ENGINEERS' FORUM

VOLUME 19 • NO 1 FEBRUARY • 2000

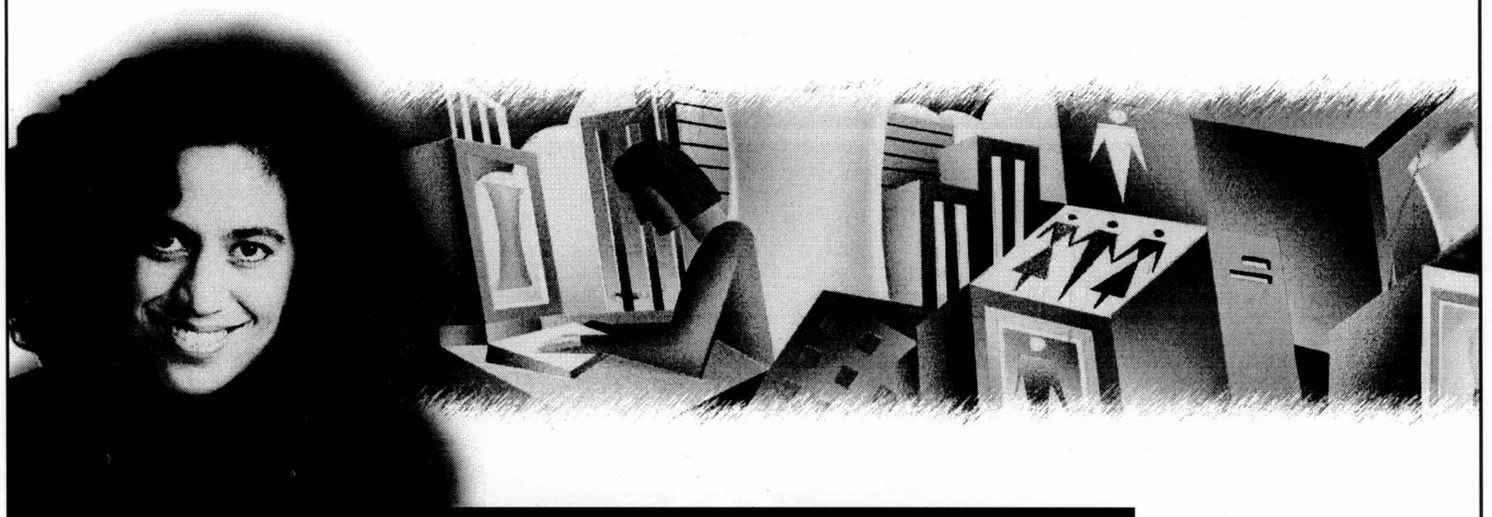
Coal Mining

How does it affect the environment?

E-Week is Coming

Also inside:

Aero Senior Design • An SWE Holiday • Headlines



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What & When:

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Tuesday 22: Fair

10-4: Connection Career Fair
5:00: Edible Tower Contest

Wednesday 23: Interview Day

5:00 Alumnus Guest Speaker
Kendall Anderson: Anderson and Associates-Consulting Engineers

Thursday 24

12:30-2:00 NASA International Space Station Teleconference: "Ventures in Space"
5:00: Alumnus Guest Speaker Hyde Tucker

Friday 25

6:00-10:00PM Monte Carlo Night

Saturday 26

9:30-1:00 Engineer's Week Olympics

*Engineering Department Penny Wars will be held Monday-Friday. Proceeds will go to benefit Montgomery County Science Programs.

Who:

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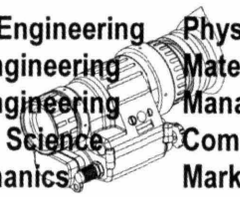

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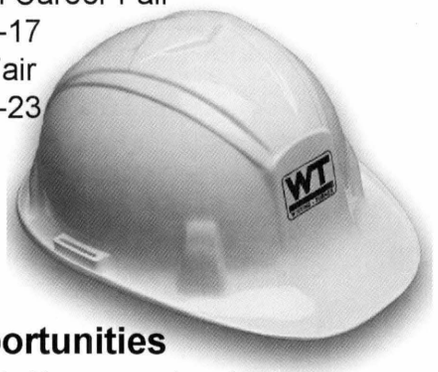

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SWE Brings Holiday Cheer

by Anna McEntee

Members of the Society of Women Engineers at Virginia Tech take a break from studying to and remember there is more to life than HOMEWORK!

What takes over eleven months of planning is over in a whirlwind of four shopping days. Over 1000 families shop at the Montgomery County Christmas Store, and for many, it is the only way Christmas would happen in their households. Those who are no more than 25% above the federal poverty level are eligible to shop at the store. Points, the money system of the store, are assigned based on the number and ages of family members. Shoppers who volunteer their time setting up the store before the doors open, can earn bonus points to be used in any department of the store.

Every year, during the insanity of exams, SWE members make the time to help stock shelves, watch children, and assist shoppers

The Society of Women Engineers is one of many organizations from Virginia Tech and around the community that volunteer their time at the Christmas store. Every year, during the insanity of exams, SWE members make the time to help stock shelves, watch children, and assist shoppers at the store. Being a hostess is one of the more personal jobs for volunteers at the store. A hostess walks around the Christmas store helping one shopper at a time chose items from each department. New and used items are donated from the community and sorted into departments that include clothing for infants to Senior Citizens, household goods, toys, and food. For my self and other SWE members, it is a time we look forward to all year.

The doors to the Montgomery County Christmas store open. My first customers of the day! In their matching army coats, the couple timidly approached me. The woman – looking too old in her clothes – her eyes shining, unable to mask the excitement she felt. The man – tiny yet rough looking – lets his wife go ahead, treating her like the lady she is. They are Christmas shopping for their son Wesley…and maybe something for themselves.

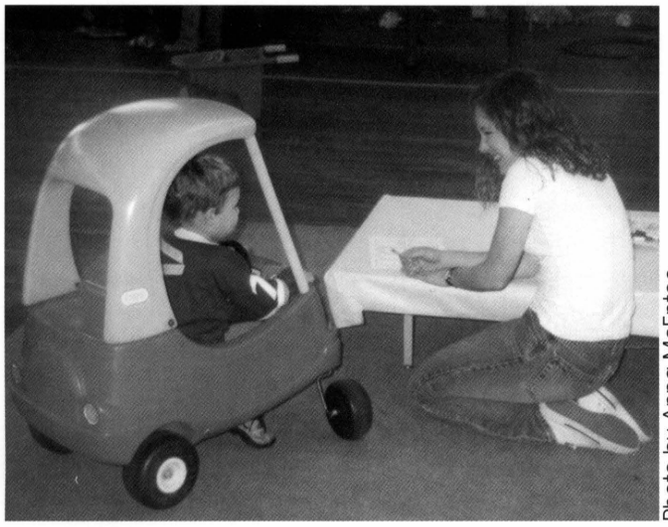


Photo by Anna McEntee

Sara Leavitt encouraging a little boy to draw with her.

Photo by Anna McEntee

Martha Patnovic helps a customer's child in "kids world" make christmas cards.

We take off and start shopping in the clothing department. FREE UNDERSHIRTS the sign says. He cannot believe this. "As many as I need?" he asks me. He takes seven. All of the points allotted for clothing are spent winter clothes for Wesley. She is careful to coordinate the shirt and tie Wesley will wear to church.

