I think one of the more important thinks to talk about is to what students actually do here: internships, co-ops, getting involved in research, student organizations, competition teams, studying abroad, all of those great experiences," Cutsforth elaborates by saying, "part of the presentation is to just give them a tidbit of what the Wisconsin experience is like for engineering students. We have undergraduate students participate in those presentations and take them on a tour afterwards. People do want to learn some information from me, but they really achieve the information well when they hear it from a student to see what their experience is like. It's very reassuring and exciting over what their potential experience could be like." Eventually, the presentation will tie in even more with the tour, working as a Google Earth view of campus and zooming in on specific buildings.

To gain more insight into the introductory process for prospective students, I signed up for the informational session and tour of the engineering campus. To start out, a half hour presentation was given concerning university statistics, admittance and general engineering guidelines, stating that UW-Madison is the #1 buzzed about university, measured by online presence, or internet brand equity. The Wall Street Journal ranked the university #16 overall, and was given a #9 ranking through Kiplinger's Best Public Value (number one in the Big Ten). With 131 undergraduate majors (12 within engineering) and over 50 options for certificates covering a variety of subjects, students have a wide variety of options, even if engineering may not be a first choice.

One of the key ideas presented was for incoming freshman to maximize their first year on campus. Many new students have a desire to choose general engineering, but with limited knowledge on what to concentrate on. In introductory engineering courses, students have the option of focusing on design, leadership, career development or grand challenges within society in order to gain a better understanding of what path to pursue. Through the help of professional and peer advising, students can select the best individual option. Furthermore, workshops and department programs are held throughout the year. Over 55 engineering student organizations provide great opportunities

Engineering Drive, the main street for all applied sciences.

to gain leadership and engineering experience. Disciplinary groups, affinity groups and honor societies can provide academic and career-related support in addition to networking opportunities. Competitive teams, volunteer organizations and service-oriented/outreach groups build great hands on engineering experience.

Another key idea presented focused on admission into specific engineering departments. After admittance through the main university admissions office with an intended major of engineering, students must apply and be accepted to the specific desired engineering program. If there is any interest

"Encourage them, from day zero, to engage, to learn about what they're interested in, and to ask questions. We're looking to provide them an opportunity to ask the right questions instead of just telling them what to do."

- Tanya Cutsforth

in engineering, it is a better idea to start within the College of Engineering and transfer out later due to a tight curriculum. Within the first four semesters, an application to a department should be made, after the needed requirements are satisfied. The majority of engineering departments are not at capacity, so if the minimum requirements are met, admittance will be granted. However, if a department is full, the GPA cutoff varies from semester to semester based on the number of applying students and their qualifications. Students typically have three chances (after second, third, or fourth semester) to gain admittance to a department. The chart to the right highlights how each of the engineering disciplines vary beyond the foundational coursework.

Many engineering students enter the College of Engineering with earned Advanced Placement credit for either Math 221 (first semester calculus)

Biomedical
- Biomedical Design
- Zoology
- Organic Chemistry
- Physics
- Math

Mechanical
- Materials Science
- Dynamics
- Math
- Computer Science
- Physics

Civil and Environmental
- Environ. Engineering
- Surveying or AutoCAD
- Dynamics
- Geoscience
- Economics

Electrical and Computer
- Design Fundamentals
- Physics
- Intro ECE Lab
- Math
- Computer Science

Industrial
- Statistics
- Economics
- Physics
- Math
- Computer Science

Nuclear, EP, and EMA
- Dynamics
- Computer Science
- Physics
- Strength of Materials
- Math

Chemical
- Intro to Chemical Eng.
- Organic Chemistry
- Physics
- Math
- Analytical Chemistry

Material Science
- Physics
- Materials Science
- Computer Science
- Organic Chemistry
- Math

Geological
- Geological Structures
- Dynamics
- Strength of Materials
- Math
- Physics

or Math 221 and 222 (first and second semester calculus). However, taking calculus in high school does not ensure success in math classes at UW-Madison. Depending on one's comfort level with the material, repeating a math course at UW-Madison may be the best decision. Some students who choose to skip a calculus course do poorly and risk jeopardizing their admittance to a department, as approximately 40 percent of students who score a four on AP Calculus receive a grade of BC (2.5 GPA) or lower in the next course in the series. Alas, students are not to be discouraged because there are plenty of resources available to help them master those calculus courses. Adjusting to university courses can be difficult and it is strongly recommended taking a light credit load (12-14 credits) for the first semester to help guarantee success. Time is needed to adjust to the teaching style, academic rigor, and expectations of becoming a Badger.

