VIRGINIA TECH
COLLEGE OF ENGINEERING
ENGINEERING NOW 2009

ENGINEERING NOW

Contents

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ENGINEERING NOW 2009

With the college's new revenue stream,

it is the best time to be a

HOKIE
ENGINEER

In the past two years, Virginia Tech's College of Engineering has greatly improved its instructional facilities, renovating laboratory space, updating equipment used for teaching, and redesigning space to better meet students' needs.

In some cases, teaching equipment was more than 80 years old, such as the wind tunnel used by the aerospace and ocean engineering department. In other cases, we considered environmental problems, such as an outdated system that needed proper venting to maintain good air quality in a windowless room, as well as a floor that was built over old creosoted wood joists. We also found that maintaining computer labs for computer science students when they carried around their own laptops did not make sense. It would be better to provide them with access to specialized machines.

The articles on the following pages will provide more elaborate, concrete examples of how we have improved our undergraduate education in the past two years. Due to space constraints, we are not able to feature all of the improvements made by our 13 departments. However, we want you, the reader, to understand that all students in our undergraduate curricula are benefiting from the engineering fee.

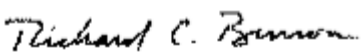
We were able to improve our already highly ranked undergraduate program — 14th in the country according to the *U.S. News & World Report* survey — because of the engineering fees approved by the university's board of visitors in 2007. Prior to this enactment, Virginia Tech had not differentiated in its cost of undergraduate instruction. However, the university had computed that undergraduate engineering costs $117 more per credit hour than the overall university average, making it the most expensive undergraduate program at Virginia Tech. This cost is driven largely by the essential role of laboratory and design work in our curricula.

Our engineering fee ensures the continued availability of the necessary resources to support our excellent engineering program. As dean, I have instructed that the revenue from the fees can be spent only on instructional labs. Thus, all students who enroll in engineering courses benefit. To ensure that costs are equally distributed to students taking engineering courses and students in joint-degree programs, the fee is applied in relationship to the actual courses taken. Off-campus students and online students participate equally.

The $30 per-credit-hour charge has the potential to generate more than $3 million per year when fully implemented in 2010-11. Obviously, the freshman pays less as he or she is taking fewer engineering courses. Upperclass and graduate engineering students incur greater charges.

The College of Engineering is extremely excited about the changes occurring in its various departments through the use of the engineering fees. They allow us to maintain and enhance the quality of our "Hands On/Minds On" philosophy of education. In the past, the rapid growth of technology made it difficult for an institution of higher education to provide state-of-the-art classroom environments. As a state school, we were not able to rely on any steady stream of funding for instructional labs. The engineering fee has addressed this problem, and we hope you will enjoy the following pages that provide concrete examples of our improved educational system.

Sincerely,



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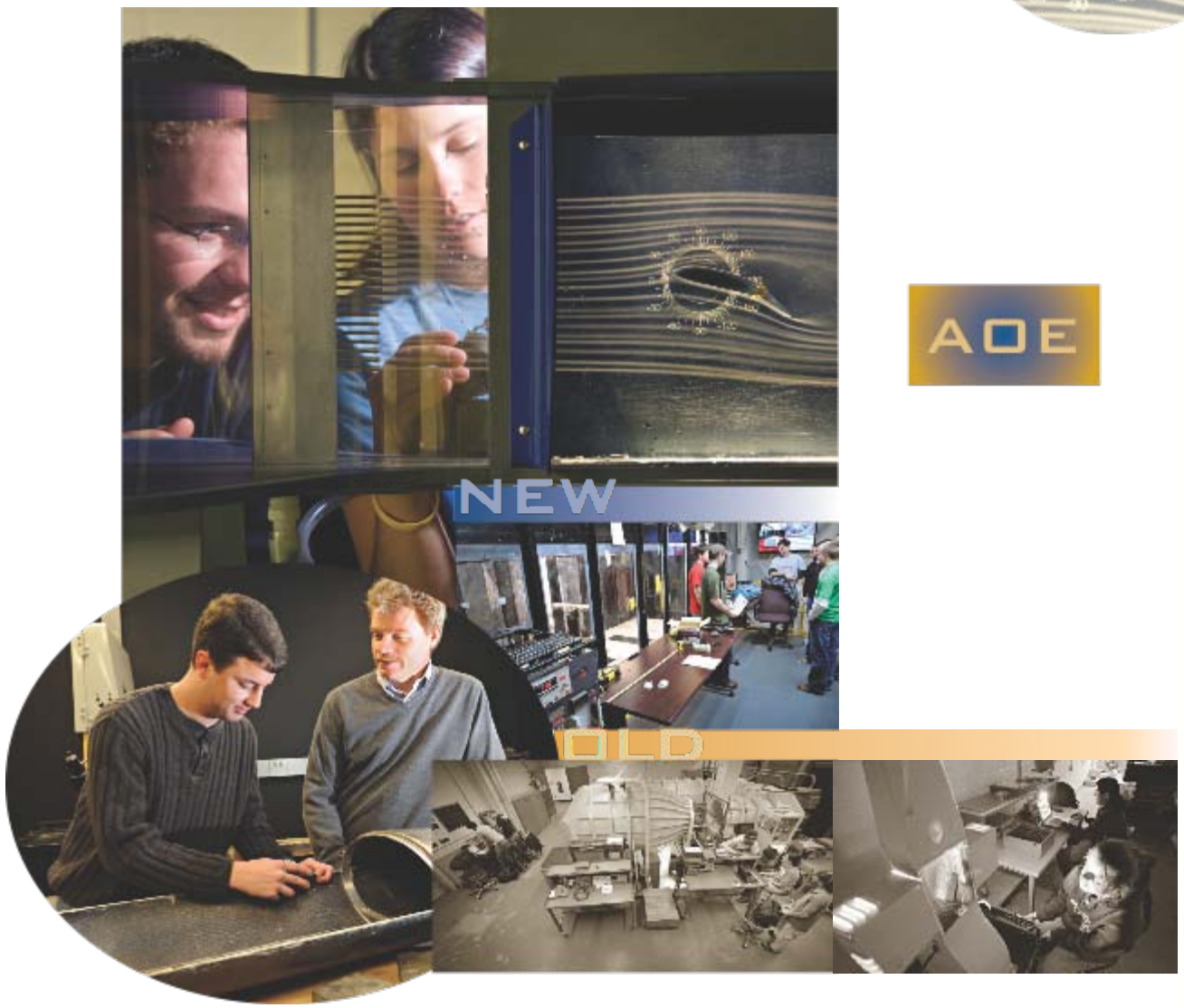
Aerospace and Ocean Engineering (AOE)

