NC STATE UNIVERSITY

College of Engineering News

For Our Engineering Alumni Summer 1998

Civil engineer develops super strong concrete

Neven Krstulovic-Opara holds a novel stainless steel fiber-mat used for manufacturing of Slurry Infiltrated Mat Concrete (SIMCON).

Most people don't think about the tons of concrete in the buildings, bridges and overpasses around them, but Neven Krstulovic-Opara thinks about concrete every day. When the North Carolina State University researcher talks to people about concrete, he flashes images of the Kobe earthquake on the projection screen—gloomy slides of cars crushed beneath cement rubble. "The high performance concrete we are developing can prevent this from happening," says Krstulovic-Opara, assistant professor of civil engineering. "It has a great potential to revolutionize the way concrete structures are built and used."

Krstulovic-Opara's special, new High Performance Fiber Reinforced Concrete (HPFRC) system will possibly save lives, buildings and bridges by changing the way concrete structures fail. It is super strong, durable, comparatively easy to use and economical. (A concrete system is concrete used alone or combined with a reinforcement such as steel bars and/or fibers.)

Since Krstulovic-Opara obtained his doctoral degree at Carnegie Mellon University under the guidance of the original inventor of fiber-reinforced concretes, James Romualdi, he has been developing the new HPFRC systems using steel fiber-mats injected with special concrete grouts. Grouts are made by mixing cement with aggregate and liquids. Fiber-mats are manufactured of recycled stainless steel and are provided in large rolls that can be easily cut and shaped to fit the space or use desired. The fiber-mats add significant tensile strength and ductility, energy-absorbing properties, to the concrete—features particularly desirable for seismic resistant design. These new systems use a technology called Slurry Infiltrated Mat Concrete, or SIMCON, says Krstulovic-Opara.

In addition to developing the HPFRC system, Krstulovic-Opara has also been using it for both repair/strengthening of existing structures as well as building new structures.

"The HPFRC system our team is developing can save time and money when

(See **Concrete**, *page 2)*

NC State team designs construction of lunar habitat, wins national competition

Students and faculty at NC State were shooting for the moon as they created plans that may help NASA develop a lunar station. The team of students and faculty from a broad range of disciplines, including students and faculty from electrical and computer engineering, mechanical and aerospace engineering, civil engineering and the School of Design, developed prototypes of a robot, lunar lander and habitat module to create NASA's proposed living quarters for astronauts and researchers on the moon.

The team took the name HELIOS, an acronym for Habitat Exploration Leaders in Outer Space and a reference to the Greek god of the sun. Their mission was to compete in the Space '98 Robotics Competition, a national competition sponsored by the National Aeronautics and Space Administration and the American Society of Civil Engineers as part of the national Space Education Initiative. Their goal was accomplished when the NC State team took first place (see related story, p.5). The ideas generated by the student teams will be reviewed by NASA personnel and members of the aerospace industry in the effort to meet NASA's goal of making the moon habitable by the year 2010.

"Our designs or modifications of our designs could be what NASA uses to create the first lunar station," said Jason Janet, HELIOS adviser and doctoral candidate in electrical engineering. "It is exciting to play a part in the future of space exploration."

(See **Lunar**, *page 5)*

Concrete - *continued from page 1*

strengthening or repairing existing structures because fiber-mats can be wrapped without much effort around existing columns and beams."

The approach has been experimentally verified: SIMCON was successfully used to strengthen prototype concrete structures which were then seismically tested at NC State's laboratory and which withstood full seismic loading without failing.

Currently Krstulovic-Opara is working with a team of NC State researchers to develop new structural systems that would best employ the advanced features of HPFRCs—high strength, durability, low cost and easy construction. The researchers include Paul Zia, Distinguished University Professor Emeritus of civil engineering; John Hanson, Distinguished University Professor of civil engineering and construction; and postdoctoral research associate, Jamal Shannag. The research projects are funded by the National Science Foundation with some funding for materials provided by Ribbon Technology Corp.

