ENGINEERS' FORUM

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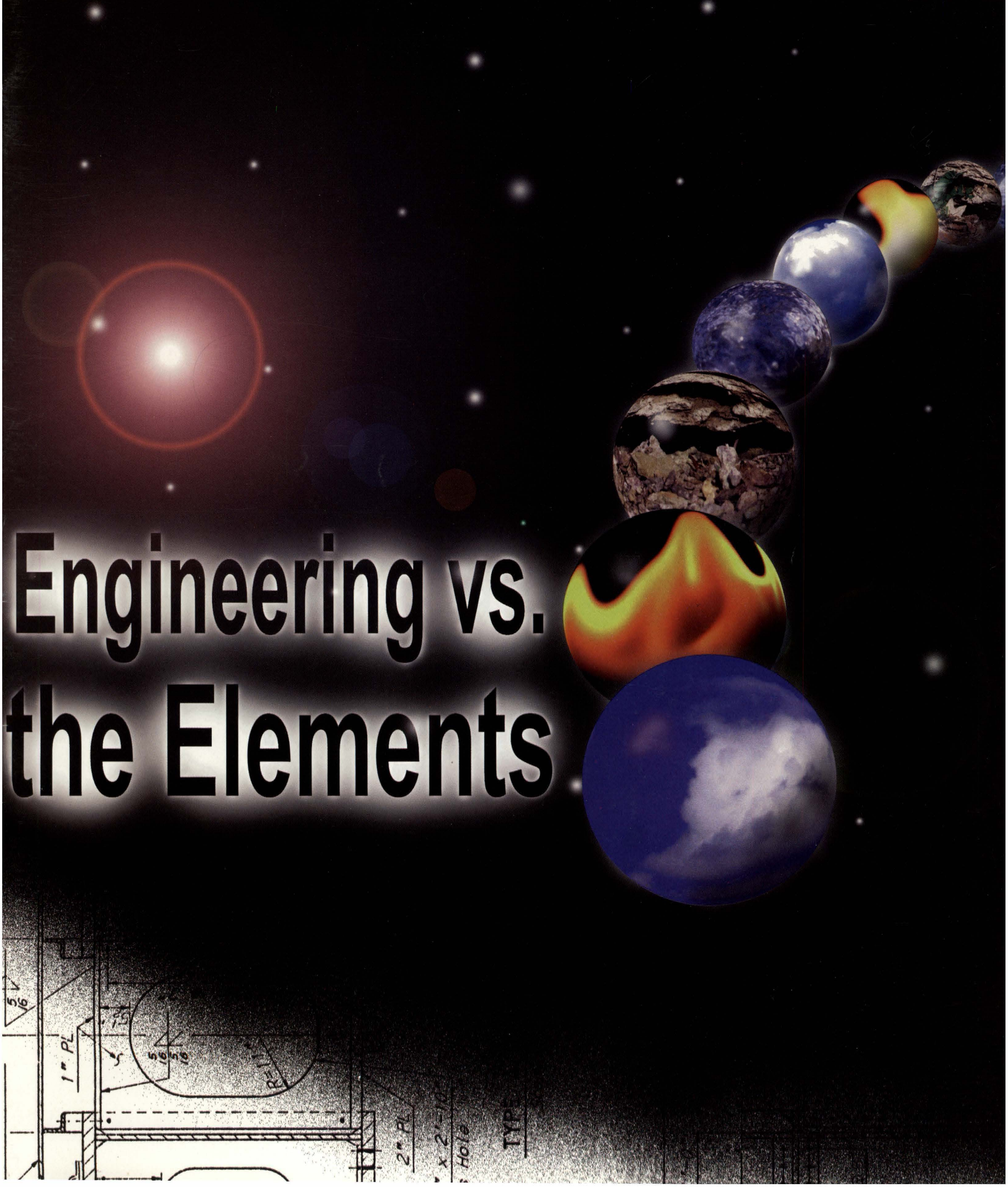
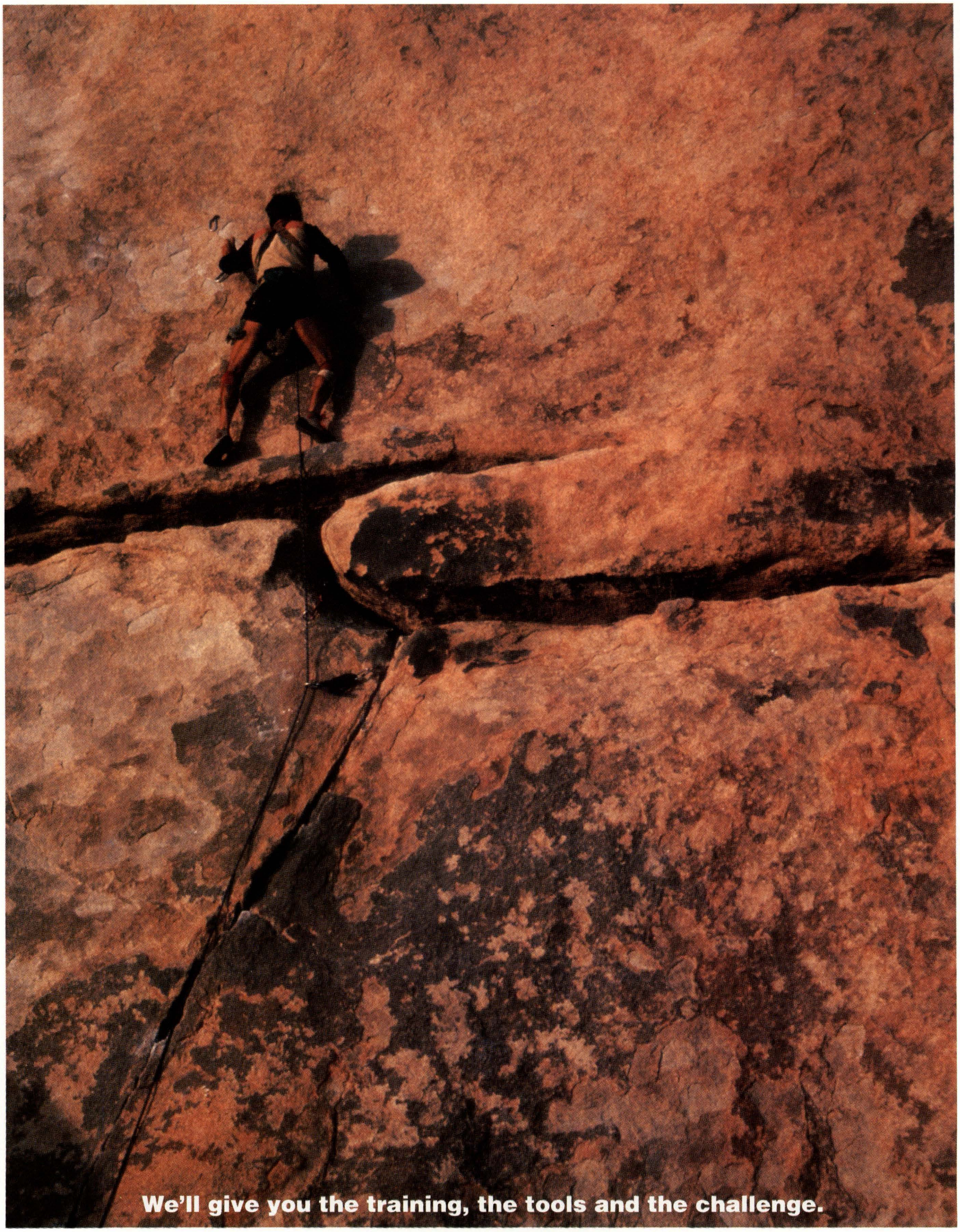