Launching a major facelift, not just a few nips and tucks



Equipment as old as Methuselah — okay, maybe not quite — is being replaced and the incoming engineering classes will be reaping major benefits.

Topping the list for replacement is the historical open jet wind tunnel that takes up much of the space in Virginia Tech's Randolph Hall basement. Sometime in the 1930s, speculated Chris Hall, head of the AOE department, this wind tunnel was built for model testing to serve as an educational laboratory for the Engineering Experiment Station, then under the directorship of Earle Norris. At that time, the acquisition of this training tool was a coup, trumpeted in 1937 in the Bulletin of Virginia Polytechnic Institute. Later, this facility was moved

"No one is a bigger fan of the engineering lab fee than I," said William Devenport, AOE assistant department head for laboratory facilities. "The lab fee has provided the inspiration for these improvements and the means to make them a reality." He also noted other improvements that have been made possible through the lab fee, including an LCD video system that undergraduate students now use to operate the department's supersonic wind tunnel. "We decided it was not safe for people to be in the lab when the facility is in operation, but with the video system, they can control the wind tunnel and see what goes on inside the lab. In general, we are raising the level of experience the undergraduates can have, and the

to the newly constructed Randolph Hall and used successfully to test the aerodynamics of the historic Mackinac Bridge of Michigan, the third longest suspension bridge in the world when it opened in 1957.

But after many decades of use, the old wind tunnel's issues started to outweigh its educational value. It is not alone. Other antiquated pieces of equipment that Virginia Tech's AOE undergraduates have used for decades, such as a pressure measurement system and the smoke visualization wind tunnel, also concerned Hall and the other AOE faculty members. This latter piece generated streams of smoke so students could see the airflows around various models. The problem was that the smoke is generated by vaporizing kerosene, and the resulting fumes had to be vented out of the windowless basement of Randolph Hall. "Our new smoke tunnel will operate on water vapor," an environmentally sounder way of exposing the students to the concept of shapes of wings and blades, Hall explained.

"We are trying to put a new face on everything," Hall said. When deciding on how to best spend the engineering fee money dedicated to AOE, "we met with our juniors and seniors to obtain their input. They raised a lot of concerns, even about little things, such as tools for a student shop, and even getting printers," Hall said.

When the classes resumed in fall 2009, the students found a new research-quality open jet wind tunnel surrounded by new state-of-the-art instrumentation and equipment, including a computer-controlled traverse, a pressure scanning system, and the new water vapor flow visualization facility. The entire laboratory will have also been renovated and reorganized into a much better teaching space.

upgrades are also having a positive effect on the research laboratories."

And because of students' suggestions, AOE now has a model-building shop. "The students told us they were unable to access the Ware Lab (as it is already filled with student projects), so we found the perfect spot to remodel for them — a room next to the loading dock and our machine shop," Devenport said.

The improvements brought by the lab fee have been augmented by improvements in student access to the college's large-scale commercial facility — the Stability Wind Tunnel. "We are significantly increasing the undergraduates' use of the wind tunnel, both inside and outside required classes. Student groups can now write proposals to obtain wind tunnel time.

"We are just beginning to see the impact of the engineering fee. It will help with our nationally renowned program," Devenport added. AOE currently ranks 10th and 16th in the nation at the undergraduate and graduate levels, respectively.

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Biological Systems Engineering (BSE)

The fee will help BSE reach its top-five goal

BSE

When the Department of Biological Systems Engineering (BSE) learned that they would be receiving income from the College of Engineering's engineering fees, Saied Mostaghimi, department head, knew immediately how he could best serve his undergraduates. BSE would now have its own unit operations lab, previously conducted in five different locations, and an instrumentation lab.

The entire first floor of Agnew Hall, adjacent to Seitz Hall where BSE is located, received a much-needed facelift, providing the undergraduates with the types of facilities that the top 10 BSE

"We pulled the instrumentation course apart to decide what our BSE students really need, what they have to monitor, and what do they have to control," Mallikarjunan said. The large industries that employ BSE students are looking for employees who have "specific skill sets" when it comes to dealing with biological systems. "Biology often fights back," and there can often be false positives, he added.

"We need students who can work with the instrumentation. They need to know why something doesn't work, how to fix it, and how to evaluate different pieces of equipment. This can only be done with

departments in the country already have. Since Virginia Tech's BSE department has already moved to seventh for the quality of its graduate program in the 2009 *U.S. News & World Report* survey, up from its previous ranking of 12th in the U.S., Mostaghimi said he expects that enhancement of BSE's teaching laboratories will help realize the department's vision of ranking among the top five U.S. programs. "Facilities and equipment have been our problem, and now the engineering fee is providing the opportunity to address that," he said.