Because failure is inevitable in all structures, engineers have to design the best and safest way for a structure to fail. In conventional concrete systems, steel reinforcing bars (re-bars) give the concrete tensile strength.

For safety and design reasons, conventional concrete is designed so that the re-bars fail before the concrete fails. But steel rusts over time, leading to deterioration and failure of the entire structure. Another problem with the conventional concrete is that during extreme structural stress, such as is experienced during an earthquake, the concrete breaks apart in large chunks and separates from the steel re-bars, causing further damage and injury to the inhabitants.

Krstulovic-Opara's concrete system breaks that tradition.

The HPFRC system is designed to sustain much higher loads and deformations, and when it finally fails, the concrete pieces remain stuck together, held in place by steel fibers.

In addition to its safety features, the HPFRC system may change the way new buildings are built. To build a concrete structure, workers now use a labor-intensive process that involves bending of steel re-bars into specific shapes, constructing wooden or metal forms around re-bars, pouring concrete, followed by removing the forms once the concrete has hardened.

Unlike the conventional concrete systems, the HPFRC system can be easily bent into any shape and used as stay-in-place forms that serve both as forms and as reinforcement. This can reduce the labor costs by eliminating work associated with conventional re-bars and forms. The result is a beam or column that is super strong and more economical than conventional concrete alone.

Another advantage of the HPFRC system is related to a very common problem with many of our buildings, bridges and pavements—durability. Conventional concrete develops large, connected cracks which allow water seepage that over time compromises the integrity of the structure. The HPFRC develops only very small, disconnected cracks. In fact, the cracks are so fine that they are barely visible, reducing the possibility of water seepage. As an added benefit, the HPFRC grout is made with very little water to allow it to be packed tightly into the fiber-mat, causing some of the cement powder to remain inactive. Over time, if water happens to seep in through the fine cracks, it will activate the dormant cement powder, which can close the fine cracks, essentially making the HPFRC system self-healing.

Contrary to other advanced composites, the HPFRC system is designed to use traditional construction equipment and expertise and can thus be easily introduced into the field without major retraining or changes in existing practices.

"This new concrete can reduce the cost of repairing existing concrete structures and give them added strength and durability," says Krstulovic-Opara. "And it can be used to develop new concepts in high performance structural systems. But, most importantly, because of the way we make it, it can easily be transferred from the laboratory to everyday use."

Krstulovic-Opara has just moved into the new Constructed Facilities Laboratory on NC State's Centennial Campus, which has some of the largest testing machinery in the United States and enough power to fully test the capabilities of his advanced composite materials and structures.

"The cost of civil infrastructure constitutes a major portion of the national wealth," says Krstulovic-Opara. "Therefore, its rapid deterioration has created one of the major challenges facing the nation today. Government is very interested in the development of advanced, long-lasting and cost-effective construction materials and systems, which it feels are essential for the long-term economic well-being of our country.

"We believe that the HPFRC system we are developing can provide very attractive solutions to the problems of the deteriorating infrastructure. The exciting thing about our new Constructed Facilities Laboratory is that now we can test our solutions by evaluating behavior of full-scale HPFRC-based structural systems under actual field conditions. We can build an actual bridge or building and test it under seismic loading, test it while exposed to aggressive environments."

Career Fair draws crowd

Latesha Young (right), a senior in computer engineering, discusses job opportunities with Lynne Torning of Anderson Consulting at the first Engineering Career Fair, sponsored by the NC State University Engineers' Council. A large turnout of 1,500 students plus representatives from 58 companies made the fair a big success.

Notes

The awards listed here represent just a few of many. More awards and notes appear at http://www.engr.ncsu.edu/news.releases/coe.awards.html.