Engineering vs. the Elements



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The Engineering Magazine of Virginia Tech

ENGINEERS' FORUM

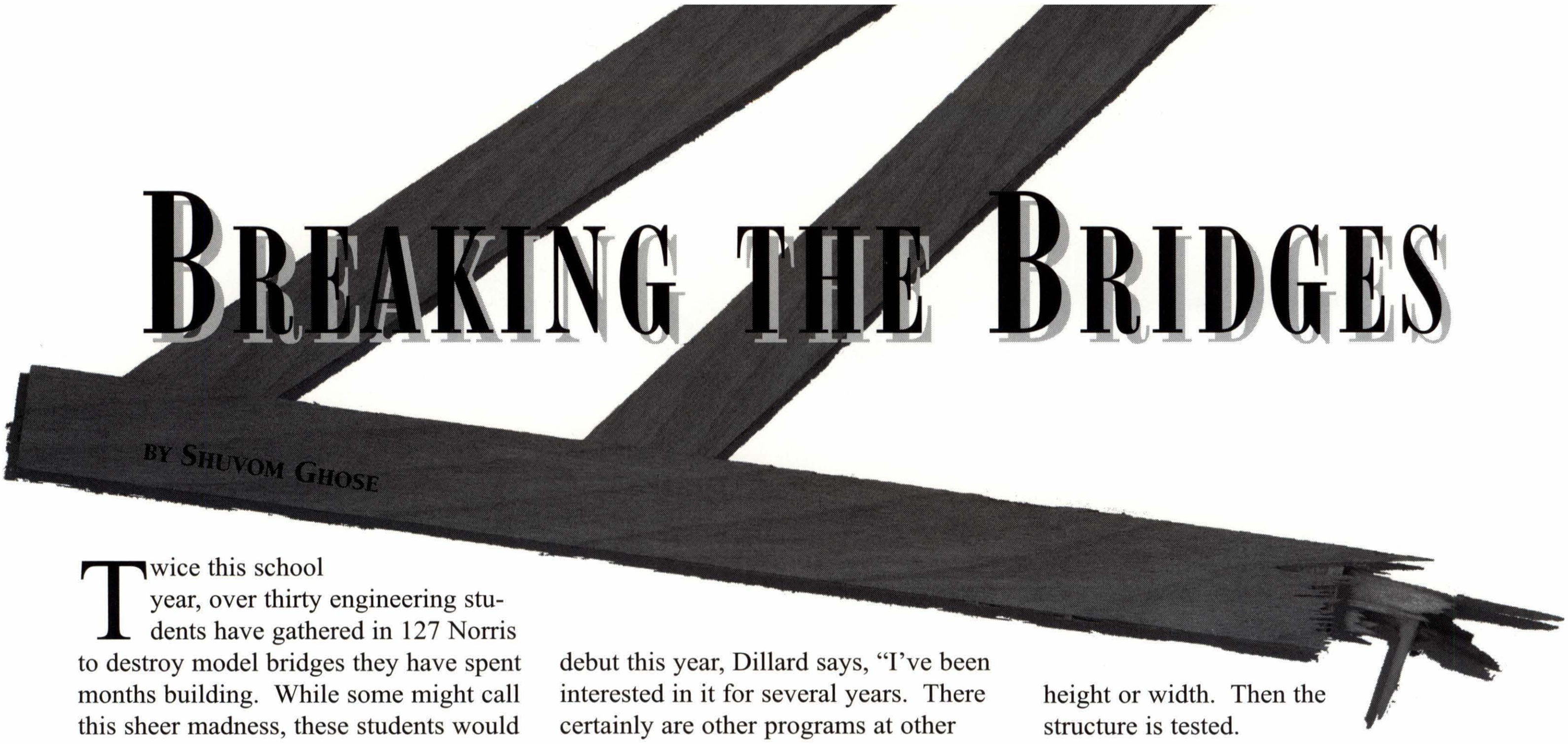
April 1998 VOLUME 17, NUMBER 2

Table of Contents

On the Cover

Science versus Nature:
The elemental forces of Earth, Fire, Wind and Water have ruled the world for centuries. Now, engineering gives us a chance to fight back. Photos by Jason Gibbs and Layout by Chris Smith.

Breaking the Bridges

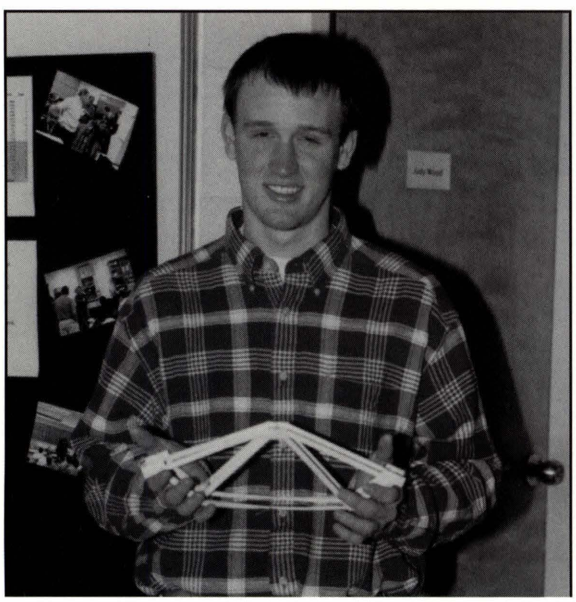


by Shuvom Ghose

Twice this school year, over thirty engineering students have gathered in 127 Norris to destroy model bridges they have spent months building. While some might call this sheer madness, these students would describe it as *shear* madness. They were taking part in the ESM 2004 Design Competition, in which participants strive to maximize a structure's ability to support a lateral force applied mid-span. Such forces create bending moments and shear forces in the structure, both of which are major considerations in structural design. Unfortunately, to find out what a structure can hold, you have to find out what it cannot.

The man responsible for setting up this cycle of creation and carnage is David Dillard, a professor in the Department of Engineering Science and Mechanics. When asked how long the competition had been in the works before making its debut this year, Dillard says, "I've been interested in it for several years. There certainly are other programs at other schools around the country. We just have not had one along these lines here, and we decided we wanted to try and do that. I think it helps the students to have a little more of an appreciation for the practical importance of what they're doing in the course curriculum."