For the first time in the history of the department "we are now able to designate a 'wet' teaching laboratory customized to meet the needs of our students, which we could not have accomplished without these additional funds," he added. "The engineering fee is a godsend."

The new unit operations facility provides BSE students with the ability to learn about bioprocess engineering in small groups using new equipment. They might use the bioreactor for fermentation or work with proteins for use in bio-pharmaceuticals. "When we were in five locations and using research equipment to teach, we had to employ several graduate teaching assistants to help all of the students," Mostaghimi said.

"And since we never had an instrumentation lab for our students, we were sending them to mechanical engineering and engineering science and mechanics (ESM) to take instrumentation courses where the content was not suitable for BSE students. When the instrumentation lab was cross-listed with ESM, our students found it to be an unhappy marriage," explained Kumar Mallikarjunan, associate professor of BSE. ESM Professor Muhammad Hajj "deserves high accolades for trying several scenarios to manage the course, but when he tried to include the needs of the BSE students, then he could not cover what his ESM students needed."

hands-on methods," Mallikarjunan said.

"Our instrumentation course focus is on the development of biosensors for rapid measurements in complex biological systems. An example might be micro-electric-mechanical (MEMS) based biosensors for detecting foul odors in a bioprocessing facility or a microfluidics type DNA-based biosensors for detecting pathogenic bacteria in food or in water," Mostaghimi said. "As an emerging field, biosensors development has a wide range of opportunities for BSE graduates and we would like to get them ready for such challenges."

The BSE program is enjoying renewed popularity among engineering students, with its undergraduate class almost tripling in the past few years and its graduate enrollment moving from about 20 in 2003 to approximately 65 today, most of whom are doctoral candidates.

The BSE program "brings engineering to life" by combining biological sciences and engineering. The undergraduate program focuses on two areas of bioprocess engineering and land and water resources engineering. The engineering fee has enabled BSE to develop the badly needed facilities for its undergraduate students. Future plans include purchasing new teaching equipment for the department's wet teaching laboratory. "We strive to provide world-class education and training to engineers who use their talents to make our world a better place," Mostaghimi said.

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Civil and Environmental Engineering (CEE)

Unfortunately, laboratories just don't age like fine wine

CEE

When one refers to an early 1930s vintage, one might hope the reference is to a fine wine. But when the reference is made in regard to one of Virginia Tech's main engineering buildings, Patton Hall, the 80-year-old plus status can instead give cause for heartburn.

William Knocke, the head of the Via Department of Civil and Environmental Engineering (CEE) from 1994 until 2009, spent much of his administrative time dealing with the improvement of facilities for his top-15 ranked undergraduate department. So when the engineering fee allowed him some flexibility, he immediately looked at how he could "gain the most bang for the buck." The key in each upgrade included "hands-on" work, a vital component of Virginia Tech's teaching philosophy in engineering.

It's unusual for a top-ranked environmental program (15th in the 2009 *U.S. News & World Report* chart), to not have an environmentally based instrumentation laboratory for undergraduates. "We taught it as a two-dimensional science," Knocke explained, "but by 2010 the students will be able to perform hands-on process experiments,

The CEE measurements class, with an enrollment of some 400 students per academic year, also benefitted greatly from the undergraduate engineering fee. Randy Dymond, a CEE professor who has won numerous teaching awards from his students, said the fee allowed the purchase of new surveying instruments that permit the undergraduate students to measure distances, existing terrains, buildings, sidewalks — just about anything in its line of sight.

Worried about the large number of students, Dymond and his colleague, Jeff Connor of engineering education, selected a manufacturer that provided the best learning opportunities for the undergraduates. They found one company that was acceptable for both the large classroom environment and the smaller hands-on laboratory work. After the students meet in a lecture class and view what they would be learning on computer screens, they will move on the labs for the practical work, similar to what they will find after graduation.

"We divide everyone into eight labs, 24 students per lab. We have

analyzing such field parameters as stream data and water quality."

Julie Petruska, CEE's environmental laboratory supervisor, and Mark Widdowson, professor of CEE, developed the plan to renovate the teaching labs on the first floor of Patton Hall. Their ideas modernized two adjacent spaces that facilitated the needs of state-of-the-art teaching labs.

Using its share of the revenue from the engineering fees, CEE was also able to purchase concrete compression test equipment that allows twice as many undergraduate students to work in the materials testing lab, directed by Tommy Cousins, CEE professor. These concrete cylinders with various curing times are "loaded" until a failure occurs, teaching the CEE majors through hands-on experimentation about engineering principles as they relate to materials, structures, failure, and load.

the 24 divide into six groups of four. So only four people at a time are using one surveying instrument, thus optimizing the learning time," and providing a quality learning environment, Dymond explained. "The students are now working with up-to-date equipment that they will also see when they get jobs."

"It is difficult to find someone who will contribute the $300,000 necessary to renovate instructional labs," Knocke admitted. The engineering fee "allows us to address needs we would otherwise have to ignore."

