NC STATE UNIVERSITY

College of Engineering News

For Our Engineering Alumni and Friends Winter 1998-99

NC State engineers improve sterilization process of food packaging

Researchers Roger Rohrbach and Mohamed Bourham hold drink boxes in front of a brickpack machine. Their research could change the way that drink box packaging is sterilized.

Food packaging is of little interest to most of us while we are at the market, but modern food packaging technology has increased the safety and variety of foods available. At NC State University, engineers are developing ways to make packaged foods safer.

Roger Rohrbach, professor of biological and agricultural engineering, along with Mohamed Bourham, professor of nuclear engineering, are working to improve the process that sterilizes drink box packaging to make it safer for consumers and less expensive for manufacturers.

Currently, drink boxes are sterilized using a hot peroxide bath. The process is very good at reducing the bacteria population on surfaces, but it leaves an oxidant residue—an unwanted byproduct of the processing.

Bourham and Rohrbach have devised a way to use low energy electron beams to deactivate (sterilize) bacteria on the surface of packaging materials rapidly and at very little cost. Low energy electron beams are found in many daily applications, such as delivering pictures to television screens and computer monitors.

"Recent medical research has shown that oxidants, such as peroxide, are harmful to living tissues. That is why peroxide is so effective in sterilizing packaging," says Rohrbach. "Today, we take antioxidant vitamin complexes because we realize that oxidants are damaging. The sterilization process we are developing would reduce exposure to harmful oxidants."

The researchers are working to retrofit a brickpack processing machine with their electron beam device. Brickpacks are popular in the boxed drink industry. The machines are able to sterilize, fill and seal several hundred drink boxes per hour. During the production process, the machine bathes the packaging material with hot peroxide and then folds, fills and seals the box without exposure to sources of contamination, such as airborne particles or human hands.

*(See **Aseptic** page 2)*

Chemical engineer's research to aid oil industry, environment

In a nation that relies heavily on the use of internal combustion engines in its automobiles, trucks, airplanes and other machines, the production of oil and gas is of paramount importance. But extracting and refining crude oil often makes a strong impact on the environment—so much so that President Clinton recently extended the ban on off-shore drilling for 10 years. Efficiently producing crude oil from deep sea reservoirs—crudes that frequently contain heavier and less volatile materials—is becoming increasingly difficult. For these and other reasons, oil companies are looking into better ways to produce, transport and refine petroleum that minimizes negative environmental impact. At NC State University, Peter Kilpatrick conducts research that will make crude oil production and refining more efficient and better for the environment.

Kilpatrick, professor and associate head of chemical engineering, studies the properties of various heavy crudes and the ways in which mixtures of crude and water and other contaminants respond to the production process.

The crude oil extracted from wells is a mixture of oil, salt, water, rocks, waxes and asphaltenes—large and complex organic materials in crude oils. Using temperature and solvent changes, Kilpatrick can cause the contaminants in the crude to partition selectively, making them easier to remove. The processes he has developed have the potential to make crude easier to extract from the well and easier to refine.

*(See **Oil**, page 5)*

Aseptic - *continued from page 1*

The electron beam device sterilizes the packaging by passing the box material across a small window that emits the dose of electron beams delivered to the packaging. The irradiation process takes just a few seconds and does not leave any type of residue. The technique does not require irradiation of the actual juice drink.

Bourham and Rohrbach so far have used energies as low as 55 kiloelectronvolts (keV)—55,000 volts—to successfully sterilize the packaging. Their goal is to decrease the energy used in the process to about 40 keV.

"If we can deliver a sufficient dose of electron beams at a low enough energy, then our process will not only decrease the cost of processing, it will also increase the safety of the packaging by eliminating oxidant residues," says Bourham. "Our goal is to make the sterilization process as safe as possible while keeping it low cost to the manufacturer."