The course to which Dillard refers is ESM 2004 Mechanics of Deformable Bodies, a requirement for most engineering majors. The purpose of Deforms is to teach students what happens to different types of beams and members when they are loaded with forces and torques. For most students, however, the concepts they learn for different configurations and loadings of beams remain purely theoretical until they graduate, or in some cases, forever.



All Photos by Jason Gibbs

Brian Okerberg with his team's bridge.

"This competition," Dillard explains, "gives people an opportunity to use a variety of structural shapes and put some of their knowledge to practical use in coming up with something." The rules of the contest are simple.

Only students enrolled in Deforms are allowed to enter, in teams of up to three people. Each team, after submitting a report stating the nature of their proposal, enters a structure to the judges. The structure, made of any combination of materials readily available to the consumer and hobbyist, must be between 5 and 1000 grams in weight, between 325 and 350 mm in length, and not over 100 mm in height or width. Then the structure is tested.

To make this competition one of skill and not just brute strength, the bridges were ranked by the maximum force they held, (at failure or at 10 mm of deflection, which ever came first), divided by the weight of the bridge.

"And so obviously," Dillard says, "some people competed with steel, fairly heavy things, and they were going for high breaking load, and other people were working with balsa wood and string, and they were going for maintaining a low weight. When you put the low weight in the denominator, it makes their structure look good."

The truth behind this strategy was shown by the team of Ean Schiller, Todd Heil, and Brian Okerberg, whose bridge was the lightest in the Fall semester competition, won second place overall, and was, according to the judges, the "Most Aesthetically Pleasing". The team's final design was more a product of evolution than planned creation.