The tour covers what the regular campus tour does not: all of engineering campus. After leaving a lecture hall in Engineering Hall, the tour passes through each engineering building. "I think the outcome of the tour can vary quite a bit with the size of the group," Cutsforth says. "When the groups are smaller, they have more time with the guide and are much more willing to ask personal questions. We try to pull in some of the content from the presentation. It also depends on the particular student guide and their perspective. Each student gives a pretty different tour, depending on what they like to talk about. It varies with their interests. If they turn to academic support, go to the libraries, or if they're in a research lab they sometimes ask if the group would like to see their lab. The competition teams might be working and they're in their space, a professor might come out and say hi. It really depends on who's out and about during the tour, timing really." The purpose of the tour, as my charming and erudite guide for the day explained, was to give a general overview of engineering campus from the perspective of current students. For incoming students, it may be worth their while to take the tour a second time to gain a whole new perspective.

In addition to serving as tour guides for the engineering campus, undergraduate students can also serve as peer advisors for Student Orientation, Advising and Registration (SOAR), the gateway to a successful first year. It is a two-day program that is scheduled through the Office of Undergraduate Admissions, but administered through the College of Engineering if the engineering path is chosen. The programming for parents is extremely beneficial, and the advising for students gives them the confidence of being on the right track.

Advisors will help develop and enroll class schedules. However, as Cutsforth says, "SOAR is a huge thing right now. One of the major changes this year is that instead of having all the advising on one day, the advising is being split over two days. We recognized scheduling could be a stressful time for students. It's a stressful time for faculty, it's a stressful time for advisors; it's a stressful time for everybody. And it shouldn't be, because it's really exciting." Historically, advising has always been on one day. "Why does it need to be like that? Let's spread out the advising over two days," Cutsforth says. "That way we can talk to students, get to know them, talk about their situations, what classes do they need to be taking or want to take and give them a night to sleep on it. And then come back, focus on selecting the section, and enrolling." Spreading out the advising over two days will hopefully mitigate stress and set the right environment for the students.

The engineering advising office is very excited about the new model. "The changes to the format of SOAR really evaluate how we do SOAR, as an office. We're engaging it as a new opportunity. Do something cool and different. We're also getting rid of a lot of things we did in the past, like a long presentation at the front end. No one wants to listen to that. I don't remember listening to the presentation when I was a student here," Cutsforth says. "If you're a student at SOAR, you're anxious about how you did on the placement tests, what math class you're going to take, if you're going to take chemistry. You have questions." Through a shorter presentation and focused ideas, more emphasis can be placed on involvement, small groups and one on one advising. "We're going to set up a resource table with information on different opportunities on campus," Cutsforth says. "Encourage them, from day zero, to engage, to learn about what they're interested in, and to ask questions. We're looking to provide them an opportunity to ask the right questions instead of just telling them what to do." After leaving SOAR, students will have a rich knowledge of their future curriculum, and will most certainly know who to "come along with" if they want to be a Badger. We

Written by: Steve Wishau
Photography by: Chris Ross
Design by: Marita Thou

Forward WITH Energy

With the doors of the Wisconsin Energy Institute opening on January 1, 2013 many are wondering what will be inside. The Wisconsin Energy Institute (WEI) will be a center for renewable energy on campus that seeks to focus on energy-related education, service activities and research at UW-Madison. This new building is a joint venture between the College of Agriculture and Life Sciences and the College of Engineering. Tim Donohue, Director of Great Lakes Bioenergy Research Group, says the Wisconsin Energy Institute is being constructed "in a prominent location, which respects the importance of energy and the future research activity for the university." The Wisconsin Energy Institute has a signature site; not only is it being built on a narrow site, squeezed into the crossroads of University and Campus Drive, the location of the facility exemplifies the prospect for future increased cooperation between the two colleges and research enterprise that surrounds energy technology. The joint efforts of different departments that will be working together in the building will allow the students, university and state to benefit from the diversity of ideas for research that will pour out from the investment in the construction of WEI.

Image courtesy of project architects Potter Lawson and HOK.