Kenan Center for the Utilization of CO_2 in Manufacturing established

The Kenan Center for the Utilization of Carbon Dioxide in Manufacturing has been established as an official center jointly administered by NC State University and the University of North Carolina at Chapel Hill, with a special partnership with the Oak Ridge National Laboratory. The center's main laboratory is located in Partners I building on the NC State Centennial Campus. Chancellor Fox received official approval from the University of North Carolina Board of Governors for the establishment of the center in August.

Supported by industry partners and funding from the Kenan Institute for Engineering, Technology and Science, the center fosters collaborative, multidisciplinary research into applications for a new class of detergents that can be used in carbon dioxide for a wide range of industrial applications. Dow Chemical, DuPont, Eastman Chemical and B.F. Goodrich are among the center's 16 industrial members. The partnership is designed to support university-industry cooperation to achieve environmental improvement while maintaining manufacturing competitiveness and increasing economic growth.

Joseph DeSimone, professor of chemical engineering at NC State and the Mary Ann Smith professor of chemistry at UNC-CH, and Ruben G. Carbonell, Hoechst Celanese professor of chemical engineering and head of the Department of Chemical Engineering at NC State, will serve as co-directors.

The new center was developed as an extension of research being conducted by DeSimone into the uses of carbon dioxide as a detergent. DeSimone developed the chemistry behind the new solvents that may make many types of manufacturing processes more environmentally friendly. Center-supported researchers will develop ways to convert manufacturing processes that currently use organic, aqueous and halogenated solvents to the more ecological carbon dioxide-based processes.

Finding solutions for North Carolina manufacturers

For Sale. Plant Closed. Going out of business. These are the signs of change today. For some manufacturers, they might be signs of the future. Last year, 13,998 manufacturing jobs in North Carolina were lost due to plant closings, and there were 4,406 additional permanent layoffs due to consolidations, relocations and similar reasons. Some of these plants might still be in operation had they received help in identifying operation and business procedures and processes that ate profits. Every day, NC manufacturers solve problems using the expertise of the Industrial Extension Service (IES) of the College of Engineering and its partner institutions. This valuable assistance can help protect the jobs of 830,000 people of North Carolina's manufacturing workforce.

IES engineers and management specialists provide on-site technical assistance to help identify excessive costs and faulty processes, determine causes of product defects and make improvements. Help from IES comes in many forms — from a telephone call to an on-site assessment or project. IES assistance has streamlined production processes, reduced inventory and scrap and eliminated wasted employee efforts. IES works with the manufacturer and often conducts projects using the plants' own staff and equipment. The impact of these projects can be measured in production output, technology improvements and more efficient operations. IES does not charge fees for brief consultations and referrals but does recover costs for substantial projects and certain laboratory services. Annual support from the State of North Carolina and federal government helps to defray the cost of project development, allowing these services to be offered at affordable rates. IES specialists often collaborate with other service providers such as community colleges, the Small Business Technology Development Center (SBTDC) and private sector consultants. Last year, $122 million in reduced costs and increased business was poured back into the State's economy.

For more information about programs and services of the Industrial Extension Service, call (919) 515-5377 or visit their web page: http://www.ies.ncsu.edu. IES is an affiliate of the NIST Manufacturing Extension Partnership.

Undergraduate recruitment brochure available

The Office of Academic Affairs in the College of Engineering has produced a new undergraduate recruitment brochure to attract outstanding students to the College. If you know a high school student who might like to receive a copy, call Kay Leager at (919) 515-9669 or write to leager@eos.ncsu.edu and request the "NC State University – College of Engineering Undergraduate Programs" brochure.