"We didn't ever really sit down together and say, 'Let's do this'," says Okerberg, a sophomore in Materials Science Engineering. "We just all thought about different stuff and talked about it. We just kept talking about it until we got something that worked."

Originally, they considered making an A-frame out of aluminum, but the group realized manipulating the adamant metal would be a problem, since they lacked access to the appropriate tools. The team finally settled on balsa wood, because, "It's so easy to use, and it's so easy to get. And it's cheap," Okerberg says. This

TO THEIR FUTURES

decision literally paid off, since the final cost of the bridge was between $10-$15 dollars, with the glue being the most expensive element at $7.

Okerberg admits that the team didn't apply many principles from Deforms in designing the bridge, but says, "We used statics a lot, actually. We found this program on the Internet that does static calculations, like truss designs." The group used the program to calculate the performance of the different designs under their consideration.

"Since balsa is better in tension, we wanted to maximize the tensile loads, if we could, and minimize the compression," Okerberg says. "And I was thinking string would be good, because it's so light, and you can put a lot of load on a light string like that. Especially in tension."

The team's final design, made of balsa wood and Kevlar string, weighed 0.156 Newtons and supported 824 Newtons, for a load-to-weight ratio of 5283. Only one structure in the Fall competition bested this effort, the one put forth by the group of Jess Underwood and James Gunnell, two juniors recently transferred from Virginia Western College.

This team entered the competition seeking goals much loftier than applying their knowledge or gaining practical experience.

"The whole purpose of the design competition was to give you 5 extra credit points on your final grade," says Underwood, a Mechanical Engineer. "That was our whole motivation."

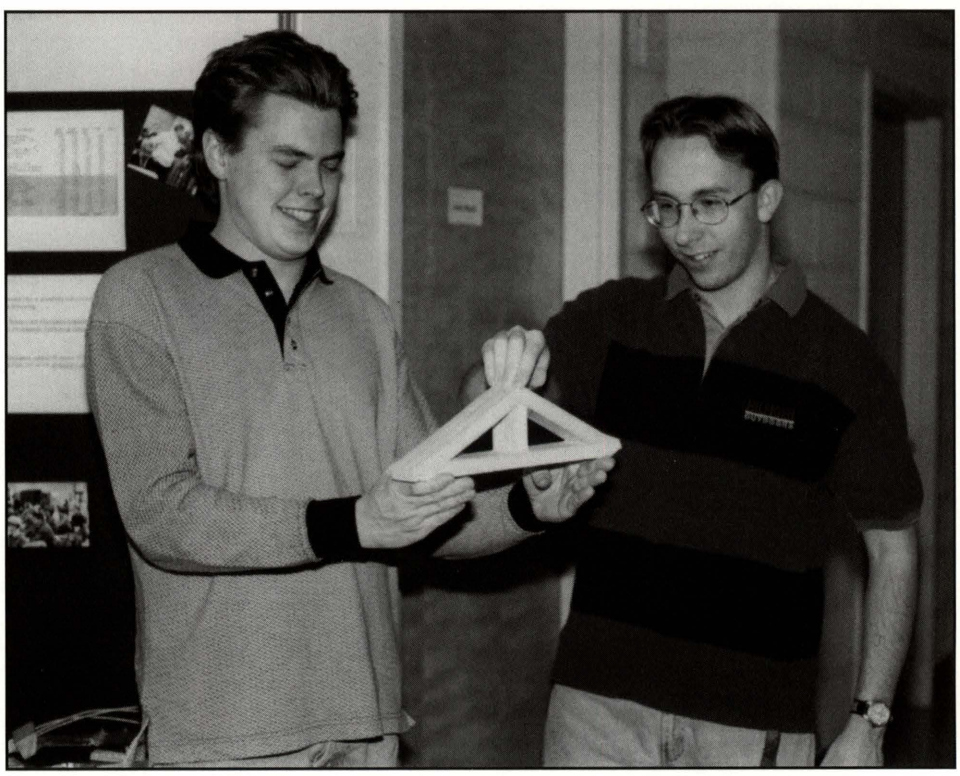
In the Fall semester, everyone who completed the competition received three extra percentage points on their final grade, and those in the top 50 percent of the contest standings received five. In the Spring, teachers toned it down to two and three points, respectively. Once Jess and James figured out why they were in the contest, they had to figure out how they would win it.

"I had some experience with woodworking," Underwood says. "I knew from the start I wanted to do something out of wood."

"We thought about using a steel rebar," Gunnell adds, "But since it was only good under tension, we didn't use it at all." The team settled on their final design through a combination of intuition and experience.

"I didn't put a lot of math or engineering into it," Underwood says. "It's just more of a common sense thing. Dr. Dillard had talked about laminates, and how the strength is much higher than a single piece of that material. That kind of gave me the idea of using laminated strips. If you think about how much area is in between those strips, that's a lot of area for the glue."

Excellent craftsmanship also played a part in the high performance of their structure. Once the team had glued together the 7 strips of poplar wood that



Jess Underwood and James Gunnel demonstrate how their bridge was tested by the Instron Machine.