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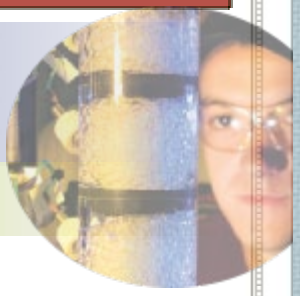
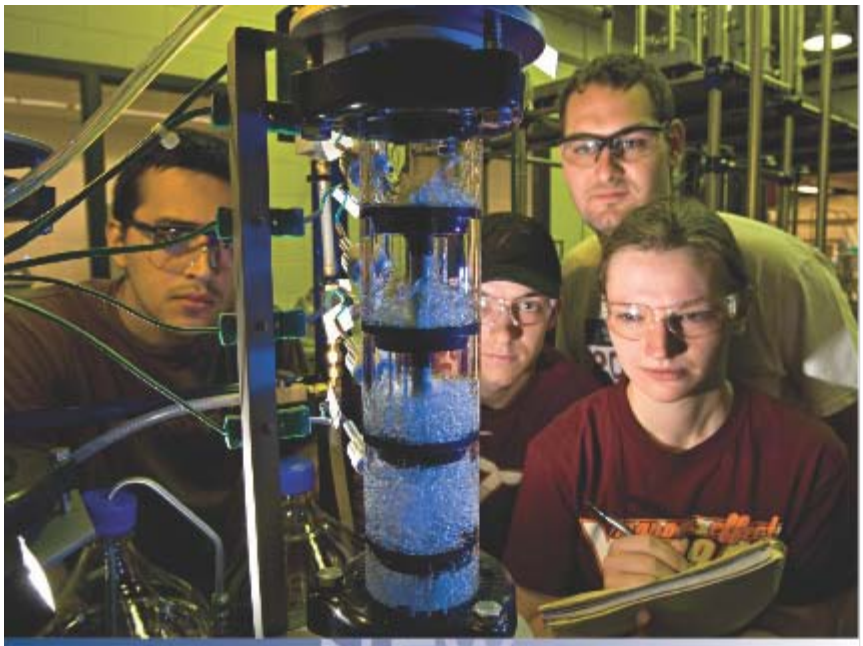
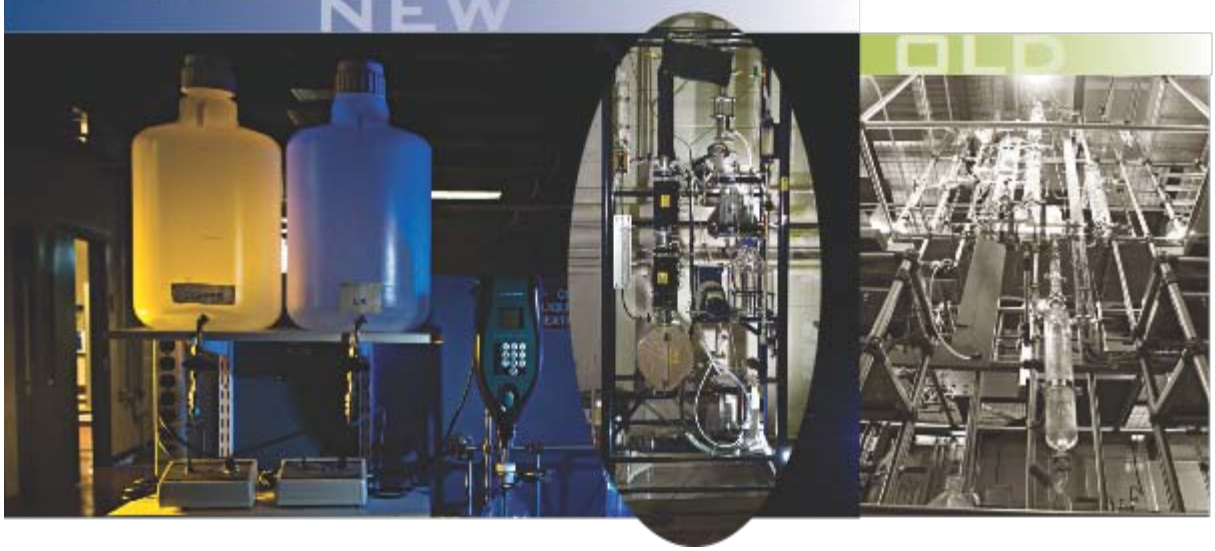
Chemical Engineering (ChE)

Unit ops lab now rivals commercial facilities







Hancock Hall's undergraduate unit operations (UO) engineering laboratory operated by the chemical engineering (ChE) department is quiet through most of the school year. But it buzzes during the summer. It is then that dozens of rising seniors majoring in the field take an extensive six-week lab session that involves eight lab experiments.

The tasks — separating liquids or gases from one another,

"This is exactly what people in the chemical lab at commercial facilities would be using," said Preston Durrill, an adjunct faculty member within the department. Along with other faculty members, Durrill heads up the summer sessions with planning lab experiments and supervising students as they work. He called the summer lab sessions vital.

"The UO lab is particularly important for our department as it is

leeching gases off solids, and the like — are so extensive and time-consuming, department administrators moved the sessions to the summer so the experiments do not interfere with regular fall/spring class work.

But this summer, the lab could have been missing its centerpieces. Several months ago, one of the department's key pieces of lab equipment, a distillation column, ceased working, said John Walz, ChE professor and department head. It wasn't surprising, though. The piece of equipment — used to separate liquids, such as alcohol from water — was 17 years old. It was well past its prime and needed replacing.

Luckily, there was an easy and available answer to the problem. With income from the new engineering department fee collected during a two-year period, the sessions could go on using an updated distillation unit purchased for $130,000.

The unit was installed in early 2009 and was used for the first time this summer. It was tested this past May, just as the regular academic school year ended. "It's the most important piece of equipment our department uses," Walz said. "The loss of the device and no replacement would have be a major setback for the department."

Stephen Martin, an assistant professor within the department, added, "We now have a new, smaller, and more versatile distillation apparatus that will allow us to introduce a variety of new objectives, such as vacuum and azeotropic distillation, continuous distillation, and process control elements."

the only hands-on experience the students get during their careers at Virginia Tech — outside of internships and co-ops — and it allows them to apply the knowledge learned in the other core courses of the curriculum," said Martin.