Notes

- S. Ranji Ranjithan is the recipient of a prestigious NSF Faculty Early Career Development (CAREER) Award.
- Winser Alexander has been awarded NSF's Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, which honors outstanding mentors and role models in the sciences.
- Thomas K. Miller III has been named associate dean for distance education and information technologies.
- Richard Spontak received the 1998 Alexander von Humboldt research fellowship.
- Jagdish Narayan was named fellow of the Materials, Metals and Minerals Society.
- Thomas W. Stephenson has been elected president of the American Industrial Extension Alliance.
- Salah E. Elmaghraby received an honorary doctorate from University Claude Bernard Lyon I in October.
- Michael J. Rigsbee became head of the Department of Materials Science and Engineering November 16. Rigsbee was professor and chairman of materials and mechanical engineering at The University of Alabama at Birmingham.
- John S. Strenkowski received ASME International's Blackall Machine Tool and Gage Award.
- Michael A. Littlejohn, Distinguished Professor of Electrical and Computer Engineering, was awarded the Alexander Quarles Holladay Medal, the highest honor bestowed on a faculty member by the NC State University Board of Trustees.

Angelo scholarship awarded to Miranda Anne Williams

Williams

Miranda Anne Williams of Kernersville has been selected to receive an Ernest James and Ethel Hudgins Angelo Memorial Scholarship at North Carolina State University. Williams is the second recipient of an Angelo scholarship.

Dr. E. James Angelo Jr. and his brother, William E. Angelo, established the scholarship in memory of their late parents. Recipients must be from Forsyth County and demonstrate an interest in the environment and pursue an engineering degree that will give them the opportunity to work to protect the environment.

Williams is the daughter of Mr. and Mrs. Freddie Odell Williams of Kernersville and a graduate of Robert B. Glen High School in Kernersville. The class valedictorian, she has received numerous academic achievement awards, including the Montegue Award, Math Achievement Award, U.S. Marine Corps Scholastic Excellence Award and the 4.0 Average Award.

Angelo scholarships are valued at $7,500 and provide full tuition, fees, room and board for one-year and are renewable. They are the single largest merit scholarships awarded by the College of Engineering.

Legends racing team finishes third

NC State's Wolfpack Legends Racing Team ended the intercollegiate racing season with a third place finish at Charlotte Motor Speedway May 23. The team competed against seven other university teams in the last race of the 1998 Intercollegiate Association for Racing (ICAR) Legends series. The teams race Legends cars, scale models of the 1934 Ford equipped with a Yamaha motorcycle engine.

ICAR, an affiliation of ABET-accredited engineering colleges, was developed to enhance engineering educational programs through student design contests and participation in auto racing as drivers and crew members. ICAR members hope the racing series will grow into a new national intercollegiate sport in auto racing. Joseph David, associate professor of mechanical and aerospace engineering, serves as the adviser for the Wolfpack team.

Nortel supports scholarships

Gayle Lanier (center), director of DMS100 Release Management at Nortel, presents a check to Dean Nino Masnari (left) and Associate Dean Sarah Rajala (right). The annual gift supports 25 scholarships in the Department of Computer Science and the Department of Electrical and Computer Engineering.

Teamwork and partnership are key to Rajala's success

Accepting tough challenges comes naturally for Sarah Rajala, associate dean for academic affairs in the College of Engineering. From earning degrees in a male-dominant field in the early 70s to becoming the first woman professor in the Department of Electrical and Computer Engineering at NC State, she is a person who doesn't turn away from an uphill journey.

Her most recent challenge comes in leading the academic affairs office for the College of Engineering. Again, she is the trailblazer as the first woman to hold an associate dean position in the College, and after two years on the job, she has already begun to make her mark on how the College serves its students. Her challenge in this new office is to maintain and expand the successful programs already in place, such as the minority engineering program, while developing new programs that address other issues, such as recruiting new students and supporting women engineering students. Since stepping into the position in August 1996, Rajala has made changes that have increased enrollment, emphasized women students' needs and changed freshman student education.

"Coming to academic affairs was a natural progression for me," says Rajala. "As a teacher and a professor, I have always been interested in student issues. I have always wanted to find better ways to help students learn and ways to help faculty better teach students. My primary interest is to make sure that the students we admit receive the best education possible."