The Final Score

Results of the Fall 1997 competition

Rank	Force Supported (N)	Force to Weight Ratio	Primary Materials
1	23,510	8080	Laminated Poplar
2	824	5283	Balsa/Kevlar
3	2,397	4272	Balsa/Plywood
4	15,270	3264	Fiberglass
5	6,365	2285	Wood

1 pound = 4.45 Newtons

made up their structure, they held them together for 24 hours with ten to fifteen clamps, to allow the glue to dry securely.

Since Jess and James didn't have their bridge completed by the optional prototype testing day given to all entrants, they walked into the competition unsure of what their structure could do.

"We knew it was strong," Gunnell says. "But not as strong as it turned out to be," Underwood adds. "I don't think we had any idea it would hold that much."

The team's structure, weighing in at 2.91 Newtons, surpassed every other bridge in the contest by supporting an amazing 23,510 Newtons, for a load-to-weight ratio of 8080.

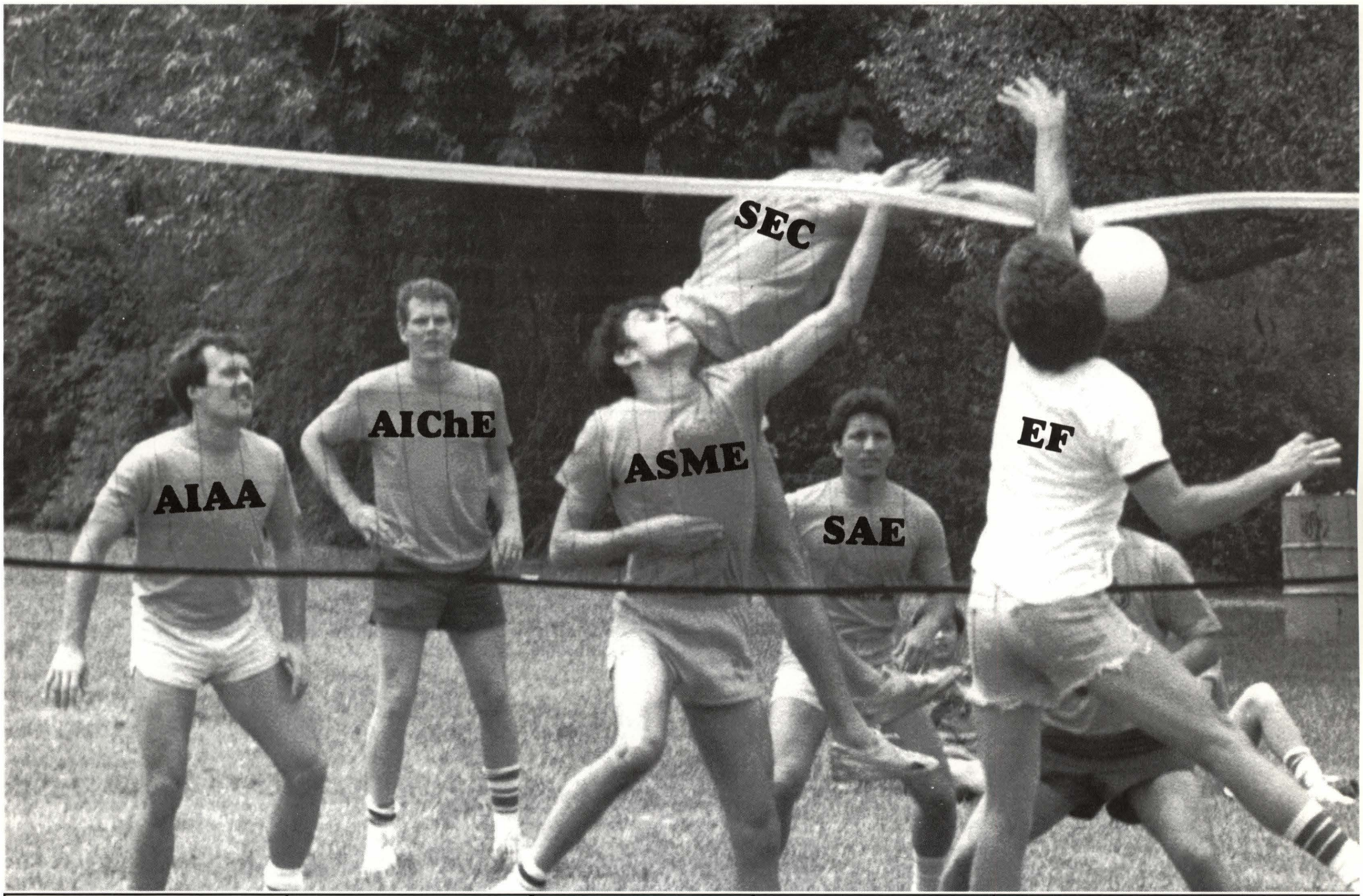
For their effort, the team received a $50 gift certificate to the Farmhouse Restaurant for first place, a second $50 certificate to the University Bookstore for the Best Workmanship Award, and a personal copy of "Roark's Formulas for Stress and Strain," a leading handbook for Deforms calculations donated by the McGraw-Hill publishing company.

Extra credit, gift certificates and free books aside, the real benefits of the ESM 2004 Design Competition were clear to all who entered. Brian Okerberg admits joining this contest made him "think about a lot more stuff that you don't consider in class."