- B. Jayant Baliga, Distinguished University Professor of Electrical Engineering and director of the Power Semiconductor Research Center, received the UNC system's highest faculty honor, the O. Max Gardner Award.
- Gwen Bell, NC Engineering Foundation; Rose Hardison, Mechanical and Aerospace Engineering; and Robert Edwards, Industrial Extension Service, each received the 1998 Award for Excellence from the College.
- General Henry Hugh Shelton (Textile Engineering '63), Chairman of the Joint Chiefs of Staff, delivered the spring commencement address at NC State.
- Jennifer Weston, Engineering Publications, received two awards from the Council for the Advancement and Support of Education (CASE) for news writing. She is the only writer in the Southeast to receive this year's Grand Award, the top honor for news writing.
- Walthea Yarbrough-Churn became assistant coordinator for the Engineering Undesignated Program January 1998.
- Paul Zia, Distinguished University Professor Emeritus, civil engineering, was elected an Honorary Member by the American Concrete Institute.
- John Gilligan, professor of nuclear engineering and associate dean for research and graduate programs, chaired the 25th IEEE International Conference on Plasma Science held in Raleigh June 1-4.
- Thomas A. Dow, mechanical engineering and director of the Precision Engineering Research Center, received the 1998 Alcoa Foundation Distinguished Engineering Research Award.
- Y. Richard Kim, civil engineering, received the 1998 Alcoa Foundation Engineering Research Achievement Award.
- Yasuyuki Horie, civil engineering, was named Fellow of the American Physical Society.
- Richard Felder, chemical engineering, received the 1997 UNC Board of Governors Award for Excellence in Teaching and the ASEE Chester Carlson Award.
- George Roberts, chemical engineering, was named Fellow of the American Institute of Chemical Engineering; he also received the AIChE National Student Chapter Adviser of the Year award and NSF Lucent Technologies Fellowship award.
- Joseph DeSimone, chemical engineering, received the Presidential Green Chemistry Challenge Award.
- Carl Zorowski, mechanical and aerospace engineering, has been named a Fellow of ASEE.
- Carl Osborn, electrical and computer engineering, was named Fellow of IEEE.
- Akhtarhusein Tayebali, civil engineering, received the Kimley-Horn Faculty Award.
- Yahya Fathi, industrial engineering, received the C.A. Anderson Award.
- Linda Taylor, Industrial Extension Service, was honored as PENC Young Engineer of the Year.

College holds endowed scholarship dinner

Over 170 scholarship donors and recipients gathered at the Brownestone Hotel for the Second Annual Endowed Scholarship Dinner held by the NC State University College of Engineering April 17. The annual event pairs student scholars with the people who have provided their scholarships for a meet-and-greet reception and dinner.

"This is a very popular event for both the students and the donors," says Ben Hughes, director of the North Carolina Engineering Foundation. "It gives the donors a chance to meet the beneficiaries of their gifts, and the students enjoy having an opportunity to thank the people who are helping them achieve their goals."

Each year the College of Engineering offers over 80 named scholarships from endowments to new and returning students. The College is currently participating in the Campaign for NC State Students, which is intended to increase the number of endowed scholarships offered in the college. So far, the college has received more than $12 million toward a campaign goal of $13.4 million to be reached by December 1999. The North Carolina Engineering Foundation administers the majority of the endowed scholarship funds for the College of Engineering.

Wolfpack Fest on the way!

Mark your calendar for Saturday, **November 28**, for the **1998 Wolfpack Fest**, a pregame (NC State - UNC) brunch and party in Charlotte at the Merchandise Mart. The College of Engineering will host this event along with the colleges of Agriculture and Life Sciences, Forestry, and Textiles, the School of Design and the Wolfpack Club. More details will follow in the mail.

Campaign passes $12M mark

As of May 1, 1998, the College reached $12,248,622 in gifts and pledges toward its $13,390,000 commitment to the Campaign for NC State Students, which has a goal date of December 1999. The Campaign Committee, led by Worley "H" Clark (IE '56) and C.E. "Ed" Vick (BSCE '56, MSCE '60) increased the College's goal from $12 million at its last meeting, thanks to the generous response of you — our alumni and friends. Permanently named scholarship endowments begin at $25,000 (over 5 years) and can be funded with estate gifts, planned gifts, gifts of appreciated securities and cash. For more information on how you can be a part of this vital effort, contact Ben Hughes, Ed Hand or Kelly Porter, NC Engineering Foundation, Inc., Box 7901, 231 Page Hall, NC State University, Raleigh, NC 27695, (919) 515-7458, email: ben_hughes@ncsu.edu.