Master plan for the Wisconsin Energy Institute.

This 107,000 gross square foot building will be home to researchers focused on clean, efficient energy solutions. Energy is the crucial force powering world economies, supplying national security and contributing considerably to the economic output of the United States. The largest of cross-disciplinary research centers which will relocate to the newly constructed facility is the Great Lakes Bioenergy Research Group. Other research centers which will call the Wisconsin Energy Institute home are the Wisconsin Bioenergy Institute (WBI), the Solar Energy Lab, the Engine Research Center, the Wisconsin Institute of Nuclear Systems and the Wisconsin Public Utility Institute.

Funded by the department of energy at UW-Madison, the Great Lakes Bioenergy Research Group will be the largest department and will consist of almost two full floors of WEI. Great Lakes Bioenergy currently has five years of funding, with $25 million dollars per year, and they anticipate five more years of funding starting in December 2012. Ever since the Department of Energy (DOE) awarded one of three nationwide Bioenergy Research Centers to UW-Madison in fall of 2007, the Great Lakes Bioenergy Research Group (GLBRG) has worked in close partnership with a collaboration of national laboratories, university research centers and private-sector businesses to pursue research encompassing a variety of biological solutions for bioenergy applications. Advances in research will provide the knowledge required to develop new bio-based products, specifically research that may facilitate the production of fuels from biomass.

The different sectors of Great Lakes Bioenergy Research Group involved in producing, processing and ultimately converting biomass to energy compounds will have the opportunity to operate as a collective unit that aims to establish sustainable bioenergy practices. Tim Donohue currently conducts research in the Microbial Sciences building at UW-Madison; other labs associated with Great Lakes Bioenergy are located in the Genetics building, the Enzyme Institute and other renovated space across campus. Donohue's research involves generating ethanol and advanced fuels, or hydrocarbons, from non-edible parts of plants. Donohue views this new space as a prospect and says, "People will be moving in to breed new types of plants that will be easier to process and convert into fuels. We will also have a lot of our computational and bioinformatic people moving into this building."

The vision of the construction of the facility is to utilize sustainable energy features to get the operation of the building to reflect the clean, renewable research that will take place there. The building is currently tracking gold LEED (Leadership in Energy & Environment Design) certification. "It is

going to be well below the state code in terms of energy efficiency for a research building, which is something that we're very proud of. It is using a lot of recycled materials and is probably going to have a demonstration area outside the building to demonstrate biofuel cropping systems," says Donohue.

The building committee expects to have at least one other display elsewhere in the building to demonstrate renewable energy technology. Through these displays, visitors of WEI will be able to explore how the systems in the building are operating at optimal efficiency. Among many features that WEI prides itself on are the domestic hot water solar panels on the roof. By using low-emitting paints, sealants, adhesives, carpets and furnishing occupants will experience clean indoor air quality.

Energy is the crucial force powering world economies, supplying national security and contributing considerably to the economic output of the United States.

For Tim Donohue, the newly constructed research space at WEI is an endless opportunity that is both flexible and pragmatic for the field of energy. Due to the fact that the architects worked in conjunction with the researchers, the lab space will be able to accommodate shifting research when the research centers move into the building in 2013 with minimal to no cost. Tim Donohue says, "This is critical to the university as research changes very rapidly when it comes to fields like energy, and we need space that can adapt to interdisciplinary changes without costing the university a lot of money to renovate space." Donohue is pleased that the architects have given the research centers a facility that will easily accept changes in research without needing to renovate the space. We

Written by: Elizabeth Puck
Photography by: Nicholas Lepak
Design by: James DeBano

Building Features

The $57.1 million, 107,000 square foot Wisconsin Energy Institute will develop new technologies for renewable and sustainable energy