Now on to the toy section. He heads immediately for the remote control monster truck – chrome wheels and everything! She is hesitant to spend so much on one toy, but agrees to it because Wesley will love it (and so will his dad, she whispers to me with a smile). They finish picking out stocking stuffers and then we head over to the houseware department. He returns her kindness by agreeing to use their free points all on a set of Garfield sheets. "Garfield is her favorite," he tells me, "actually, she loves ALL cats!"

My second customer is my age. Her one-year-old daughter, Kacie, is sleeping in her arms. As we move through each depart-

Continued on page 18

Mine Over Matter

contributed by: guest writer

The Nature of Mining

Coal mining has been a vital aspect of America's economy ever since the invention of the steam powered locomotive. After the invention of the steam powered generator, the demand for coal skyrocketed. Profit-hungry mine operators had no regard for the environmental impacts of the their work. Soon the mountains of Appalachia would begin to show the devastating effects of mining. Uncontrolled strip mining operations devastated 800,000 acres of land before the Surface Mining Control and Reclamation Act (SMCRA) of 1977 was passed. Once-clear streams have become choked with unknown quantities of silt washing from neglected strip mines and haul roads. An estimated 3.2 million tons of acidic materials are discharged from underground and surface mines annually.

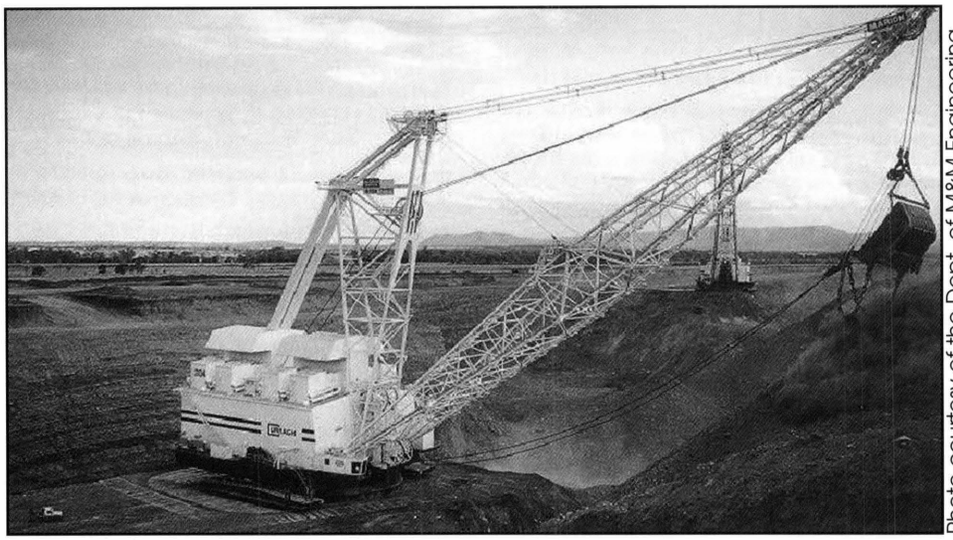


Photo courtesy of the Dept. of M&M Engineering

Strip mines like this one are the most economical way to extract coal and other minerals from the earth, but the environmental clean-up they require is extensive and problematic.

The Surface Mine Control and Reclamation Act was designed to decrease the negative effects of mining by requiring companies to restore current mining sites to their original contour. Once the original contour is achieved, a variety of trees, shrubs, and grasses are planted to prevent erosion. The mining companies are responsible for monitoring the vegetation for five years. Mine operators are also held liable for any environmental problems that occur during the five-year period. To ensure reclamation, SMCRA requires mine operators to pay a significant bond, which is returned upon the completion of the reclamation process. To be efficient most mine operations repair the land as they mine. SMCRA also provides money for the reclamation of abandoned mines by taxing every ton of coal that leaves a mine. The money that is collected from the tax goes into a reserve called the abandoned mine land fund. The abandoned mine land fund is spent on the abandoned mines that are not reclaimed through re-mining. Re-mining is performed when mining companies operate on an abandoned mine that contains profitable coal deposits. Re-mined sites are held to the same SMCRA standards as current mining sites.

The reclamation process is a vital aspect of mining in today's society. It provides a sound way to prevent many undesirable effects of mining—such as acid mine drainage, soil erosion, and increased turbidity in water bodies. Reclamation provides economic benefits created through post-mine land uses such as recreational areas, pastures, tree farms, wetlands, and some forms of commercial development. Another benefit of reclaiming mines is the beauty it adds to the once-devastated ecosystem.

The Surface Mine Control and Reclamation Act has been very successful in controlling the future of the mining industry. However, the act is not efficient enough to remedy the problems of past mining practices. There are not enough companies re-mining and there is an insufficient amount of money in the abandoned mine land fund. There are approximately 150,000 acres of abandoned mine lands (AML) in Kentucky and over 60,000 acres in Virginia. Many of these AML need immediate attention.

The revenue generated by the abandoned mine land fund is spent on abandoned mine lands that have been prioritized by SMCRA. The priorities are based upon the condition of the abandoned mines and the dangers the mines pose to public health and safety. The first and second priority levels of SMCRA deal with the dangers AML pose on public health and safety, the first being extreme danger and the second being moderate danger. A general example of a priority one would be a polluted stream leading into a town's water supply. An illustration of a priority two would be a 200-foot-tall cliff created by past miners. The third priority level projects are the abandoned mines posing environmental dangers to our ecosystems. In Virginia alone, there are an estimated thirty-three years before priority ones and twos will be contended with. There are over three hundred million dollars worth of priority three abandoned mines that are depleting the quality of our environment more and more each day.

Abandoned mine lands are a product of

past miners and pose many problems for aquatic ecosystems. Unsealed deep pit mines leak acid into our watersheds. Abandoned surface mines often exhibit barren to semi-barren landscapes and can have a soil pH as low as 3. This is equivalent to the acidic pH of lemon juice. A lack of vegetation to hold the soil in place creates a scenario where water from rain and melting snow washes acidic soils into rivers and tributary streams. The soil carried from the abandoned mines often contains minerals like pyrite, which releases sulfuric acid as it dissolves. Water running off the abandoned mine increases turbidity, sedimentation, and lowers the pH of our steams.

The Impacts Abandoned Mines Have on Aquatic Ecosystems

Families of terrestrial insect larvae such as Mayflies, Stoneflies, and Caddisflies live in the water and have a major impact on stream quality. Aquatic insects are the foundation of the freshwater food chain. These insects feed in a variety of ways: they shred leaves that have fallen in the water, scrape algae off of rocks, and filter the suspended sediments out of the water, creating pristine water bodies. Aquatic insects are also a primary food items for waterfowl and fish. When in favorable environments, aquatic insects can reach enormous numbers. One study on the New River found over 22,000 Caddisflies in one square meter of water. The weight of this population was over four pounds. Aquatic insects have the potential to change the chemical and physical composition of streams. They filter and breakdown inputs from the terrestrial environment.

Aquatic insects are very sensitive to changes in their environment. Their survival depends on the stability of their surroundings. Streams are directly influenced by all activities on land. When it rains, sediments from abandoned mines get washed into nearby streams. This creates poor conditions for aquatic insects. An event as common as a thunder storm can produce sudden increases in acid mine drainage and turbidity which reduces the variety of life that can exist in a stream. As the sediment that creates the turbid conditions settles to the bottom of the stream, it covers the insects' eggs and their habitats. Fewer aquatic insects filtering the water and consuming organic inputs result in poorer conditions downstream where fish live.