B. Jayant Baliga: leading inventor in power industry

Have you turned on your computer today? Maybe turned on your air conditioning or started your car? If you have done any of these, then you have probably used a power switch invented by B. Jayant Baliga, Distinguished University Professor of Electrical Engineering and director of the Power Semiconductor Research Center at North Carolina State University.

His invention is the Insulated Gate Bipolar Transistor (IGBT), a device that saves energy and controls power flow in commercial and industrial power systems. It is used in everything electronic, including Japan's Bullet train, air conditioners, electric cars, lighting systems and many industrial and household appliances. The device increases efficiency resulting in the reduction of fossil fuel use and environmental pollution. Recently, this device has been used to make compact, portable defibrillators for saving the lives of cardiac arrest victims. The American Medical Association projects that this development will save 100,000 lives yearly in the United States alone.

Baliga

A member of the prestigious National Academy of Engineering, Baliga was recently named one of the "new candidates for hero status" by Glenn Zorpette in a special issue of *Scientific American* magazine entitled "The Solid State Century," commemorating the invention of the transistor. In his article, "Fifty Years of Heroes and Epiphanies," Zorpette discussed the "legends, heroes and epiphanies" from the history of solid-state electronics. In his history, he specifically mentioned the IGBT as a device that has revolutionized the entire field of power electronics. Zorpette wrote that Baliga is among the rare few who are destined for hero status, joining legends in the field of solid-state electronics.

This spring, the UNC Board of Governors selected Baliga to receive the system's highest faculty honor, the O. Max Gardner Award, as someone who has "made the greatest contribution to the welfare of the human race."

One of the leading researchers on power semiconductors and high-voltage integrated circuits, Baliga is a prolific inventor—he holds 97 patents with 5 currently pending. In addition to his patents, he has written 8 books and published nearly 500 scientific publications. His inventions are known around the world in the power industry.

One of Baliga's most recent research projects led to the invention of the Trench MOS Barrier Schottky Rectifier (TMBS), a new semiconductor component that will greatly reduce power losses in computers, telecommunications and other appliances. He is also working on smart switches for the automobile industry. His goal is to reduce the amount of wiring necessary to operate the various electrical components of an automobile, such as headlights and turn signals.

Baliga joined the College in 1988. He is the founding director of the Power Semiconductor Research Center (PSRC), an international, industry-supported center established in 1991 for research in the area of power semiconductor devices and high voltage integrated circuits and the only university center of its kind in the world.

Baliga worked for 14 years at the General Electric Research Lab in Schenectady, New York, before coming to NC State. He received his MS and PhD degrees in 1971 and 1974 from Rensselaer and his bachelor's degree in 1969 from the Indian Institute of Technology in Madras, India.

Engineers help reduce back injury in home building industry

Springtime brings the sweet perfume of flowers and the soft colors of budding trees, but in the burgeoning Triangle, there's something else in the air — the sound of hammering nails and sawing boards from new home construction. The recent surge in home building is a result of the booming economy, but with increased construction comes a surge in construction-related low back injury. At NC State University, Gary Mirka, assistant professor of industrial engineering, and Leonhard Bernold, associate professor of civil engineering, are working with epidemiologists to reduce the risk of low back injury in the home construction industry.

To conduct this research, Mirka enlisted the help of the NC Home Builders Association, the Raleigh-Wake County Home Builders Association and local contractors. Epidemiologists from Duke University surveyed workers from three high-risk trades—masonry, framing and drywall hanging. From the survey results, the researchers create a baseline of workers' health and comfort.

In addition to assessing risk using the survey's anecdotal information, Mirka is developing tools that will provide biomechanical data to indicate risk factors. To produce a biomechanical measurement model, Mirka initially selected three local builders to conduct on-site studies. He uses tools, such as a lumbar motion monitor, a device that measures and records back movements, and other methods to design a model that can be applied to construction work and can pinpoint the activities that can lead to injury.