To accomplish her goals, she has made partnership and teamwork an important part of her administrative style. She believes that teamwork is especially important in the academic affairs office because success is dependent upon the work of many people, including the faculty, the students and the administration.

"We have to work together to accomplish our goals," says Rajala. "Our office has to work as a team with our faculty and with other colleges within the university to develop programs that support and improve our educational environment."

Developing a program that enriches freshman education and improves retention has been one of Rajala's most important goals. It is a project that has required teamwork within the College and development of partnerships with industry and other colleges on campus. By incorporating the best of many successful experimental programs tested during the past few years, Rajala's team has developed a freshman course that combines math, chemistry and physics concepts with engineering, laboratories with hands-on activities and experiences with design problems that build on concepts learned in class. This fall for the first time, the College is piloting the new Introduction to Engineering experience to all 1,100 engineering freshman.

"We have taken what we considered to be the strengths of the earlier pilot programs and integrated them into this new introduction to engineering experience to provide students with what we hope is a better understanding and appreciation of what engineering is all about," says Rajala. "Our biggest challenge was finding a way to scale up the program to serve 1,100 students. We had to maintain quality and control costs when expanding the program to the full freshman class."

Rajala

While change is often a part of a new administration, Rajala remains committed to supporting programs that have proven successful in the past. She looks for ways to expand existing programs to a broader population.

"We have a very strong minority engineering program," says Rajala. "I am committed to continue strengthening that program because it can be beneficial across the board. We have maintained our status among the top engineering schools in minority enrollment. Other successful programs that we will continue to support are the Student Introduction to Engineering, or SITE, program and the summer program in nuclear engineering. They are very beneficial recruiting tools that provide high school students an opportunity to see what it means to be an engineer."

The success of the minority program has given her ideas about ways to increase the support for women engineering students. Her experiences as an engineering student in the 1970s have made her deeply committed to finding ways to encourage and support women students in engineering fields.

"I was the only woman in my class in electrical engineering and one of only a few women in engineering at Michigan Technological University," says Rajala. "In the early 1970s, women engineering students were not taken very seriously, and there was very little academic support for us as students. Our college has not had a focus on women in engineering so I am interested in establishing more of a focus on women in engineering in partnership with the minority program so we can look for ways to recruit, retain and encourage a diverse population of students. Part of the changes that I have implemented since taking this position, and one of my priorities, was to identify and hire someone who could coordinate and direct women in engineering program activities."

Rajala has also focused on the issue of recruitment for the College. In the early 1990s, engineering colleges across the country experienced a decline in enrollment. As a result, competition for the best students has increased. To meet that challenge, the College established a new position focused on recruiting top students. The resulting climb in enrollment has moved the College back to target levels. Programs initiated by the new recruiter have resulted in an increase in the quality of students enrolling in the College. The average grade point average for entering freshman is now 4.01. Rajala attributes much of the success in academic affairs to the programs that support and encourage students and the efforts of her staff and the faculty to create a good educational environment for the students.

"My goal is to maximize the potential of all our students by focusing on our strengths—the strengths of our faculty, our students and our support programs," says Rajala.

Mini Baja car places high

A team of Engineering students designed and built a mini Baja car that has placed among the top five vehicles in a national competition in Milwaukee, Wisconsin. The student team took first place in aesthetics, first place in braking, second place in overall vehicle performance and finished a respectable 25th in the Baja endurance race in a field of more than 90 teams.

Sponsored by the Society of Automotive Engineers (SAE), the Midwest competition comprises 13 judging divisions, and teams are judged according to set criteria in each. The teams also compete in an endurance race that is run in two heats of two to three hours.

"Our car held together very well during the endurance race," said Julian Lamb, a senior in mechanical engineering and co-leader of the team. "Many of the cars that started the race didn't finish. We were knocked out of the race for about 30 minutes for repairs following a crash, but we were able to make the repairs and go back in and finish the race."