This is the very motivation behind starting the contest, and the reason Professor Dillard says, "I would like to see it become part of the engineering education program in our department." But he adds, "Probably after two or three times, we'll have pretty well exhausted a given topic." Jess Underwood, however, already claims to know the "whole secret to winning this thing." His advice?

"Use plenty of glue."

Get in the Game!



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The Virginia Tech section of AIAA is a student chapter of the national professional society. They aim to get students involved in aeronautical and aerospace activities above and beyond the classroom. The society often has speakers from industry and sponsors the Design/Build/Fly Remote-Controlled Electric Unmanned Aerial Vehicle competition. **Contact:** E-mail Dr. Frederick Lutze at lutze@aoe.vt.edu or visit their webpage at www.aoe.vt.edu/aiaa/aiaa.html	AIChE is for chemical engineers interested in meeting other chemical engineers and learning about the different types of companies that employ them. The club has a corporate speaker at every meeting, sponsors plant visits, helps with departmental recruiting, holds a banquet in the spring semester, and does service projects. **Contact:** E-mail Diane Patty at dpatty@vt.edu	ASME is part of a national, professional organization for Mechanical Engineers whose activities include plant trips, corporate speakers, socials, and national/regional meetings. Freshman have free membership! **Contact:** E-mail asme@vt.edu or call th E-mail asme@vt.edu or call the ASME office at 231-4175	The SEC represents the student body of the college of engineering, and unites all the engineering societies. They provide many leadership positions and organize events such as Engineers' Week, the Engineering Leadership Conference, and the Freshman Planner. Any engineering major is welcome! **Contact:** E-mail sec@vt.edu or visit their webpage at www.eng.vt.edu/eng/org/sec.html	SAE's official objective is to enter student design competitions sponsored by the national branch of the Society of Automotive Engineers. **Contact:** Visit their homepage at www.vt.edu:10021/org/sae **Engineers' Forum** The Forum is Virginia Tech's student-run engineering magazine. Are you creative? Would you like to have a blast doing something only a handful of college can claim to have done, run a self-supporting magazine? Then join us! **Contact:** E-mail forum@vt.edu or visit our homepage at www.vt.edu:10021/eng/forum

Student Projects

BY MIKE BURGISS

The Autonomous Vehicle Team of Virginia Tech is moving into a new facility this spring. The Old Laundry Building on campus has been renovated and will house many of Virginia Tech's student engineering projects. Virgina Tech's entire Car Factory including the Autonomous Vehicle, Hybrid-Electric Vehicle, Baja Car, and Formula SAE teams, will move to the new lab. In addition, student project teams from Aerospace Engineering, Engineering Science and Mechanics, and the Virtual Corporation will move into the new facility. The new laboratory will showcase Virginia Tech's nationally recognized student design projects.

Base renovations to the old laundry building were made possible by funds from the University and the College of Engineering. Additionally, the Mechanical Engineering Department has received a major gift from one Tech alumnus, Joseph F. Ware Jr. Mr. Ware graduated from Virginia Tech in 1937, and he has since pursued a very successful career at Lockheed Martin's Skunkworks Division.

Mr. Ware has made his gift with the intention that it will be used to help the student project teams execute more advanced designs. His gift has been used thus far to purchase new machine tools and equipment for the project teams. Mr. Ware's gift is much appreciated by the university, and in recognition, the university has named the newly renovated facility the Joseph F. Ware Jr. Student Projects Laboratory.

"Joseph, and his wife Jennifer, have taken a special interest in the Autonomous Vehicle Team," said Dr. Rienholtz, Assistant Department Head of Mechanical Engineering and Faculty Advisor to the Autonomous Vehicle Team. Mr. Ware has explicitly specified that the primary focus of immediate expenses should be the aggressive pursuit of improved autonomous vehicles.

Mr. Ware's gift has enabled the Autonomous Vehicle Team to develop a new breed of autonomous vehicle. The team's newest vehicle, NEVEL, has three wheels and a differential drive with dual 2.5hp motors. NEVEL will have the highest power to weight ratio compared to all vehicles previously built by the team. Dean Haynie, leader of the NEVEL team, has also lead his team to design the vehicle to have an extremely small footprint and low profile. These design advantages will help the Autonomous Vehicle Team of Virginia Tech defend their 1st Place title in the design competition at the 1998 International Ground Robotics Competition to be held this May. Additionally, the NEVEL vehicle will have a substantial advantage in the competition's