"Once we have isolated the activities that can cause injury, we will look at ways to

(See **Injury**, *page 8)*

Lunar - *continued from page 1*

The competition, which was run similarly to calls for government design contracts, was designed to challenge students in traditionally non-space-related engineering disciplines to apply their skills toward the solution of space-based problems. NASA provided a set of specifications, and each team presented design proposals and demonstrated proof-of-concept using 1/12th scale prototypes.

"Our multidisciplinary approach to design and development more closely matches the industry approach to engineering in which teams of engineers from different disciplines develop solutions to complex problems," said William Allen, HELIOS adviser and director of the Undergraduate Design Center in the Department of Electrical and Computer Engineering. "This gives our students invaluable experience for when they leave the university environment and go into industry careers."

Allen and Janet have been working with the group since 1996. Other HELIOS faculty advisers included mechanical and aerospace engineering professors, Abdel Bayoumi and Gordon Lee; Bryan Laffitte, associate professor of industrial design; Philip Lambe, associate professor of civil engineering; and James Tomlinson, research director of the School of Design Research Laboratory.

At the center of the HELIOS team's project is a remote-controlled robot named Thumper. About the size of a small dog, Thumper is a scale model of the machine designed by the NC State team to do all of the assembly and excavation of a lunar habitat before any humans return to the moon.

Thumper is the first student-machined and manufactured vehicle to be used in the competition. It has variable speed control and can work completely untethered. In addition, Thumper sports an on-board video camera with a radio-frequency video link, an extendible boom with a dual-purpose bucket that can both transport the habitat and excavate soil, and a six-wheel positive-traction drive system for better maneuverability.

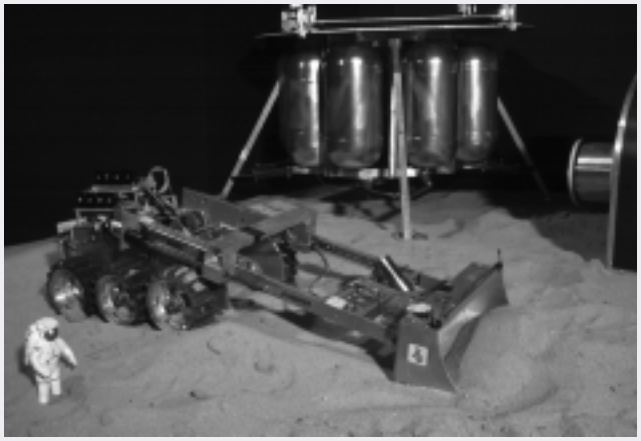
NC State's team had an edge over the competition because of the extra elements they built into their design and engineering plan. They went beyond the assigned task of building a robot capable of off-loading and covering a habitat module, adding ways to conserve energy when building the habitat and provide extra power sources for the habitat and the robot. Many of the components of the rover, lander and habitat were fabricated by students in laboratories on NC State campus. The team also used a movie-quality, computer-generated animation video, created by School of Design team members, that illustrated the functions of the lander, vehicle and habitat.

For students from the School of Design, the project provided the opportunity to interact with a broad range of technical disciplines, preparing them for the type of team-based problem-solving that is often encountered in industry settings. They also learned how their discipline can enhance the design process by helping members better communicate their ideas.

"One of the keys to making teams effective is to make the design process visible so that all can contribute," said Laffitte. "Through the use of such brainstorming techniques as concept sketching and quick mock-ups, the participants from the School of Design were able to contribute to the form of the design process as well as to the form of the final product."

The NC State team kept the designs simple and multifunctional in order to complete the entire mission. They designed retainer walls to reduce the soil needed to cover and protect the habitat modules from Solar Proton Events (SPEs) that would be encountered on the lunar surface. Other solutions included a plan to extend the usefulness of the lunar landers by fitting them with solar panels that collect and store power to recharge the robot and provide a backup power source.