Though a lot of fun, participating on the mini Baja team is also a lot of work. Students often devote as much as 20 hours per week to the project in addition to attending classes and doing homework. The project has its benefits, however. Working on the team gives students an edge in the job market after graduation. The automotive industry likes to have employees who are already familiar with working on team projects, says Lamb.

Team members receive some funding, but they are required to raise money to support the bulk of the project.

"The students have done a great job with this project," said Eric Klang, associate professor of mechanical and aerospace engineering and project adviser. "For the most part, they have designed and built this mini Baja vehicle themselves, based on what they have learned in the classroom and trial-and-error. They certainly deserve all the credit for their success."

The mini Baja project is one of three extracurricular motorized vehicle projects in the Department of Mechanical and Aerospace Engineering.

NC State's mini Baja team placed first in aesthetics and braking and second in overall vehicle performance at the Midwest competition. Pictured with the Mini Baja car are mechanical engineering team members Julian Lamb (left), Jeremy Weitzel (seated in car) and David Motley.

Oil - *continued from page 1*

"As crude is removed from a production well, it frequently becomes too thick due to the drop in temperature of the crude or due to the formation of an emulsion caused by the asphaltene and water content," says Kilpatrick. "It can make extraction almost impossible, and the resulting crude is more difficult to refine."

Kilpatrick

During the extraction of crude oil from a well, an emulsion is formed when asphaltenes stick to the outside of extremely small water droplets in the crude, causing a stabilized mixture of oil and water. In crude oil production, stable emulsions make processing more difficult because the contaminants are suspended in the crude and because the thick emulsion is more difficult to pump out of the well. To remove the contaminants and to make the crude more liquid, the emulsion must be broken down often by stimulating the production well with added solvent or increased temperature.

"By understanding how and why emulsions form in crude and how the different components, such as the asphaltenes, work in the formation of crude oil emulsions, we can find ways to break them down and make them work to our advantage," says Kilpatrick. "This knowledge is helpful both in the process of extracting oil from wells as well as in the refining of the crude oil at the plant."

In addition, this oil refinery research promises to help the oil and gas industry improve its production while reducing the impact on the environment. Crude taken from deep sea wells is often contaminated with salt water. If the refinery processed the crude oil without first removing the salt, the refining equipment would quickly corrode, causing costly repairs. The current technique for removing salt from crude to prevent equipment corrosion requires refineries to use thousands of gallons of fresh water to "wash" the salt water droplets from the crude before starting the refining process. The resulting water is contaminated with salt and other impurities, and it must be cleaned before it is released into the environment. Kilpatrick has found that by manipulating the makeup of crude oil, he can reduce the amount of fresh water needed to remove the salts and other impurities from the crude oil.

Kilpatrick is one of only two or three university researchers in the United States developing these techniques for manipulating emulsions in crude oil extraction and refining. His research is funded primarily by the Petroleum Environmental Research Forum (PERF), a consortium of oil companies, including Exxon, Shell, Mobil, Chevron, Arco, Texaco and several others, formed to fund research into crude oil production in relation to the environment.

"While this research has little immediate impact on the consumer in the form of reducing gas prices at the pump, the knowledge gained concerning emulsion formation is of significant importance to the oil companies and will ultimately affect American consumers," says Kilpatrick. "The processes developed from this research will certainly help make production more efficient, resulting in an economic benefit, and help reduce the impact of production and refining on the environment."

Foundation News

Gardner receives RJR award

Robin P. Gardner, professor of nuclear and chemical engineering and director of the Center for Engineering Applications of Radioisotopes, received the 14th R.J. Reynolds Tobacco Company Award for Excellence in Teaching, Research and Extension in October. The award, which carries a $25,000 prize, was presented before Gardner's lecture, "Radioisotope and Radiation Measurement Applications."