Some older equipment, perfectly usable and having undergone little change during the past few decades, also needs new piping, which the fee can provide for. "So much equipment is old. It requires replacement and/or maintenance so we can use fees for all of that," Durrill said.

Among the newer major purchases is the $20,000 gas absorption lab unit, which can be used to separate gases from liquids. Durrill called it a commonly used piece of safety equipment in commercial labs across the country. "When fuel is used in a lab or work space, this thing can remove the vapor/fumes, so it is less volatile and dangerous." Additional new equipment includes a reactions kinetics lab set-up and a controlling device that separates gases, such as oxygen and nitrogen in air.

"The fee has been vital to the department," Walz said.

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Computer Science (CS)

Students benefit from creative financing, based on guaranteed revenue

When Virginia Tech's Department of Computer Science (CS) decided it wanted to upgrade its undergraduate facilities from a dark, dreary windowless basement area in McBryde Hall housing rows upon rows of personal computers to a modern learning center, it actually took out a mortgage of sorts. The CS department felt the improvements were that important to the students.

The renovation costs were close to $1 million. The loan would come from the "parent company," the College of Engineering, and

Steve Harrison, a CS faculty member who also holds an architectural degree from the University of California, Berkeley, carried "a lot of the redesign responsibility," according to Ryder.

As Harrison explained his role, the new area "didn't just spring from my head. We had a lively debate about keeping the old-fashioned lab. We had numerous meetings and some town halls with the undergraduates. The students gave us good feedback. It was very important to them that the space be considered theirs. In

the "mortgage payments" would be returned to the college over the course of several years, with money from the engineering fees.

The CS department did not want to have to wait years for the fees to accrue before they could redesign the space.

"We were dissatisfied with the kind of learning that was transpiring. Much of the students' work is done in teams, and we had no facilities to support that learning environment," said Barbara Ryder, CS department head and the J. Byron Maupin Chaired Professor. "They certainly no longer needed computer labs to do their work, as all the students carried their own laptops."

Consequently, the department decided to provide specialized lab space where the students could utilize dedicated machines. "We can't teach concepts without allowing the students to experiment. We are also providing specialized software, academically licensed, that supports teamwork. CS students can use this software to explore aspects of computer science that are beyond what is available on their laptops," Ryder added.

Andrew Mussey, a freshman in CS, agreed. He described the new facility as one where he could go to find help in solving problems. He enjoys the cooperative learning atmosphere that the new space is designed to encourage.

With a Hokie Card, students like Mussey are able to avail themselves of the facility 24/7, a necessity for the night owl CS students.

The space is unstructured, with a white board for instruction and collaboration on group projects. Movable chairs and tables facilitate teaming. Teaching assistants have carrels to maintain office hours, and a lecture space is also easily arranged. CS student organizations are also able to use the space for meetings. Nearby, CS houses its media, software and systems labs. Still under development is the new animation lab.

some ways, the new area was considered to be an experiment where we could always put back the old PCs. But now, that is no longer discussed."

Harrison added that he looked at models at other universities, specifically citing the Strata Center at the Massachusetts Institute of Technology, home to its CS and Artificial Intelligence Laboratory. Its intentionally unfinished look is supposed to serve as a metaphor for the creativity of the research that is conducted inside.

Providing for creativity is key to the renovated CS space in McBryde. The design allows a "continuum between the classroom and the social space of students. That's why it was so important to have the TAs maintain space that was immediately available to the students," Harrison said.

During the initial remodeling discussions among the CS faculty, Harrison recalled that the group reflected on their own education and remembered that their learning was enhanced by being among students with similar problems. Since many of the CS courses have group assignments, the new design works well. "It is not clear to me that this would transfer to other curriculums," said Harrison, who teaches Media Computation, Creative Computing Capstone Design, and Design of Information.

Ryder, who arrived at Virginia Tech in fall of 2008, acknowledged that much of the credit for this renovation belongs to her predecessor, Dennis Kafura, who remains on the faculty, and Ginger Clayton, the department's financial manager, who "lived this project."

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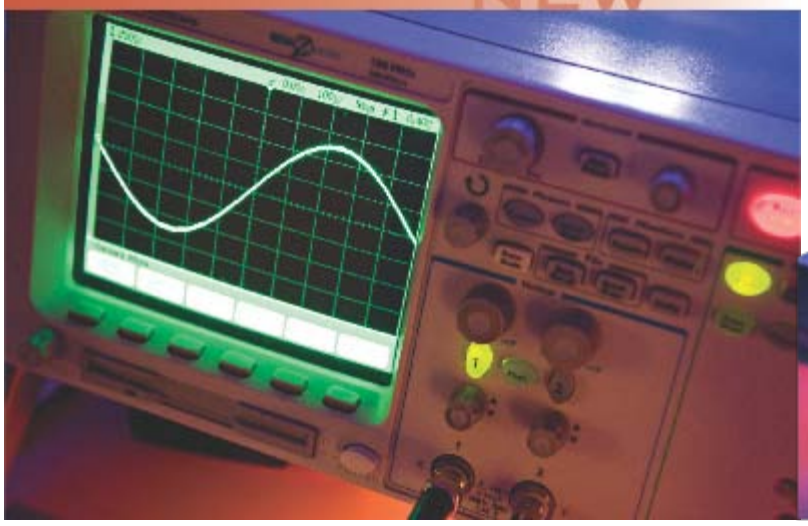
Electrical and Computer Engineering (ECE)

The “dungeon” moniker no longer applies



Using the engineering fee funds, “We took two labs that looked like dungeons in the past and now they look like work environments for the industry,” said Jaime de la Ree, assistant department head of undergraduate studies and a professor of electrical and computer engineering (ECE). The drop ceiling with florescent lighting replaces a high ceiling where pipes were visible and lights bland. “We have students working on benches that look very similar to what they have in the industry. So when students learn there [in the lab], they are training for what they will use after they graduate.”