"We are excited about our design," said Janet. "We have made some important modifications to the robot rover that address many of the problems encountered in previous competitions."



A scale-model astronaut stands beside Thumper, the lunar excavation robot. NC State students designed and built Thumper, a lunar lander and habitat for the national Space '98 Robotics competition.

HELIOS team takes top prize at competition

NC State's HELIOS design team took first place in the Space '98 Robotics Competition held in Albuquerque, NM, April 26-30. A second NC State team, CARL (Construction Automation and Robotics Lab), placed fourth in the competition.

Ten HELIOS team members attended the April competition, including Amanda England, Rob Bledsoe, Johnnie Jones, Dwayne Lancaster, Chris Roseman, Scott Pratt, Taylor Arnold, Sara Washburn, John Colthar and Terri Buchanan. Jason Janet, an adviser for the team, also attended the competition.

The team has been working on the project since 1996. More than 60 students and faculty members from electrical and computer engineering, mechanical and aerospace engineering, civil engineering and the School of Design have been involved in the project. The CARL team began work on their entry during the 1997-98 academic year. Leonhard Bernold, associate professor of civil engineering, is the CARL team advisor.

The HELIOS team received funding for the project from NASA, United Technologies, Caterpillar, the NC Space Grant Consortium and NC State University Student Government.

Foundation News

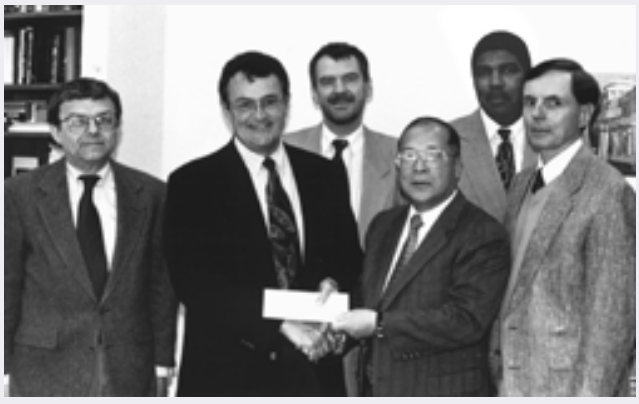
Foundation welcomes new board members

In April 1998, six new members joined the Engineering Foundation Board of Directors for a four-year term: Harry C. Grimmer (IE '60), Charlotte, President of Harry Grimmer & Co.; James R. Jones (ME '75) Raleigh, Founder and President, Datamark Corporation; Ed C. Scott (ME '65), Winston-Salem, management and engineering consultant and lobbyist; Roger M. Scovil (CE '51), Atlanta, Georgia, President of Lockwood Greene International; Robert E. Troxler (EE '83), Raleigh, Research Director at Troxler Electronic Laboratories, Inc.; and E.O. Ferrell (EE '66), Charlotte, Senior Vice President of Electric Distribution, Duke Energy Corporation.

ChE lecture hall to bear BASF name

BASF Corporation has pledged $125,000 to the Department of Chemical Engineering for a much-needed renovation of Room 11 Riddick, which many of you will remember as an auditorium in the basement. The newly expanded BASF Lecture Hall will have multimedia and telecommunications capabilities, added handicap accessibility, greater seating capacity and mechanical improvements. Many thanks to BASF and their employees Larry Blair, Jerry Briggs (ECE '65), Mike Finley, Gary Gibson (ME '62), Diane Kent (Textile Materials and Mgt. '82), Harold MacDonald, John Sullivan, and Phillip Wilson (ChE '88) for help in attaining this shared vision.

Fujitsu shows support



Hisao Kanzaki (third from right), executive vice president for Fujitsu Network Communications Inc., presented a $10,000 check in March to Dean Masnari as part of a $20,000 annual scholarship fund for students in computer science and electrical and computer engineering. Others pictured are (from left) Alan Tharp; Zdenek Holy, director of switching development for Fujitsu; Tony Mitchell; and Jack Brickley.