Alumni, friends enjoy Tailgate

Stephen Roberts, head of industrial engineering, and granddaughter, Meghan Emily Picquet, IE Class of 2017, enjoy Tailgate.

More than 700 alumni, friends and staff enjoyed the annual Engineering Tailgate event at Carter-Finley Stadium October 10, prior to the NC State/Georgia Tech football game. Blue skies and warm temperatures were a nice bonus for a day that allowed friends to meet and remember old times at "State College" while enjoying barbecue and all the fixin's.

Chancellor Marye Anne Fox brought greetings. Door prizes donated by the North Carolina Engineering Foundation, the NC State Bookstore and the Alumni Association were presented to alumni. The NC State Band stopped by and helped build up team spirit and enthusiasm for the game to follow. Current student projects and activities were also on display. Everyone enjoyed the afternoon's events. Our thanks to MCI/Worldcom, the exclusive sponsor of this event for the third year.

UTC supports engineering programs

Thompson

United Technologies Corp. has donated $45,000 to support academic programs, scholarships, fellowships and projects in the College of Engineering at NC State University. NC State is one of only 13 focus universities chosen by United Technologies to receive funding.

United Technologies representative Earl Thompson, along with William Campbell and John Davis, presented a check for the funding to Sarah Rajala, professor of electrical and computer engineering and associate dean for academic affairs, following a tour of engineering facilities and a luncheon meeting held June 10.

"This funding will be very important in helping us achieve excellence in engineering education," said Rajala.

The gift will support six undergraduate student scholarships, two women and minority scholarships, six graduate student supplements, the Benjamin Franklin Scholars program, the UTC Excellence in Teaching Award, a graduate teaching fellowship, UTC project and activity grants as well as an academic enhancement fund.

Microsoft donates software

Microsoft Corporation has awarded a "Microsoft Instructional Lab Grant" valued at $80,472 to the Department of Computer Science for software licenses for the new Computer Literacy Lab. Located in Leazar Hall, the lab is a key component to a course designed for non-computer science majors.

"We are pleased to continue our relationship with Microsoft," said Alan Tharp, professor and head of the Department of Computer Science. "These software licenses are very beneficial to our undergraduate program and will allow our students to explore exciting new technologies."

Hoffman endows scholarship

Louis B. Hoffman (ME '48) of Summerfield has generously endowed a scholarship to benefit students in the College of Engineering. The fund will provide income sufficient to generate several annual scholarships for eligible students. Mr. Hoffman is the retired founder and president of Hoffman and Hoffman Incorporated of Greensboro.

Researchers run first full-scale test in new Constructed Facilities Lab

Breaking large concrete structures is usually the job of earthquakes and demolition specialists, but at North Carolina State University, it is the job of John Hanson. His project—testing pocketed spandrel beams—is the first of its kind in the College of Engineering's new Constructed Facilities Laboratory (CFL). Designed and built for large-scale testing, the lab is unique in the United States, housing some of the largest testing equipment available at any university.

Hanson, distinguished professor of civil engineering and construction, is the first researcher to put the new Constructed Facilities Laboratory to the test using full-scale elements of concrete structures. Located on the university's Centennial Campus, the CFL is part of the Engineering Graduate Research Center (EGRC). The facilities make testing designs of large structures possible without using scale models—a major advantage in construction engineering research. Hanson's project will use hydraulic rams reacting against the CFL's strong floor to test precast concrete spandrels, a type of member used to build parking decks.

John Hanson (right) and graduate students David Hawkins (center) and Jeffery Morrison (left) are the first NC State researchers to use the Constructed Facilities Laboratory for testing large-scale structures. The CFL is unique in the United States, housing some of the largest testing equipment available at any university.

"While the designs are very safe," says Hanson, "we need to determine the ultimate strength and the mode of failure."