The funds are providing the students in the Bradley Department of Electrical and Computer Engineering with new equipment that

Students in a senior level electronic lab, where studies focus on energy efficiency, have seen new equipment trickle into their lab thus far. But next year that will change as money from the engineering fee flows in. At the top of the list to be replaced are motors used to power experiments. The motors are 25 years old and constantly break down, thus hampering classroom time. The new motors, along with additional lab equipment, will complement new, high-tech smart grid equipment recently donated by Dominion Virginia Power. The equipment is able to monitor the operations and power flows on the transmission grid, as well as detect and locate system faults. The donated equipment and other instruments and

can help further their education and prepare them for the present-day commercial market. They also have newly renovated labs on the second floor of Whittemore Hall with better lighting and seats to make the process of learning more comfortable.

In two labs, some windows have been added so people in the hallways can peer inside and see students working in a lab environment. De la Ree said the purpose wasn't solely aesthetic. "I like it when other students and faculty and possible sponsors walk by the window and they can see the room buzzing with students."

The technology on those classroom lab benches allows students to test circuits they build with computer precision and deeper analysis. Transistors, oscilloscopes, meters, circuit boards, network analyzers, desktop function generators, and a host of other equipment have been replaced. Before, students had to test and record by hand and draw out curves and graphs. Now, that data and printouts all are produced by computer. Curve tracers, which allow for testing of a circuit over a short period of time, soon will be replaced with money from the engineering fee.

tools purchased with funds from the engineering fee will help students train to fill the void of jobs within the energy power industry, de la Ree said.

"It's been a real godsend to us" because the students like the lab environments better, said Dennis Newman, the technical support director for ECE who oversees the labs.

The fee also has funded the purchase of 110 USB oscilloscopes — at $150 each — for Kathleen Meehan's 3074 electrical engineering lab. The new devices have a frequency range of 1 megahertz, far better than what the lab was using — a free software oscilloscope package that topped out at 10 kilohertz. "That's a huge difference," Meehan said. The new USB devices also are more user-friendly for students, and will result in newly expanded lab experiments in class because of the higher range.

New curve tracers also are being purchased for the ECE labs, replacing older models purchased in the 1980s that have aged, Meehan, an ECE assistant professor, said. The new curve tracers also will have better ranges — in this case, down to 1 microamp. The current devices cannot measure that low.

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Engineering Science and Mechanics (ESM)

When the 20,000-gallon towing tank sprung a leak, it could have been curtains

In the basement of Norris Hall sits the towing tank, a huge below-ground behemoth that, when filled with water, allows researchers to complete any number of experiments involving the effects of water on model ships, boats, and submarines.

Built in the early 1960s, the tank can hold 20,000 gallons of water. With the pull of a lever or two and the push of some buttons, the tank comes to life. Subtle or substantial waves and turbulence will interact with a model being pulled — or towed — through the water.

The tank is due for further repairs and updates, including new controls. The trick: finding someone who can revamp the unique tank, McCord said.

The student engineering fee has gone to other uses in ESM, not just the towing tank. A third-floor lab classroom has been renovated with new electrical outlets along the floor and Internet connection boxes along the wall so that students can use the Internet on their laptops and tablet PCs. On the first floor, inside the materials

The experiments can simulate the bouncing of a model ship, helping engineers build a better, larger vessel for actual marine use. It's the ultimate game of Battleship, with the goal of some of the experiments to determine the conditions that will sink a vessel.

The tank is shared by the engineering science and mechanics (ESM) and the aerospace and ocean engineering departments. Both consider it a vital resource to a number of lab courses, and as a unique lab set-up among universities (the tank runs the length of a massive basement room floor). Yet, the tank was in danger of being shut down more than a year ago. It sprung at least one large leak and was pouring water out at a rate that drains in the floor could not keep up with. The problems were numerous.

ESM head Ishwar Puri and other faculty within the department saved the tank with funds from the student engineering fee fund. Although the budget for repairs was set at $100,000, careful use of the funds brought the final expense below $60,000. And not only was the tank repaired, but it was improved: new observation points were built into the tanks. These now allow researchers, graduate and undergraduate students, and visitors to study the motions of ships and submarines using noninvasive means of measurement. Now, instead of placing bothersome probes and other devices on models that interfere with the vessel's movement, researchers can measure a ship's performance by using lasers and lights directed through the cut-outs. Puri said this provides a truer record of how the actual vessel will perform in real wave environments, since a ship or submersible at sea will not have the probe appendages attached to it.

Virginia Tech students and researchers are not the only ones who get access to the tank. During the summers, it is used in a program that brings school children to campus to build and then test remote-controlled model boats in the water. Mac McCord, a mechanical engineer in the ESM department, who operates many of the labs, said the experience is not only fun for the children, but vital to Virginia Tech. “Those kids are our future engineers.”

characterization lab (affectionately called the “busting lab” by students), various objects, such as soda cans (full and empty), are squeezed, pulled, stretched and otherwise pulverized as students learn the strength of different materials. Almost all of the equipment in this lab was more than 20 years old and had faltering motors and sensors. With fee money, the machines were gutted and outfitted with new motors, digital sensors, and other features that bring them up to current standards, McCord said.