Approximately 95% of construction waste was recycled

The building is projected to use 48.8% less energy than code minimum

The Wisconsin Energy Institute relies on landfill gas, solar and wind energy

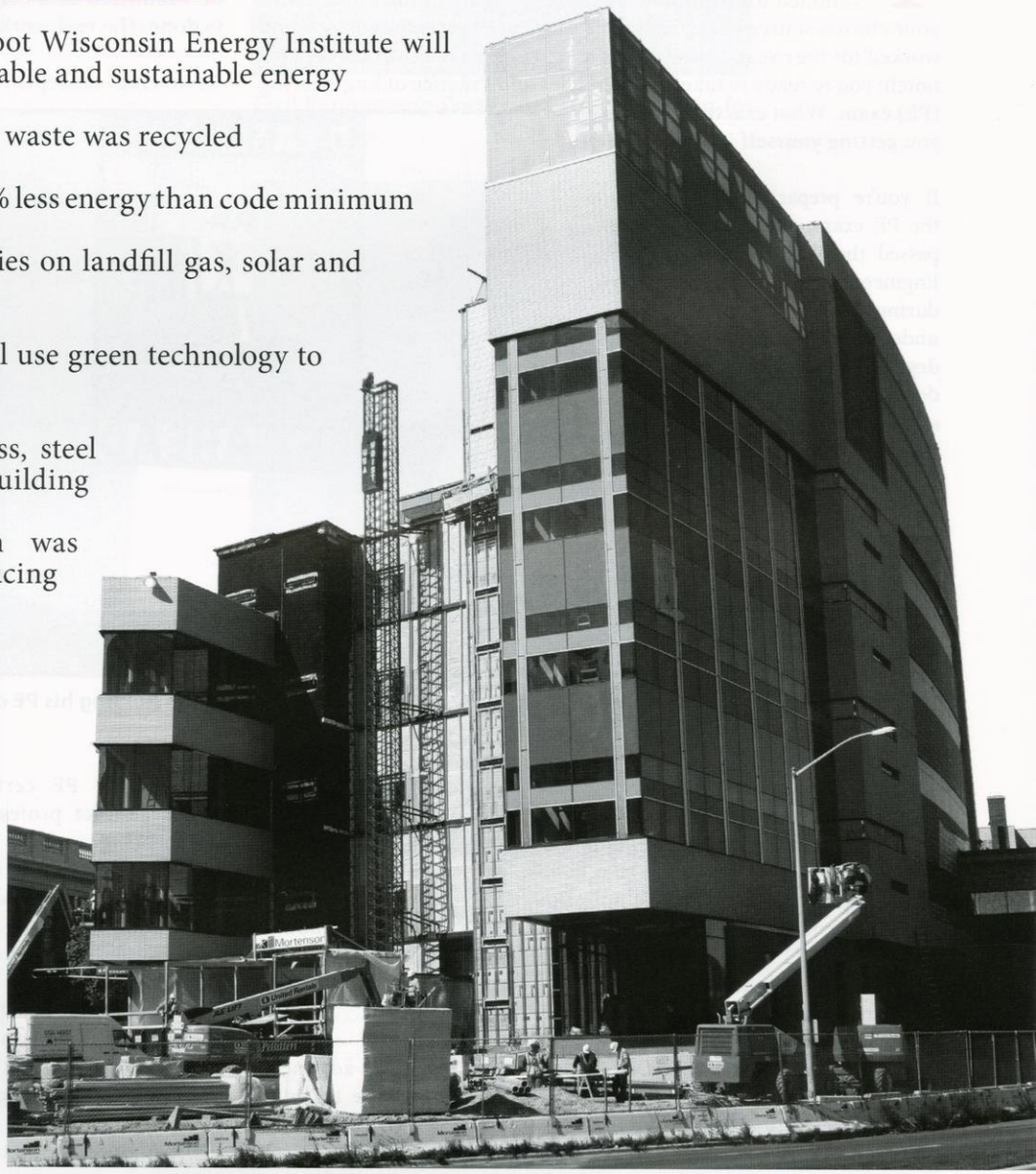
The Wisconsin Energy Institute will use green technology to reduce water efficiency by 30%

Reclaimed and recycled wood, glass, steel and carpet is used throughout the building

Building design and orientation was optimized for daylight, reducing electricity demand

University of Wisconsin-Madison
2012 Energy Summit
Innovating Our Way to a Sustainable Energy Future
October 30, 2012
Monona Terrace Community and Convention Center
Hosted by the Wisconsin Bionenergy Initiative and the UW Energy Institute
For more information, contact:
sbanks@glbrc.wisc.edu

The Summit will address the full spectrum of energy challenges and opportunities that lie ahead for our state and nation, and highlight the many ways UW–Madison is leading the way in energy research, education, and outreach.



Building as seen today from University Ave. It's expected to be completed fall 2012.