Aquatic insects are often used to measure the damage created by mining operations both past and present . The larvae of Mayflies, Stoneflies, and Caddisflies are monitored the most when measuring stream quality. Scientist monitor these particular insects because they have a variety of habitats and can be found throughout the year. These insects have limited mobility and each species requires specific conditions to survive. Most species in these families, like the Brushlegged Mayflies, live in clear, cool mountain streams with high oxygen concentrations and a neutral pH. Some species, like the Rolledwinged Stoneflies thrive in acidic conditions. If the Rolledwinged Stoneflies are the most abundant species present in a stream then one can conclude that the stream is too acidic for the pH-sensitive insects to survive.

Many streams near abandoned mines appear to be clear and pristine. Most of these streams are sterile due to extremely acidic conditions. A closer look will reveal no aquatic life at all. This type of stream would be considered a priority one by SMCRA standards if it directly influences

Surface Mine Control and Reclamation Act

The Surface Mine Control and Reclamation Act requires that once they close a mine, mining companies must

- **plant vegetation and monitor its progress for five years**
- **restore the original contour of the terrain**
- **be liable for any environmental damage that occurs within five years**
- **pay a large monetary bond, which is returned only after the five-year period**

Environmental clean-up after mining might be encouraged and improved if mining companies could

- **plant vegetation and monitor its progress for just two years**
- **adjust terrain contour to suit post-mining land use**
- **accept no liability for environmental damage after mines are properly closed**
- **clean up according to state officials' site-by-site decisions**

public health and safety (for example, if the stream leads to a reservoir used for drinking water). If the sterile stream were simply to lead to a recreational river, then it would be considered a priority 3.

In order to reduce the negative impacts abandoned mines have on aquatic ecosystems, we need to address the question: Why are there so many abandoned mines that have not been reclaimed? Currently there is no active program with the primary goal of reclaiming abandoned mines.

The Remedy

The Surface Mining Control and Reclamation Act was designed to regulate current mine operations and reduce their impacts on our ecosystems. Existing control of powers are spread among local, state, and federal government agencies. Responsibilities among these agencies are frequently uncoordinated. It has become clear that the variety and complexity of these laws cause problems for mine operators. Current mining companies typically operate in areas surrounding or directly beside abandoned mine lands (AML). Under the laws of SMCRA, mine operators cannot operate on the AML unless they fully reclaim the site to SMCRA standards. The high cost of permitting and reclaiming AML to current standards and the penalties associated with failing to meet these standards discourage mine operators of today from re-mining abandoned mines. Essentially, mine operators avoid re-mining an area where there are severe environmental problems.

One solution currently in debate is a site-by-site decision program. This program would reduce the risk mine operators take on when re-mining abandoned mines by allowing state officials to be more flexible with regulations. It would allow officials to make resonable decisions on a site-specific basis. It would encourage mine operators to re-mine AML by relieving them of certain reclamation standards. The program would reduce the amount of time mining companies are held liable for re-planted vegetation from five years to two years. The mining operators would also no longer be responsible for future environmental problems. If future environmental problems do occur, the abandoned mine land fund would pay for any further reclamation that is needed.

Many abandoned mines contain tremendous deposits of ore that could not have been profitably mined thirty, forty, or fifty years ago. With the technology of mining operations today, the ore that was unprofitable to past mining companies can easily be mined and sold at a significant profit. The Surface Mine Control and Reclamation Act encourages mining operations to practice on land that has not been mined previously.

Changes need to be made in the act to make it economically feasible to re-mine abandoned mine lands. The land is not going to heal itself. Under the current legislation it is obvious that the reclamation process of AML is not efficient. By lowering the standards of SMCRA for AML, we can create a much more profitable industry, a cleaner environment, and a more aesthetic landscape. A lowering of the

standards will create a win/win situation. Public objectives concerning the environmental issues raised by AML would be satisfied and the mining industry would profit considerably. The public would still receive the same enviromental standards that are synonymous to mine reclamation. To be economically feasible, the standard requiring the contour of abandoned mine lands to be in pre-mining condition would need to be negated. The original contour clause should not apply to abandoned mines if re-mining is going to be a feasible option. After re-mining an abandoned mine, the contour of the land should fit the post mining land use. Why spend extra money to achieve the original contour of the land if the post mining land use is going to be a tree farm? No environmental benefits result from reclaiming abandoned mines to their original contour. Reclaiming abandoned mines is much more expensive than reclaiming current mines. This is because all the soil that would normally be used to build the AML to the original contour either got hauled away or it eroded into our streams and rivers.

Many economic opportunities can result from the increase in post-mine land use. Abandoned mines have no positive effects on our environment or society. The cost of mine reclamation is going to continue to rise as the cost of equipment and labor increases. Society cannot afford to wait thirty or more years to put these valuable resources to productive use. Measures need to be taken to make the Surface Mine Control and Reclamation Act a more practical solution to the problems concerning abandoned mine lands. EF

Photo courtesy of the Dept. of M&M Engineering

Restoring terrain contours—even simple ones like this—is extremely costly.

Roadable Aircraft

by Rebecca Gassler

This fall, like many in the past, a group of students from Virginia Tech gave up their chance for a good home-cooked Thanksgiving meal to take a trip to England for their senior design project. There are two teams this year that participated in the program with Loughborough University in Loughborough, England. Each team has a different advisor and a different goal.

One of the teams is tasked with designing a roadable aircraft or flying car. A roadable aircraft is a general aviation aircraft that has the ability to somehow stow its wings and drive like a car. It still needs a runway to take off and land. A flying car, however, is much like something you would see in the Jetsons. It has vertical take off and landing capabilities that would provide door to door service. This design is part of a competition sposored by NASA and the Advanced General Aviation Transportation Experiments (AGATE) consortium. Their goal is to revitalize the general aviation field by providing a less expensive, safer and more user-friendly vehicle.

This team had to first decide what its mission was: roadable aircraft or flying car. In order to do this, both the Tech and Loughborough teams came up with several initial concepts independently. Basic sizes and feasibility studies were done and drawings were completed that would give the other members an idea of what this vehicle would look like. When the groups came together in England, each presented its initial concepts and some pros and cons to the entire team. Then, as a whole, the mission and the concept were decided upon.

While this may seem to be an easy task to explain, it was not so easy to actually execute. First, the team from Virginia Tech is made up of six aerospace engineers, three mechanical engineers, and three industrial and systems engineers. The team from Loughborough University is made up of nine aerospace engineers and four systems engineers (also known as electrical engineers here in the U.S.) So, a total of 25 people from four majors and two different universities had to sit down and quietly discuss the merits of each concept. Andrea Stevens, an aerospace and ocean engineering majot from Tech, said of this decision process, "It's frustrating because it is such a large group and it is difficult to agree on things."