Square D supports College

Doug Buchanan (right), plant operations manager for Square D Company, presents a check for $50,000 to Dean Masnari. Half of these funds will be used for scholarships, and the remaining funds will provide unrestricted support to the College.

HP donates equipment

Hewlett Packard Company has donated $250,727 in equipment to support undergraduate education in Engineering and Physical and Mathematical Sciences. The HP OmniBooks, Vectra and Pavilion PCs and accessories will be used in NC State's Student Centered Activities for Large Enrollment-University Programs (SCALE-UP), which supports successful pilot programs in engineering and physics education.

GM supports lab renovations

Gerald T. Meier (right), director of manufacturing systems for General Motors Delphi Chassis Systems, presents a check for $80,000 to Chancellor Monteith as part of a $400,000 commitment in support of laboratory renovations for the College of Engineering.

Bullock endows scholarship

William N. Bullock of Greensboro (BSEO '74), executive vice president of Environmental Air Systems Inc., has pledged a total of $25,000 to endow the William N. Bullock Scholarship. Recipients of this merit scholarship, valued at $1,250 per year, must be enrolled in mechanical engineering at NC State.

Distinguished engineering alumni honored

The College of Engineering has named Dr. E. James Angelo Jr. of Jacksonville, Florida, James M. Davis Jr. of Raleigh and A. Fred Gant of Raleigh as 1998 Distinguished Engineering Alumnus award winners.

The awards were announced by Dean Nino A. Masnari at a banquet April 16 at the Capital City Club in Raleigh, as part of the annual Alumni Weekend activities. The awards honor alumni whose accomplishments further their fields and reflect favorably on the university and college.

Angelo, a native of Winston-Salem, is a retired professor and electrical engineer. He received his bachelor's degree in electrical engineering from NC State in 1939.

He worked for Southern Bell Telephone and Telegraph Company in Louisville, Kentucky, after his graduation from NC State. In 1941, he reentered academe as an instructor and later an assistant professor at Tulane University in New Orleans. He continued his academic career at the Massachusetts Institute of Technology as an instructor and graduate student from 1947 to 1952 and an assistant professor from 1952 to 1953. He received his master's and doctoral degrees from MIT in 1949 and 1952, respectively. In 1953, he accepted an associate professorship with the Polytechnic Institute of Brooklyn and was promoted to full professor in 1957.

While on the faculty of the Polytechnic Institute of Brooklyn, he took a leave of absence for a year to serve as a visiting lecturer in electronics at Cairo University and Ain Shams University in Egypt as part of a Fulbright Commission Assignment. He returned to industry in 1968, taking a position with Bell Telephone Laboratories in New Jersey.

Angelo is the author of three textbooks; the second edition of his *Electronic Circuits* textbook has been used around the world as one of the most popular texts of its kind in print. During his career, he developed a number of techniques for the analysis and design of vacuum tube and transistor circuits and unified active circuits with passive electric circuits.

Davis, a native of Rocky Mount, is senior vice president of Power Operations at Carolina Power & Light Company. He earned his bachelor's degree in mechanical engineering from NC State in 1958 and is a graduate of the Harvard University Advanced Management Program.

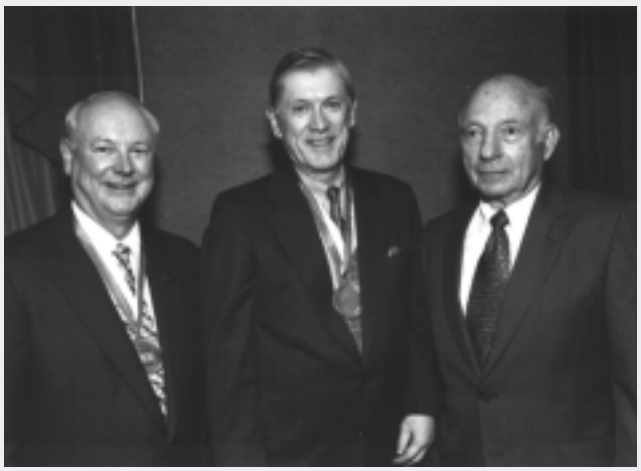
Following service as a reserve officer in the US Air Force from 1958 to 1961, he became a test engineer in the Experimental Engineering Department of Pratt and Whitney Aircraft in Connecticut. In 1965, he joined Carolina Power & Light Company as a heating and cooling engineer. He rose through the company, holding various positions, including manager of Rates and Service Practices, vice president of Fuel and Materials Management and senior vice president of Operations Support, before taking his current position.