Other labs, including an instrumentation lab and a fluids teaching lab also have been updated with the latest equipment. In the former lab, students tinker with various objects, for instance, recalibrating a commercial fan so that its speed accommodates the amount of airflow that is required. In the fluids lab, students learn about the effects of water on a body, including how a boat moves through water. New computers also have been purchased for various labs that use high-end software that did not communicate with older computers. A lab dedicated to the effects of vibrations on objects — faux earthquakes on model houses or buildings, for instance — will be updated with new equipment, said Muhammad Hajj, an ESM professor.

The fee helps the 101-year-old ESM department ensure that Virginia Tech maintains itself as a “cutting-edge integrated research and education institution,” Puri said.

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ENGINEERING NOW 2009

Industrial and Systems Engineering (ISE)

Finally, great-grandparents will no longer recognize the labs

Phillip Ratcliff, the shop manager for the Grado Department of Industrial and Systems Engineering's (ISE) Harris Manufacturing Process Laboratory, is almost being sarcastic when he says students were using equipment their great-grandparents used until just a couple of years ago.

Almost.

Located in the basement of Whittemore Hall, the Harris lab, up until 2007, did have lathes that dated from the 1940s and welders

Ratcliff has photographs of the older lathes — greenish-gray machines that would look at home in a *Life* magazine profile on a machine shop circa World War II or the beginnings of the Cold War. Yet students wearing present-day clothing are at the controls. The retired lathes, like much of the older equipment in the shop, was so old that its only resale value came from metal scrappers looking for copper and other valuable parts to tear off.

When the older machines broke down, it proved frustrating. The

from the 1960s, along with other decades-old equipment. Added G. Don Taylor, the Charles O. Gordon Chaired Professor of ISE and head of the department, "A lot of the equipment was antiquated. You'd walk past the front door, and you would see equipment from the 1940s."

The engineering fee has changed that. Since 2007, funds from the fees have helped buy not only newer equipment, but the same type of digitized tools that are being used commercially throughout the world. Taylor said the new equipment in the lab has contributed to the success of his department, recently ranked in the top 10 among undergraduate programs for industrial engineering by industry stalwart *U.S. News & World Report*. "It's been huge," he said. "This new equipment is just more modern. It's more precise, and safer. A lot more students will use this when they get out there and work."

Ratcliff has run the lab since 1996. But it has only been in the past two years, with the inception of the student engineering fee, that he has seen equipment replaced.

In a workshop off the main shop room floor, Ratcliff showed off two hardness testers. One is at least 25 years old and relies on a tricky series of levers and a dial with a needle for reading; the other is two years old, is as easy to use as a potter's hand wheel, and takes exact digital measurements. "It takes away the guessing," Ratcliff said, of the newer piece of equipment. "It has been reliable ever since" it was purchased two years ago.

The main shop floor is where the significant changes have come. Six new lathes are lined up, nearly side by side. The machines, purchased over a period of two years in 2007 and 2008 are almost new looking, and have digital reader screens attached to their tops. A stop bar is at the bottom of each machine, a safety feature not found on older pieces of equipment.

maker, Washington state's South Bend, long ago had discontinued the model. "We had to beg, borrow, and steal to get replacement parts," Ratcliff said.

A new vertical mill, used to cut flat metal, also replaced a decades-old piece of equipment. Similar to the lathes, this newer piece of equipment has digital computer controls, but for now the lab is using it on a manual basis. In a smaller room off to the side of the main floor, six new, smallish welders replaced six hulking welders that were past their prime and prone to shorting out. Also, the room itself has been refurbished. A makeshift linking of rails and curtains, and a long workbench used by six welders, have been replaced by new dividers and six smaller tables that separate each welder from one another. A line of new helmets hang on the wall. Each helmet is solar-operated and its eye-view glass tints when light hits it. These safer, sleeker helmets replace older pieces that relied on batteries to dim their eye-view areas and were more cumbersome to wear and operate. "It's a safety issue," Ratcliff said. "They're easier to use."

Ratcliff said the new equipment is a morale booster to students. And no money is spent unless the need is pressing. "I spend money tighter there than I do at home, and I'm tight at home," Ratcliff said. That said, if not for the fee, then "we'd still have the same old equipment sitting here."

Taylor is proud of the changes. "We had a fellow retire as shop manger a few years ago, and he came in recently and didn't recognize the place," Taylor said.