Once this was decided, the team had to be split into technical subteams to work on different components of the design like the structures, aerodynamics, propulsion, and human factors. Many of the teams overlap, so individuals may be signed up for two or three teams. A system of communication also had to be decided. Since there is a five hour time difference between here and England, the window of opportunity for discussion is greatly limited, but teleconfer-

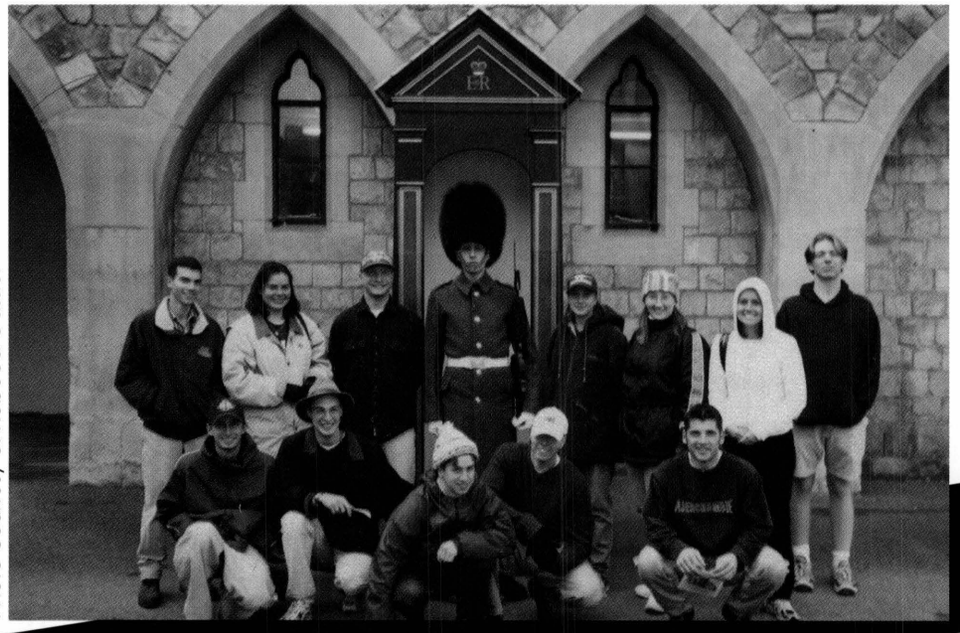


Photo courtesy of Rebeca Gassler

The Team

ences are going to be held weekly this semester. Also, the schedules of the two universities are very different, so the project must be passed back and forth several times so that one-half of the team may continue work while the other half is on break.

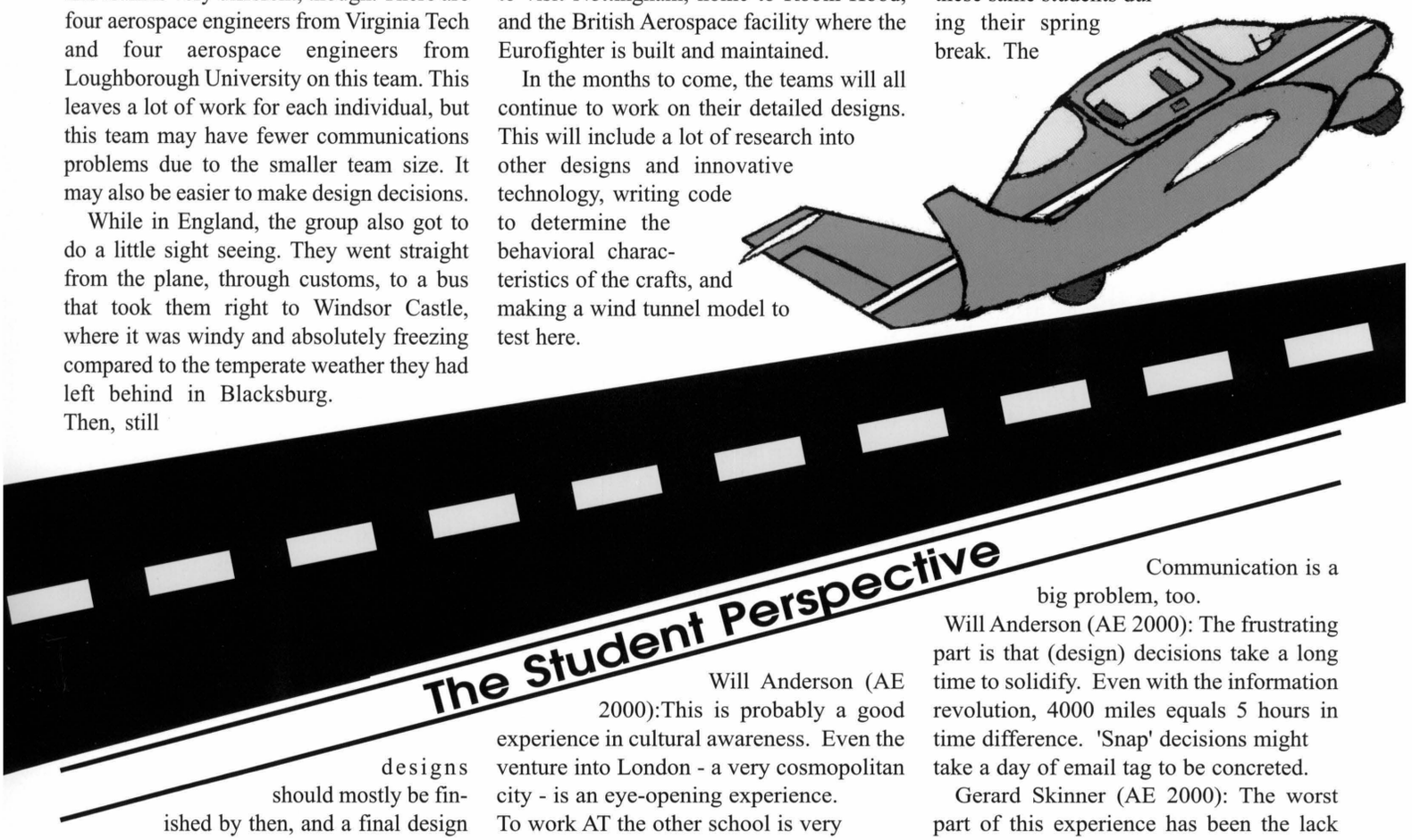
The second team is tasked with designing a cruise missile carrier. As well as serving as a cruise missile carrier, this design is supposed to perform other functions such as carrying cargo and passengers. This craft will be a replacement for the B-52, which currently carries out the missile carrier mission. So, for this project to be successful, it must be cost effective. This will probably be one of the major stumbling blocks in the design.

This team, while in England, operated much the same as the first. The makeup of this team is very different, though. There are four aerospace engineers from Virginia Tech and four aerospace engineers from Loughborough University on this team. This leaves a lot of work for each individual, but this team may have fewer communications problems due to the smaller team size. It may also be easier to make design decisions.

While in England, the group also got to do a little sight seeing. They went straight from the plane, through customs, to a bus that took them right to Windsor Castle, where it was windy and absolutely freezing compared to the temperate weather they had left behind in Blacksburg.
Then, still fighting jet lag and the need to sleep, the group went back to London to do some more sightseeing. They saw the Tower of London, the Tower Bridge, Buckingham Place and the changing of the guard, Picadilly Circus, the Royal Air Force Museum and a lot of subways. Once in Loughborough, the team got the chance to visit Nottingham, home to Robin Hood, and the British Aerospace facility where the Eurofighter is built and maintained.

In the months to come, the teams will all continue to work on their detailed designs. This will include a lot of research into other designs and innovative technology, writing code to determine the behavioral characteristics of the crafts, and making a wind tunnel model to test here.

Later this spring, Virginia Tech will host these same students during their spring break. The designs should mostly be finished by then, and a final design presentation will be developed as well as a comprehensive written report.



The Student Perspective

Dave Leasure (AOE 2000): The design class takes us all the way through the process, from initial concepts to final design. It puts all the pieces learned in preceding classes together to form a comprehensive whole.

Will Anderson (AE 2000):This is probably a good experience in cultural awareness. Even the venture into London - a very cosmopolitan city - is an eye-opening experience.
To work AT the other school is very intriguing.