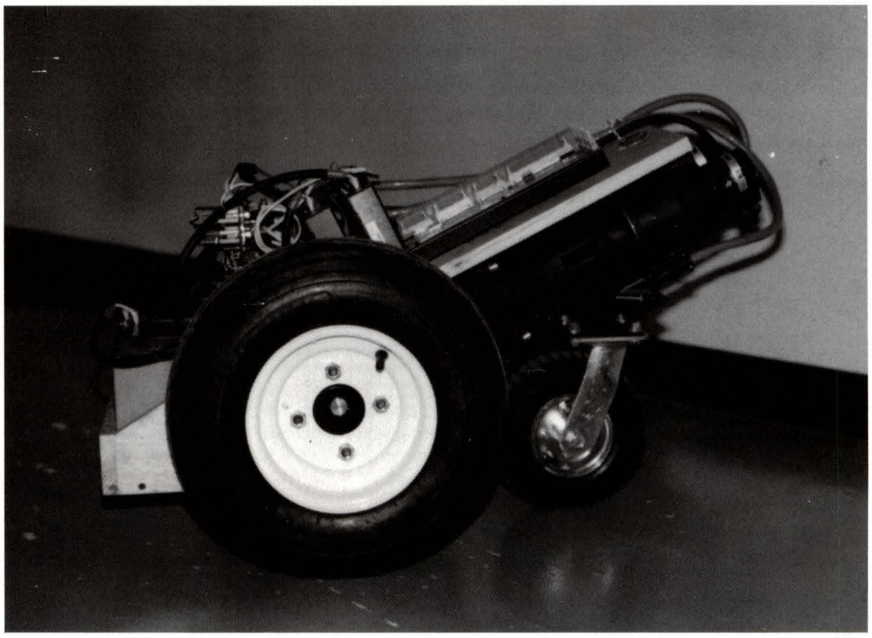


Photo by Jason Gibbs

Tech's 1998 Autonomous Vehicle is still under construction.

Make Their Move

dynamic event due to its small size. The team plans to enter three vehicles in the competition this summer, but there is much design, fabrication, and testing work left to do before the vehicles are fully operational.

The Autonomous Vehicle Team and the rest of the student project teams look forward to moving into the 'Ware Lab', as the students call it. The facility will provide just the environment they need to complete their vehicles on time. The facility will house new CNC equipment including a continuous path CNC lathe and a 3-axis CNC milling machine. Arthur C. Klages, a Tech Alumnus who recently retired from his consulting practice, has donated some of these machines and other materials, tools, and equipment to the student projects. "All of the student projects will have access to the machine shop. Students will work with the same types of modern machine tools that they will find in the workplace after graduation," said Student Shop Manager, Jerry Lucas.

The Ware Laboratory will also house a CAD lab that will be networked with the CNC machine tools. "Students will be able to create a CAD drawing and download the file through the network to the new CNC machines," added Lucas. The CNC machines are equipped to automatically fabricate parts that students have designed in the CAD lab. The networked CNC machine tools and CAD lab, along with the trophy room and welding shop, make the Ware Laboratory one of the best facilities of its type in the country.

The Joseph F. Ware Jr. Student Projects Laboratory is yet another accomplishment in education and research that makes Virginia Tech one of the best engineering schools in the country.

What is an Autonomous Vehicle?

An autonomous vehicle is a robot that can receive a set of instructions and execute them without any further guidance. When its commands include moving, as they did with Tech's 1997 vehicle shown on the right, the robot must be able to follow a given path while avoiding obstructions. This vehicle used a camera to follow lines marked on the ground while other sensors looked for blockages ahead. Missions for autonomous vehicles range from delivering office mail to exploring the surface of Mars.

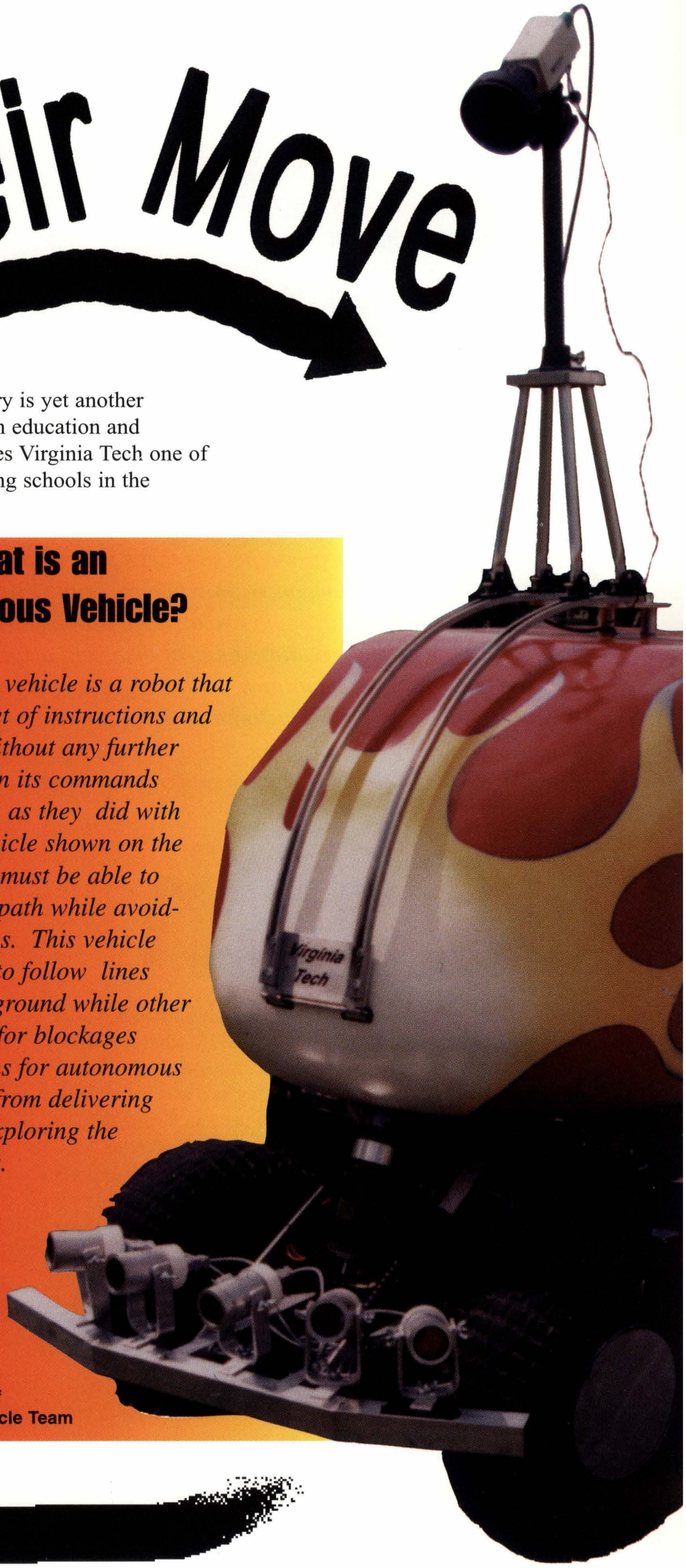
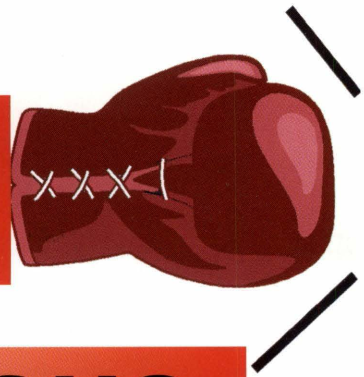