Putting the Professional into Your Profession

The Principles and Practice of Engineering exam requires some extra studying and effort, but is a chance for engineers in many fields to become a "Professional Engineer."

This is why you've worked so hard during your years as an engineering student at UW-Madison. You did your homework, crammed for finals and spent long nights in the library with your chosen source of caffeine. You got your degree, found a job and worked for four years. Now you're preparing to take your career up a notch; you're ready to take the Principles and Practice of Engineering (PE) exam. What exactly are you getting yourself into?

If you're preparing to take the PE exam, you've already passed the Fundamentals of Engineering (FE) exam, taken during the senior year of an undergraduate engineering degree. You endured and defeated that eight-hour exam. Passing this test gave you the status of "Engineer-in-Training" or "Engineer Intern." Taking the PE exam will be the last step to earn the title "Professional Engineer"

Ali Soleimanbeigi with Lori Bierman holding his PE certificate.

Both exams are written and administered by the National Council of Examiners for Engineering and Surveying (NCEES). The PE exam, like the FE exam, is eight grueling hours in duration, split in two four-hour sessions with only an hour break for lunch. The exam consists of 80 or 100 multiple-choice questions; the PE Structural II exam is the only exam with essay responses. Test takers are allowed to bring any notes they choose, as long as they are bound in some way; loose papers are not allowed. Mechanical pencils are provided, and the calculator policy is strictly limited to basic models such as the TI30 or TI36. Don't forget your conversion factors, because the test questions use both the metric and US Customary measurement units.

Just like preparing for finals week, the PE exam requires advanced planning and preparation. You must apply to take the test and provide several documents: letters of experience from your employer(s) confirming that you have worked the required four years, and five letters of recommendation, three of which must be from certified professional engineers. For international students who earned a bachelor's degree outside the US, it must be submitted to a committee for validation. Once the paperwork is done, the real work begins.

Reviewing concepts, working out practice problems and getting to know your reference materials are the most common methods of studying. Civil engineering grad student, and now Professional Engineer, Ali Soleimanbeigi began studying one and a half months before his exam date, just an hour a day at the start and building up to six hours per day in the final few weeks. His only regret was bringing too few references to the exam. There is no limit on the number of reference books that a test taker can bring. "Some people brought their entire bookshelves!" he says.

Getting the PE certification really worked for Dr. Frederick Elder, adjunct professor of engineering physics and mechanical engineering, and he advocates taking the test to all students he teaches. Having the certification has allowed him to run his own consulting firm, which keeps him busy when not teaching. "I see it the same way I see automobile insurance," Dr.Elder says. "If you buy automobile insurance, you may never use it, but when you do, you need it." Soleimanbeigi took and passed the PE exam last October, hoping it will give him an advantage in his job search after graduation. Having this certification "shows a degree of competence, and gives you a level of credit such that people can trust in your capabilities, knowledge, and work ethic," he says.

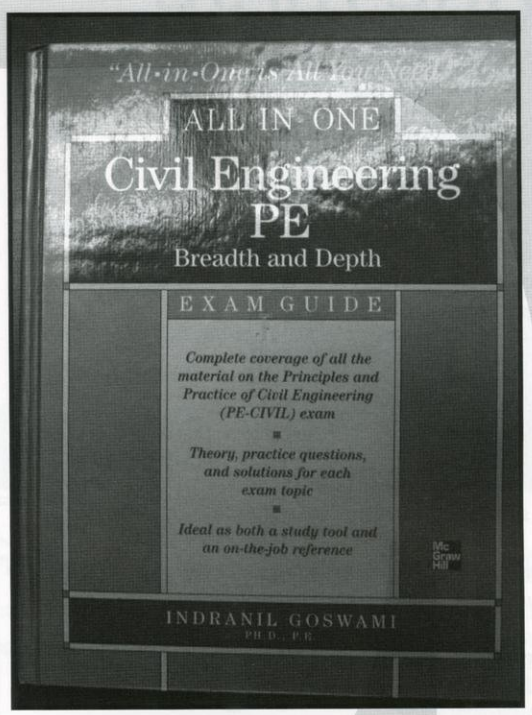
Civil engineers tend to have the greatest focus on the PE exam, but its benefits are not limited to them, Dr. Elder contends that it can

benefit engineers in every discipline. Licensure is another aspect of professional development within engineering, and it could make the difference when you want to land a job or are looking for a pay raise. Only a licensed Professional Engineer can sign and seal plans and drawings, or run his or her own consulting firm. The National Society of Professional Engineers sums up the benefits in this way: "Licensure is the mark of a professional. It's a standard recognized by employers and their clients, by governments and by the public as an assurance of dedication, skill and quality."