Trevor Bosen (ISE 2000): It is helpful working with people outside of my discipline and to see how others think and work. It simulates the working environment more than doing a project with people of the same background.

Andrea Stevens (AOE 2000): It's frustrating because it is such a large group and it is difficult to agree on things. Communication is a big problem, too.

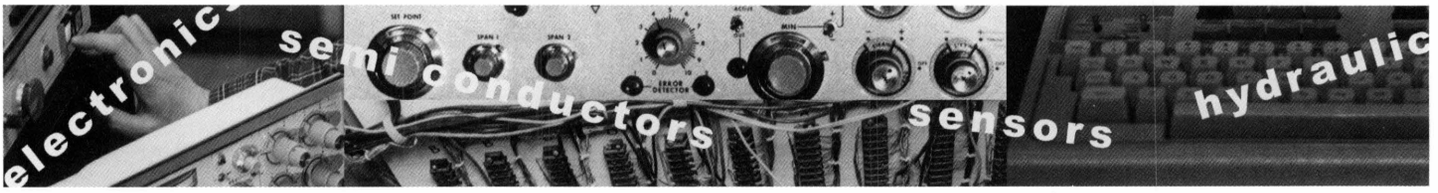
Will Anderson (AE 2000): The frustrating part is that (design) decisions take a long time to solidify. Even with the information revolution, 4000 miles equals 5 hours in time difference. 'Snap' decisions might take a day of email tag to be concreted.

Gerard Skinner (AE 2000): The worst part of this experience has been the lack common times that students from both places are actually in school. Juggling the schedules of the two groups has been and will continue to be a major headache!

Mike Libeau (AE 2000): It's a frustrating experience to watch what you think is a good idea shot down by professors or the rest of the group. I guess it boils down to working with a group and learning when to fight, to compromise, and to submit EF

Campus Headlines

from: staff reports



Premier hydraulics facility opens at Virginia Tech

Virginia Tech will host the premier facility in the mid-Atlantic region for hydraulics research, thanks to sponsorship from an alumnus and government and industry.

The Kelso S. Baker Environmental Hydraulics Laboratory, dedicated in Virginia Tech's Via Department of Civil and Environmental Engineering (CEE), "will significantly enhance our capabilities" to conduct research, said Panos Diplas, CEE professor and director of the new lab.

In the hydraulics lab, Diplas and his colleagues will be able to study phenomena related to the movement of water, sediment and pollutants through wetlands and waterways; model the behavior of stream flow during floods; simulate ecological aspects of channel flows; and develop measures to control scour around bridge piers and other structures.

Kelso Baker, a native of Campbell County, Virginia, graduated from Virginia Tech with a degree in civil engineering in 1951. In 1963, after working as an engineer for the U.S. Army Corps of Engineers and industry, he established a manufacturers' agency in Pittsburgh, Pennsylvania. The Baker Process Equipment Co., Inc., has branches in Charleston, West Virginia, and Cleveland, Ohio, and represents a number of manufacturers.

An active alumnus, Baker is a member of CEE's Alumni Advisory Board and the College of Engineering's Committee of 100, and he and his wife, Vera, belong to the university's Ut Prosim Society. In addition to the donation that helped establish the new hydraulics lab, the Bakers have funded a scholarship endowment in CEE and are regular contributors to Virginia Tech's Athletic Program. The Bakers reside in Sewickley, Pennsylvania.

"The strong dedication of Kelso Baker to Virginia Tech and to CEE is once again demonstrated through the donation establishing the hydraulics laboratory," said CEE Department Head William R. Knocke. "Our faculty and students will reap significant benefits from the generosity that the Bakers have shown to our department."

Sponsors of research activities in the hydraulics lab include the National Science Foundation, U.S. Environmental Protection Agency, U.S. Geological Survey, Pacific Gas and Electric Co., and Virginia Water Resources Research Center.

The Baker lab will increase opportunities for interdisciplinary research at Virginia Tech in the field of hydraulics, Diplas noted. "It also will help CEE recruit top-quality graduate students and provide training to undergraduates as well in the critical areas of environmental and fluvial hydraulics," he added.

Motorola donates $1.3 million worth of semiconductor equipment to Virginia Tech

Motorola, Inc., has made a gift to Virginia Tech of $1.3 million worth of semiconductor manufacturing processing tools, which the university will use in new "clean rooms" to be constructed with funds from Motorola, the Virginia Microelectronics Consortium (VMEC) and the Pratt Fund.

"Virginia Tech made a pledge to educate students for the microelectronics industries in Virginia, and our construction of clean rooms and use of this equipment from Motorola is part of that pledge," said Robert Hendricks, professor of electrical and computer engineering (ECpE) and materials science and engineering (MSE). Hendricks and Richard Claus, also a professor of MSE and ECpE, coordinated the equipment donation with Motorola. Virginia Tech received 25 semiconductor manufacturing tools, which became available when Motorola began shutting down obsolete plants and opening new ones. "The equipment we received is in top condition and perfect for our use," Hendricks noted.

The $1.3 million estimation of the Motorola gift is from the book value placed on the equipment. "If we had to buy these tools new," Hendricks remarked, "we would probably pay 10 times the book value."

Two clean rooms will be built at the university for use by students and faculty in MSE, ECpE, physics and other engineering and science disciplines. One room, in Whittemore Hall, will be used for teaching introductory undergraduate courses in semiconductor technology. The other, in Hancock Hall, will serve as an advanced undergraduate and graduate research facility. The clean rooms will have a combined space of more than 4,000 square feet, said Hendricks, who expects the facilities to be in operation by fall semester 2000. "Students in the advanced research clean room will use the Motorola equipment to actually manufacture semiconductor devices as part of their education,"

Hendricks said. The Motorola gift also will play a major role as Virginia Tech embarks on semiconductor manufacturing research aimed at supporting existing and attracting new microelectronics industries to the Commonwealth.

The VMEC was formed in 1996 in response to decisions by Motorola/Siemens AG and IBM/Toshiba to build multi-billion-dollar microelectronics fabrication facilities in Virginia that will employ thousands of engineers and technicians. The Virginia Tech College of Engineering, which has played the lead role, is joined in the consortium by the engineering schools at George Mason University, Old Dominion University, University of Virginia, and Virginia Commonwealth University and the applied sciences program of the College of William and Mary.

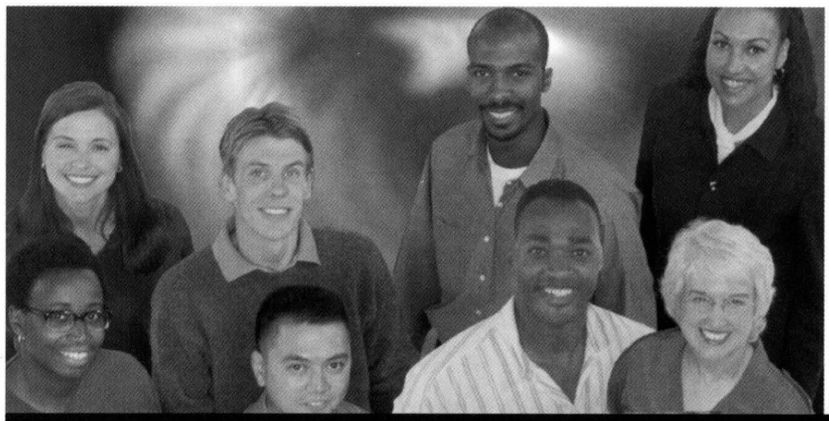
Pooling their research and educational resources in the field of microelectronics, VMEC member schools have pledged to meet the industry's demand in Virginia for skilled employees, continuing education and state-of-the-art research.