A leader of volunteerism, he serves as vice president of the North Carolina Engineering Foundation and has worked on the Campaign for NC State Students. A former president of the Episcopal Laymen of the Diocese of North Carolina, he is a member of St. Michael's Episcopal Church. He is a member of the Kiwanis Club of Raleigh.

A native of Greensboro, Gant is a retired pharmaceutical executive. A graduate of Xavier Military Academy of New York, he earned his bachelor's degree in industrial engineering in 1955 at NC State.

After graduation, Gant held managerial positions with US Vitamin and Miles Laboratories Inc. before moving into corporate executive positions with Merck and Pfizer Pharmaceuticals. In 1980, he was named vice president of Key Pharmaceuticals in Miami, Florida, and served on the Board of Directors of Key Pharmaceuticals of Puerto Rico, Inc. He also held the senior vice presidency and sat on the Board of Directors of Granutec, a drug company in Wilson. During his career, he designed and built high technology pharmaceutical plants in Puerto Rico, Florida, Ohio and North Carolina and directed the process development of transdermal sustained release products and over-the-counter and prescription drugs that sold worldwide.

An active alumnus, he is a member of the North Carolina Engineering Foundation and a volunteer for the Campaign for NC State Students. He is a member of the Canova Society of the United Arts Council, the Raleigh Racquet Club, and the Raleigh Sports Club. He attends Sacred Heart Cathedral in Raleigh.



The 1998 Distinguished Engineering Alumnus Award recipients are James M. Davis Jr., BSME '58 (left), A. Fred Gant, BSIE '55 (middle), and Dr. E. James Angleo, Jr., BSEE '39 (not pictured). William E. Angelo, BSChE '42 (right), accepted the award for his brother. The award honors alumni whose accomplishments further their fields and reflect favorably on the college and university.

Tailgate '98 is October 10

Tailgate '98, sponsored by MCI, will be held Saturday, October 10, for NC State vs. Georgia Tech. We'll have friends, football, fun, and food—barbecue, fried chicken, and all the fixin's. Watch for a flyer this summer telling you how to reserve your tickets. Hope to see you there!

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Injury - *continued from page 4*

reduce those risks by modifying equipment or changing processes," says Mirka. "For example, we are aware that repetitive motion can cause damage to the lower back so we are developing ways to reduce repetitive movements on the work site. The activities that we are looking at as specific, high-risk activities include those that involve awkward postures, such as using nail guns for flooring installation, handling heavy loads, such as moving lumber or dry wall, and repetitive bending and twisting activities, such as those required while laying brick," says Mirka.

Funded by the National Institute for Occupational Safety and Health (NIOSH), the three-year project is in its second year.

"The challenge is to develop tools that reduce load without reducing productivity," says Mirka. "If the cure is too costly, it will not be used and the risk will continue to exist." Mirka adds, "It is our hope that we can bring some of our knowledge of ergonomics to this low-tech industry and improve the longevity of the construction worker. Currently, a construction worker may suffer from low back pain after only a few years on the job. We would like to prevent that from happening so that workers do not end up injured and unable to work."

Two of Gary Mirka's graduate students, Jennie Psihogios and Daniel Kelaher, illustrate the use of a Lumbar Motion Monitor at a construction site to quantify low back stress during construction work activity.

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.
This newsletter is paid for by the NC Engineering Foundation, Inc. No state funds are used. The 35,000 copies were printed at a cost of $5,831.00.