Sponsored by the Precast Prestressed Concrete Institute as a Daniel P. Jenny Research Fellowship, the project calls for testing two types of spandrel beams, each measuring 36 feet long and 7 feet tall. One type has a uniform cross section designed to sit on a corbel projecting from a column. The other type has a dapped end, a section cut out of the end of the beam, allowing the corbel to fit into the beam. The concrete spandrels are cast with pockets that are designed to hold double tee beams, the beams that support the decks. Metromont Prestress Company of Greenville, South Carolina, supplied the beams for Hanson's tests.

Over time, the industry has refined the design to keep the face of the pockets as thin as possible and to reduce the depth below the pocket. Both of these design modifications can affect performance, says Hanson.

*(See **Spandrel** page 8)*

Foundation holds first annual Dean's Circle dinner

The first annual Dean's Circle Dinner was held Friday, October 9, at the Velvet Cloak Inn in Raleigh. The Dean's Circle members enjoyed an evening with Dean of Engineering Nino Masnari, who thanked donors for their support. Dean's Circle funds generate unrestricted support, which helps the College with the recruitment of outstanding students and faculty, as well as other key efforts. In 1997-98, a record 26 alumni and friends joined the Dean's Circle.

For information on supporting the College through membership in the Dean's Circle, contact the North Carolina Engineering Foundation, (919) 515-7458.

Gray endows scholarship

William "Bill" H. Gray (BSEE '59) and his wife Tipton "Tippy" H. Gray of Charlotte have pledged a total of $25,000 to endow the William H. and Tipton H. Gray Scholarship. Gray is retired from Duke Energy. The scholarship requirements are designated by the department, depending upon merit or need. The scholarship, which is valued at $1,250 per year, benefits students in the Department of Electrical and Computer Engineering.

Engineering Foundation announces new board members

The NC Engineering Foundation (NCEF) is proud to announce its new board members for the Class 2002. Twenty-six nominations were received by the Nominations, Orientation and Recognition Committee of the NCEF. The following six people were chosen to represent the new class: Jeffrey A. Buffo (CHE '86), Manufacturing/Engineering Manager at Nioxin Research Laboratories, Inc., in Atlanta, Ga.; Berry G. Jenkins Jr., P.E. (CE '65), Director of the Highway Heavy Division of North Carolina, Carolinas AGC, Inc.; Ann Conner Kraynik (CE '84), President, Frank H. Conner Company; and Gayle Seawall Lanier (IE '82), Director, DMS100 Release Management, Nortel.

NC State University
College of Engineering
Office of the Dean
Box 7901
Raleigh, NC 27695-7901

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The new Women in Engineering Program, sponsored by the College of Engineering Office of Academic Affairs, offers a support system for women engineering students that includes a peer mentoring program, a student-alumnae network, a day-long retreat and opportunities to participate in tutoring programs for elementary students and outreach teams for K-12 schools. For more information, contact Laura Bottomley, Women in Engineering Program coordinator, at (919) 515-2315 or send e-mail to laurab@eos.ncsu.edu.

Spandrel - *continued from page 7*

The two spandrel beams were specially cast to facilitate the testing. They were cast with sensors embedded in critical locations and with small holes through the pocket face to allow Hanson and his graduate students, Jeffrey Morrison and David Hawkins, to apply a load, simulating the reaction of a double tee beam on the bottom of the pocket. During testing, the sensors are connected by wires to computers that record the effects of loading and evaluate the performance data. The team will apply increasing loads to the bottoms of the pockets, eventually causing the beams to fail.

"We are testing to see where and how the beams will fail," says Hanson. "But we will also address other issues, such as the location of 'hanger' reinforcement within the spandrel and how the deep daps for the columns affect performance."

Once the testing is completed, Hanson and his team will make recommendations to the PCI. The information provided by the research project will help the PCI improve on current designs and help set standards for design, production and use of parking deck spandrels.

Read more news about the College of Engineering on the World Wide Web **http://www.coe.ncsu.edu/news.releases/coe.news.html.** Questions? Call (919) 515-2311.
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