Motorola has a history of supporting microelectronics and other programs at Virginia Tech. College of Engineering Dean F. William Stephenson and ECpE Department Head Leonard Ferrari worked with Motorola to develop a 1996 agreement that established an educational partnership for increased recruitment of students for jobs and internships. The partnership also includes strategic equipment donations and support of research.

In 1998, Motorola announced a gift to the engineering college of $100,000 per year for five years to benefit mutual areas of interest concerning semiconductor technology.

Smart Road sensors installed by some of our own

For three months this year, a Virginia Tech engineering faculty member, Imad Al-Qadi, was on the job by 6 a.m., at least six and sometimes seven days a week. The intensity of his work kept him each evening until about 8 or 8:30, and once in awhile, midnight. He went for almost an



entire month without eating a meal with his wife and three children.

But for Al-Qadi, his labor was for a dream come true. He was involved in a once in a lifetime event, and the sometimes sacrifice, sometimes best time of his life was well worth the exhaustion.

A member of the civil and environmental engineering department, Al-Qadi is an expert on pavements. However, his normal workday as a University professor does not include the outdoor life of a construction contractor. In fact, not many contractors keep these hours.

Al-Qadi had the first opportunity of any researcher in the country to install instrumentation in a "smart road," the first highway of its kind to be built from the ground up. He knew the chance was not to be missed.

Identified simply as the Smart Road by Virginia's Department of Transportation, it is a full-scale research facility for pavement research and evaluation of Intelligent Transportation Systems (ITS) concepts, technologies, and products. ITS technologies are all about improving communications between drivers, vehicles, and the highways by using sophisticated computers, electronics, and satellites.

In order to instrument the road with sensors and monitoring equipment, Al-Qadi had to stay several steps ahead of the contractor and not delay the job. Hence, the very long hours were necessary. "He (the contractor) never waited even a day for us," the professor says. All of the instruments were buried inside the pavement as the road was being built.

Nine graduate students, one female undergraduate, and Geraldo Flintsch, also a faculty member in civil engineering, shared the time on the project with Al-Qadi. A timetable was developed to accommodate each student's class schedule, as well as Al-Qadi's classes.

The infrastructure that "we built with the Smart Road is unique,"according to Al-Qadi. A Control Center, allowing remote monitoring and control of the instruments that are embedded in the road, is currently under construction. Also, an underground conduit network, accessible via a manhole cover, provides for the installation of a power and fiber optics data network without creating a safety hazard to vehicles that may leave the normal roadway. The road is also equipped to generate or simulate different types of weather conditions including rain and snow.

In creating these testing areas as the road was under construction, Al-Qadi says the true challenge was working without electricity except what he could manufacture from four generators. "It was a nightmare, especially when working after dusk," he adds simply.

He has divided his road test portion into 12 different flexible pavement designs. Each section is approximately 100 meters long. Seven of the 12 sections are located on a fill area, while the remaining five sections are in a cut through the existing terrain. All 12 sections have a complex array of sensors embedded beneath the road's surface.

"Each section was designed differently to obtain the desired experimental surface and structural capacity, and the pavement drainage is also different. Special sections included a newly developed geocomposite to prevent cracking and penetration by moisture. One surface design has an open graded friction course that will improve vehicular traction and reduce splashes, especially from trucks," Al-Qadi says.

Al-Qadi is using a pavement material

called SuperPave™ for testing purposes. "Virginia is moving to the use of SuperPave™ by the beginning of the new century in most of our roads. We are one of the leading states in using SuperPave™ in our roads as trial sections. The expected benefit is that it will be a better pavement with greater service life and less potholes will occur," Al-Qadi says. "Different binders in the asphalt surface mixes are used including polymerized binder and binders reinforced with fibers," he adds.

"With the Smart Road, each layer of material can be tested for its structural capacity as it is built, and again periodically after the construction of the whole pavement system, using a Falling Weight Deflectometer," he adds. A copper plate is buried between each two layers of pavement to be able to measure the dielectric properties of the materials which will be used to accurately measure the thickness of the pavement layers using ground penetration radar.

As Al-Qadi evaluates the different types of pavement materials and designs and the response of the various materials to different weight loads and to the environment through his array of sensors, his task will be made somewhat easier since the traffic will be controlled. Vehicles traveling on the test section will have prerecorded information such as tire pressure, axle loads, speed, and mismatch of dual tire pressures. Conventional traffic will be prevented from using the test bed area of the Smart Road for the present time.

Another benefit of the sensors is that they are placed so that they are directly under the wandering area of a vehicle's wheel path. If a driver of a vehicle was to start weaving in and out of the wheel path, the pavement response would still be captured. The environmental instrumentation was placed in the middle of the road. Al-Qadi is looking forward to the next stage of his work. "Professionally for me, this work is truly exciting. We have a lot to prove in the testing and design of pavements and in introducing new technologies to increase their service life at the lowest possible cost with the least amount of downtime for maintenance. This is always a challenge," he says. EF

Students: If you have an engineering-related story that you might want published then send it to us at forum@vt.edu with your name and number.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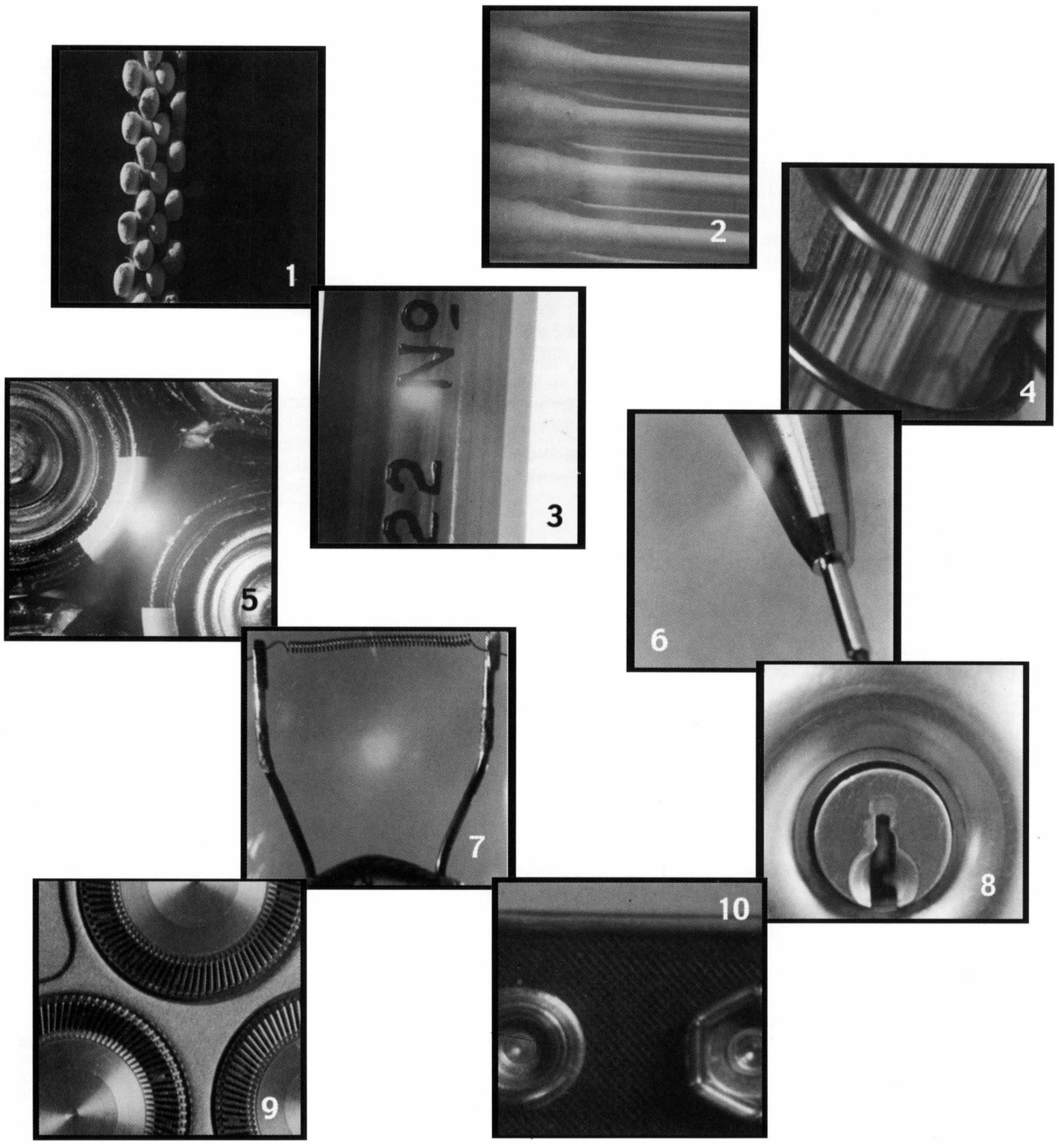
Engineers' Forum Quiz