"Licensure is the mark of a professional."

- National Society of Professional Engineers

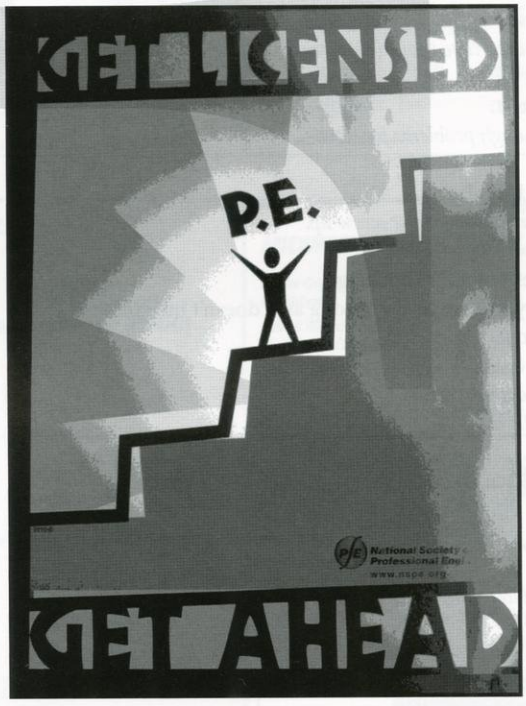
Don't panic. There are a plethora of resources to help you prepare, ranging in format and price. If you're still on a college-student budget, there are websites that offer advice on study skills and test-taking strategy. The NCEES offers books of sample questions and answers for selected tests, for a reasonable price. Many test-preparation organizations offer review courses and online seminars, some costing hundreds of dollars!



Civil Engineering Book used for preaparing for the PE Exam.

Whatever you choose, just keep this in mind:

Exam Fee: $293
Review Materials: $120
TI-36 calculator: $18
Reading "(Your name), Professional Engineer" on your business card: Priceless



Poster regarding the PE exam by NSPE in the graduate lounge, Engineering Hall.

Writen by: Lori Bierman
Photography by: Tirupan Mandal
Design by: Joe Powell

Just one more...

Translation of Top 20 Engineers' Terminologies

1. A number of different approaches are being tried.
We still have no idea what we are doing.

2. Extensive report is being prepared on a fresh approach to the problem.
We just hired three kids fresh out of college.

3. Close project coordination.
We know who to blame.

4. Major technological breakthrough.
It works OK, but looks very high-tech.

5. Customer satisfaction is delivered assured.
We are so far behind schedule the customer is happy to get it delivered.

6. Preliminary operational test were inconclusive.
The darn thing blew up when we threw the switch.

7. Test results were extremely gratifying.
We are so surprised that the darn thing works.

8. The entire concept will have to be abandoned.
The only person who understood the thing quit.

9. It is in the process.
It is so wrapped up in red tape that the situation is about hopeless.

10. We will look into it.
Forget it! We have enough problems for now.

11. Please note and initial.
Let's spread the responsibility for the screw up.

12. Give us the benefit of your thinking.
We'll listen to what you have to say as long as it doesn't interfere with
what we've already done.

13. Give us your interpretations.
I can't wait to hear this bull!

14. See me or Let's discuss.
Come into my office. I'm lonely.

15. All new.
Parts not interchangeable with the previous design.

16. Rugged
Too darn heavy to lift.

17. Lightweight
Lighter than rugged.

18. Years of development.
One finally worked.

19.Energy saving.
Achieved when the power switch is off.

20. Low maintenance.
Impossible to fix if broken.

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Have ideas for articles you would like to see?
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A technology, science, and engineering magazine published by the students of the University of Wisconsin-Madison since 1897.

wisconsin engineer

WRITE.
PHOTOGRAPH.
DESIGN.
ADVERTISE.
PUBLISH.
CODE.
LEAD.

Come to our kickoff meeting!
Wednesday, September 12, 7:00pm
@ Engineering Center's Building in Tong Auditorium
Silvermine Subs will be provided
www.wisconsinengineer.com

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