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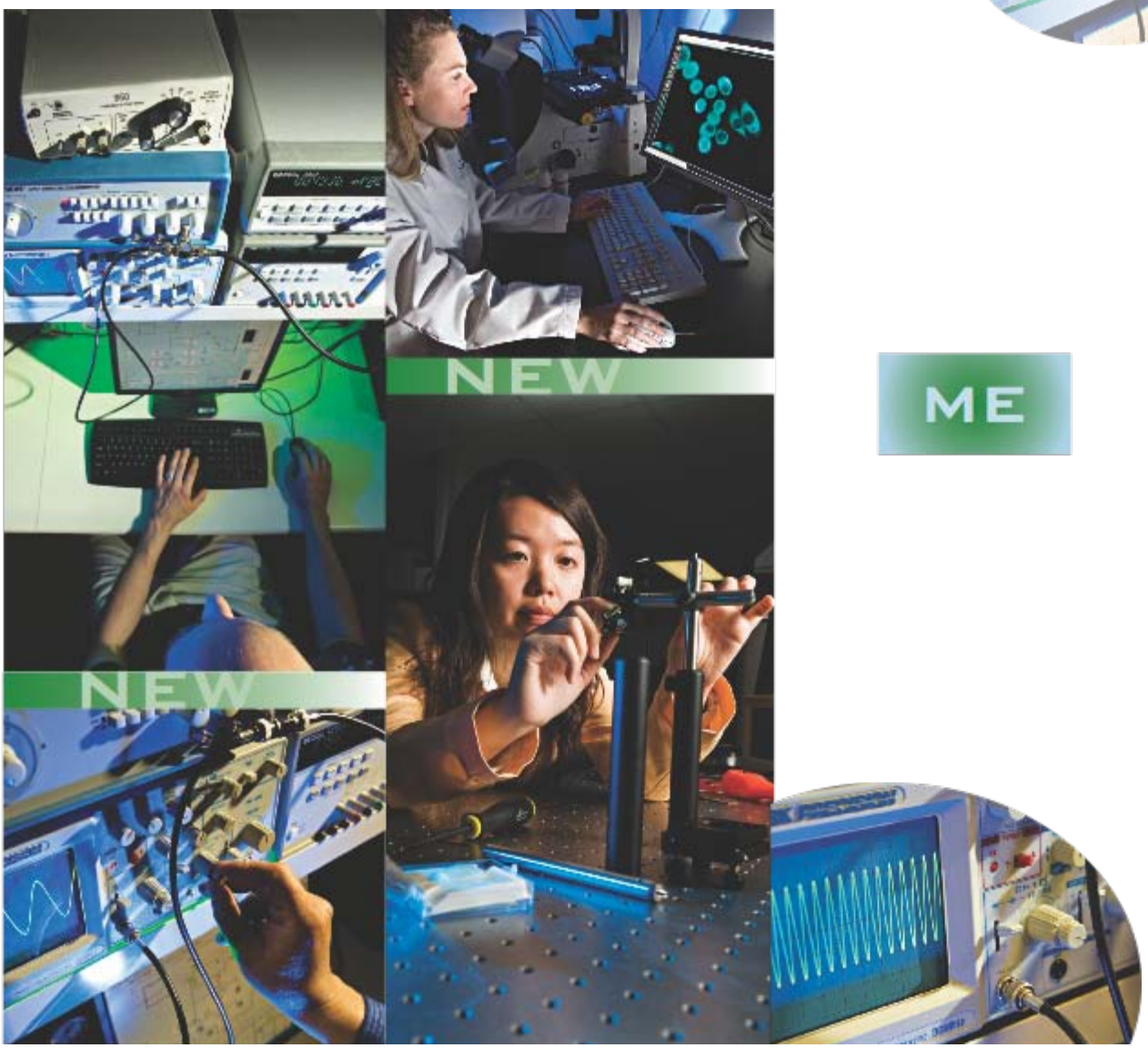
ENGINEERING NOW 2009

Mechanical Engineering (ME)

Department head credits fee for accreditation approval



Virginia Tech's Mechanical Engineering (ME) Department ranks 17th among graduate schools and in the top 15 percent for undergraduate education, according to the latest *U.S. News & World Report* surveys. But despite its strong reputation, Ken Ball, ME department head, was concerned a few years ago when he knew the Accreditation Board for Engineering and Technology (ABET) would be coming to visit during the 2008-09 academic year.

Ball credits the engineering fee for allaying his fears. With this "If you can't let students touch the equipment because if they damage it, it will shut down the lab, that's not a good thing," Ball said. "Students need that hands-on experience with the lab equipment. The entire effort is needed and wanted to give students the best educational experience they can get."

And they are. New lab equipment has students working with tabletop robotics and laptop computers that make instant measurements of small engines down to milliseconds. Tablet PCs are used in various classes and labs, also bought with engineering fee

dedicated revenue stream, he was able to authorize the purchase of needed lab equipment and vital improvements to the more than 50 year-old Randolph Hall. As an example, it was not uncommon to see the daisy-chaining of electrical extension cords from one classroom to another due to the lack of power outlets. The department desperately needed this upgrading of the ME classrooms, labs and tools — used by its students every day.

"Without the engineering fee, we would have been in jeopardy of not getting full accreditation," Ball said while sitting in his Randolph Hall office.

ME is one of the most popular curriculums among the College of Engineering's departments. According to May 2009 graduation data, 242 students graduated in ME, nearly twice as many as the second most heavily enrolled department, chemical engineering with 138 students. "Students would have been disappointed, and faculty frustrated," Ball said.

Because ME is currently attracting more students into its classes, the amount of money flowing into the department from student engineering fees is significant. A good deal of money this year has gone to the department's two core labs, 4005 and 4006, where students practice the principles of measurement, measurement standards and accuracy, detectors and transducers, digital data acquisition principles, signal conditioning systems, and readout devices statistical concepts.

Before the engineering fee, much of the equipment was so old, dating back decades, that the students were not allowed to touch the pieces. Some of the ME faculty recognized the equipment from their undergraduate days at Virginia Tech. Lab instructors would demonstrate the experiments most times because of the fragility of the equipment. Students could only watch. The hands-off approach wasn't an issue of trust, but economics. If a student accidentally broke a piece of equipment, it could shut the labs down as the item was repaired. With dozens of students flowing into and out of the lab, schedules would have been thrown into disarray.

funds.

Marty Johnson, an associate professor of ME, says until recently scales used in lab experiments were so antiquated students had to record data by eye and hand. Once a normal routine in labs, this method is now considered ancient, as valuable information is lost in the time it takes to record such data. Johnson added that lab equipment now used in classes is equal to that used in commercial labs and facilities where students will work after graduation or during college internships or summer jobs. "It's the equipment being used in the outside world, so students are getting that experience here and now," Johnson said.

Those tabletop engines, laptops, computerized scales and other tools require maintenance and regular upkeep. The fees also go toward paying those personnel, as well as graduate students who can lead or help lead lab classes. With such help, faculty members are free to do research or plan classes. That helps existing faculty members, and helps to recruit new assistant professors keyed on working with new technology. "They want to be part of that culture," Ball said.

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