WHO AM I?



1. matches 2. cotton swabs 3. pencil 4. notebook 5. batteries 6. mechanical pencil tip 7. light bulb 8. lock 9. mechanical razor 10 12V Battery

Photo by Sara Leavitt

Anna McEntee restocking shelves in the "canned goods" section.

SWE Holiday

Continued from page 5

ment and she decides what to buy Kacie, I realize we are, in different ways, years ahead of the other, yet years behind. She is talking with me about having to decide about her daughter's healthcare. The day before, I finished writing a research paper on the how engineers have contributed to the technology used in today's hospitals. A similar topic, yet worlds apart.

Upstairs, two other SWE members are helping out in the nursery. Sara Leavitt and Martha Patnovik are both freshmen in Engineering and this is there first time volunteering at the Christmas store. When children come up to the play center, Sara and Martha first take them through the children's store, helping each child select a present for their family. After which, they can spend the remainder of their time making Christmas cards, watching videos, or making Play-Dough pizzas. As we leave the store that afternoon, Martha tells of one little girl who talked about neither of her parents having jobs. "I just can't imagine having to raise three children with no job…it made me remember how hard some people have it," Martha said.

We all left the store in the best mood. Thankful for all we have, have had, will have…and what we received that day. All too often in engineering, we get into a routine that keeps us so busy, we forget that getting good grades and getting the best job offer upon graduation is not what makes the world go around.

The Montgomery County Christmas store is just one event SWE members volunteer their time with each year. Earlier in the semester about 20 members and friends of SWE braved the sleet and arctic winds of Blacksburg to paint a rundown playground. Working with the Women's Center and the Math Department of Virginia Tech at events like Math Day for Girls and Bring or Daughters to Work day, SWE members are able to help little girls feel confident about math, science, and themselves. To promote engineering as a stimulating, exciting, and rewarding field to study, SWE sponsors an annual Exploring Engineering Girls Scout Day. Local elementary school Girl Scouts participate in a day of hands-on activities led by SWE members and leave with the knowledge that they too can be an engineer. EF

To become involved in The Society of Women Engineers of Virginia Tech, stop by the office in Hancock 216, email VT-SWE at swe@vt.edu, or visit our web site at http://www.vt.edu:10021/org/SWE/ to learn of past and future events and general meetings.

from the email bag

forum@vt.edu

BUILDING A FENCE

An engineer, a physicist and a mathematician have to build a fence around a flock of sheep, using as little material as possible.
The engineer forms the flock into a circular shape and constructs a fence around it.
The physicist builds a fence with an infinite diameter and pulls it together until it fits around the flock.
The mathematicians thinks for a while, then builds a fence around himself and defines himself as being outside.

TOP SIGNS THAT YOU HAVE A NET ADDICTION

1. You wake up at 3 a.m. to go to the bathroom and stop to check your e-mail on the way back to bed.

2. You get a tattoo that reads "This body best viewed with Netscape Navigator 1.1 or higher."

3. You name your children Eudora, Mozilla and Dotcom.
4. You turn off your modem and get this awful empty feeling, like you just pulled the plug on a loved one.
5. You spend half of the plane trip with your laptop on your lap...and your child in the overhead compartment.
6. You decide to stay in college for an additional year or two, just for the free Internet access.
7. You laugh at people with 2400-baud modems.
8. You start using smileys in your snail mail.
9. Your hard drive crashes. You haven't logged in for two hours. You start to twitch. You pick up the phone and manually dial your ISP's access number. You try to hum to communicate with the modem. And you succeed. Now admit it... How many of you have made "modem noises" into the phone just to see if it was possible? :-)

FOR THE GRADS

Reaching the end of a job interview, the Human Resources Person asked a young Engineer fresh out of school, "And what starting salary were you looking for?" The Engineer said, "In the neighborhood of $125,000 a year, depending on the benefits package." The interviewer said, "Well, what would you say to a package of 5-weeks vacation, 14 paid holidays, full medical and dental, company matching retirement fund to 50% of salary, and a company car leased every 2 years - say, a red Corvette?" The Engineer sat up straight and said, "Wow! Are you kidding?" And the interviewer replied, "Yeah, but you started it."

letter from the
editor

The end of the world, or not

by Rebecca Gassler

Well, it finally arrived. The year 2000 is here. Note that I said "the year 2000", not the new millennium, but that is another issue altogether.

With all the hype, I expected a much bigger event, both socially and technologically. Many people I talked to said they were staying close to home, not spending way too much money to go to the large parties and concerts that seemed to be at every hotel in the country. This aversion caused many places to then cancel these big blowouts because of a lack of interest. I guess no one checked with the common folk when they set those prices . . . or maybe they were scared of the trains that were going to crash, the missiles that were going to fire, the banking systems that were going to go beserk, and the rioting and looting that was supposed to ensue. *Newsweek* did an online poll of what people thought of the New Year's celebration and 24% said it didn't live up to the hype and that they were disappointed. Six percent said that it was overly affected by fears of terrorism and seven percent said that they thought that the celebrations were overly affected by fears of Y2K.

So, I guess the question is, was there really a huge Y2K problem or did the government and the technological sector blow that whole thing out of proportion?

I really do believe that there were problems with older software and systems. I have often written code with flags like 9999 or gone on the assumption that the first two digits of the year would be "19". And, although many companies started updating their systems very late, everything got done on time. Contractors were busy and small computer firms made a lot of money specializing in Y2K problems.

The media kept us up to date on these problems by explaining at least once a day how the world was going to fall apart. I like to be as informed as the next person, but I was so tired of hearing about it. For most of us, there was nothing we could do to solve the problem. It's not like I was going to wake up one morning and go to some government office, knock on their door, and offer to write patches to all their non-compliant software. Part of the workforce did write those patches, but it was in their job descriptions. They didn't need the media to scare them into it.

Then, the media changed their tune. Did anyone else notice this? A couple of weeks before New Year's, the reports started to come in — the power grid was fine, the banks were fine, the military was fine. They said there may be local problems like brownouts or isolated personal computer problems. Most places didn't even experience that. Before we went out for our own New Year's celebration, we turned on the T.V. expecting some earth-shattering news. We wanted to hear that whole economies had come crashing down or that entire cities were without power. I mean, we didn't want any people to be harmed, but we wanted to see something, anything happen. All we saw were some drunk news anchors and Times Square from every angle possible.

I'll have to admit, I was kind of worried about my computer. It's 4 years old, running the first version of Windows 95 and I didn't bother to download the patches for a single program I use. I came back from break, booted it up, and it was fine. Now, if my computer made it through the crisis, I have a feeling that most others did too!

Whatever lesson you take away from this, just be grateful that we won't be around for the next millennium.

So, what lesson did we learn from this? We shouldn't wait until the last minute to do our work. Or maybe that we should talk about the problem so much that no one cares anymore, but at least we're covered if something does go wrong. Or maybe that we should blow the amount of work so out of proportion that when it all gets done, we look like heroes. Whatever lesson you take away from this, just be grateful that we won't be around for the next millennium.

On another note, this will be my last letter to you as the editor. I am graduating in May and moving on after four years on the *Forum* staff. So, until you join the real world with me, study hard and keep on reading!

Rebecca Gassler

Rebecca Gassler

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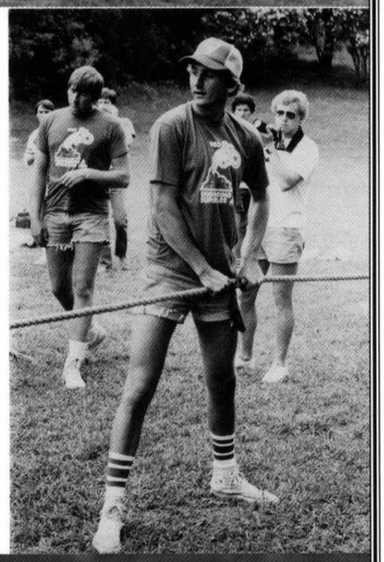

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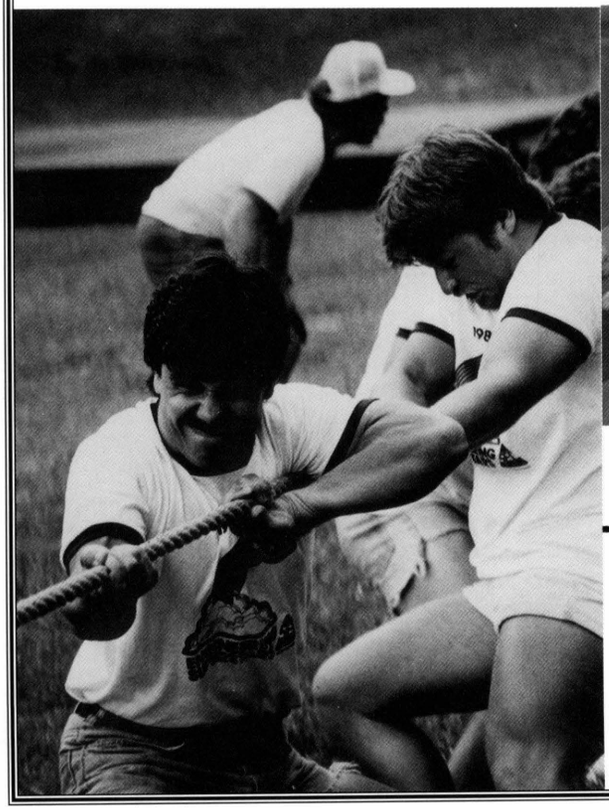

Join our side!

Contact:
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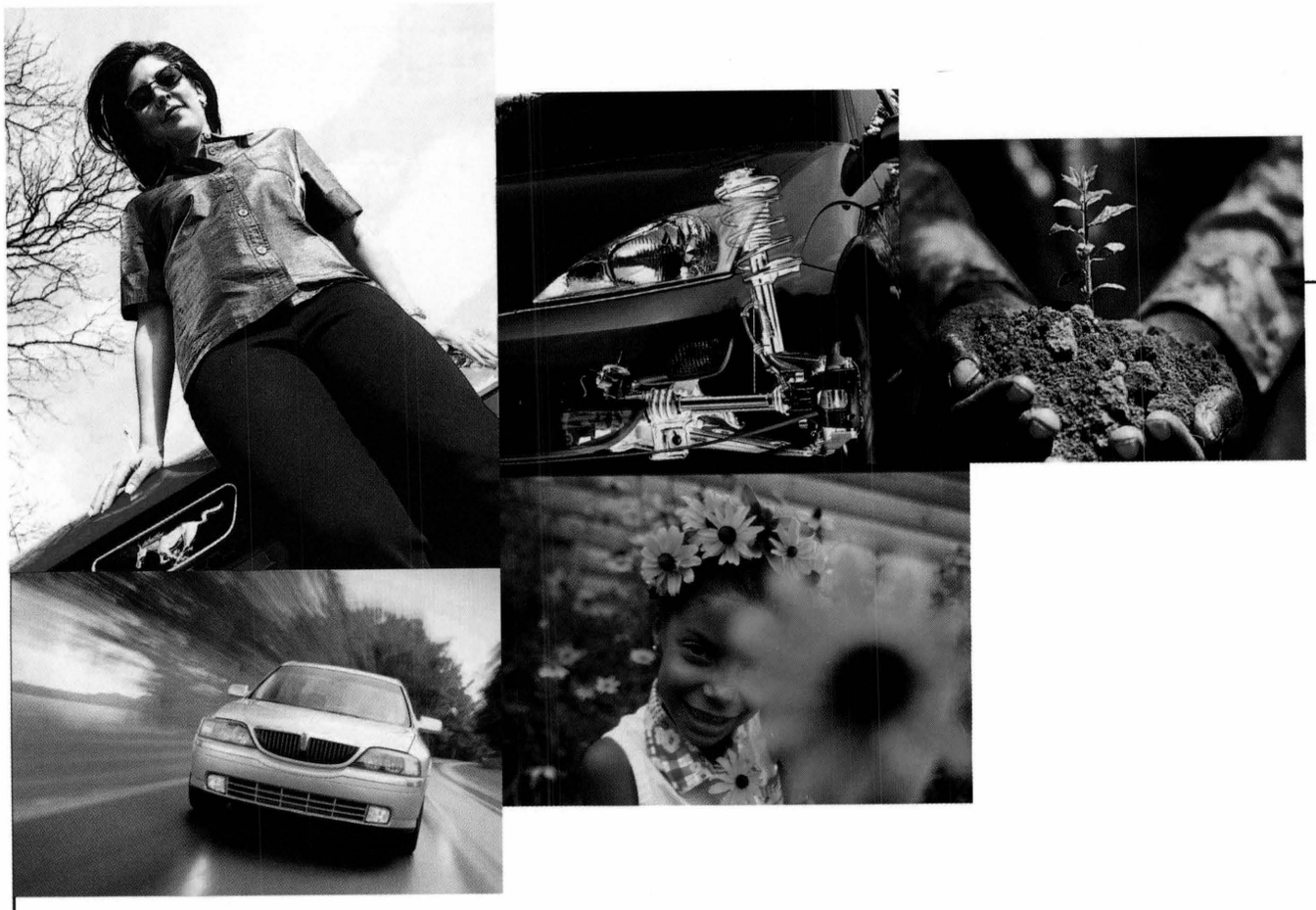
231-7738



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