Photo Courtesy of Autonomous Vehicle Team

Engineering



versus

On most days, the average person takes for granted that the ground beneath their feet will stay still, or that the clouds above them won't come ripping down taking them and everything else within its reach for a trip through the spin cycle. Still, nature seems determined to prove that nothing should be taken for granted. Every year, countless natural disasters arise throughout the planet. In previous years, much couldn't be done in these situations, but to try and recover as best as possible in the aftermath. Recently, however, engineers have taken steps to not only better recover from these situations, but also to try and prevent the damage from being as devastating. Over the course of the coming school year, the Engineers' Forum will feature four articles dealing with how humanity has begun to fight back against Earth, Fire, Wind, and Water.

Earth

At 4:31 a.m. Pacific Standard Time, the San Fernando Valley in Southern California was rudely awakened by what was afterwards dubbed the Northridge earthquake, measuring 6.7 on the Richter Scale. The epicenter of the earthquake was located 18 kilometers below the surface and caused the San Fernando Valley to move northward several centimeters. This relatively small distance rang up a bill of approximately $30 billion dollars in damage.

Still, in Southern California, such occurrences are expected, as California sits on the most active faults in the United States. Dealing with earthquakes then becomes a preparatory measure instead of a recovery one, as engineers take the offensive in protecting property. Involved in this battle are four Tech professors, Daniel Inman, James McGrath, James Mitchell, and Mahendra Singh, members of The National Center for Earthquake Engineering Research. Each of the professors is involved in different aspects of earthquake protection depending on their professional expertise.

Summarily, Professor James Mitchell assists in studying how the soil is packed around buildings to determine what additives should be mixed in to allow for the best possible resistance to seismic activity. Based on the results of their work so far, it as been by and large a success. Yet, the treat of The Big One, a quake of unparalled magnitude, still looms.

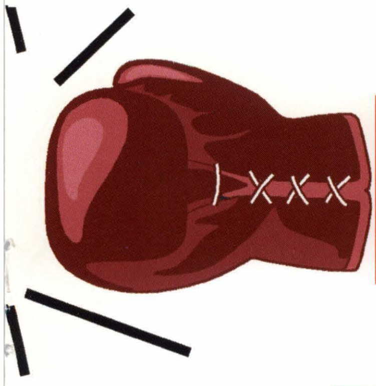
Fire

When a fire occurs in a neighborhood, it is tragic, but there are well-practiced methods of fighting it. When a fire occurs in a forest, though, putting it out can take more difficult measures. In 1996, California experienced 8134 separate forest fires that damaged 232,812 acres. They caused approximately $100 million in damage while costing $117 million to put out.

Fighting these fires can be more complicated due to difficulties in getting equipment to the scene to put it out. The solution comes not from driving water in, but rather flying it in. To implement this answer, California includes in its arsenal 16 air tankers capable of carrying 800 gallons of water, 2 air tankers capable of 2000 gallons, and 10 helicopters that can each carry 320 gallons of water.

Water, however, is not the only nor the most effective method used against this destructive force of nature. Firelines are dug to break or divert the path of a blaze. Chemicals are sprayed to suffocate the fire by cutting off its access to oxygen. Sometimes, in the most extreme cases, explosives are used to blast the fire into submission.

Whatever the method used, the art of taming the ravenous, all-consuming and merciless beast known as a forest fire is something not even modern science dares to take lightly.



the Elements

BY GARRY HALLMAN

Wind

Several years ago, the movie "Twister" hit the box office. It portrayed an incredible situation where a massive storm front emerged, causing numerous tornados to be formed. While an occurrence of this magnitude would be rare to find in actual life, the chance does exist. As with any other type of disaster, the best form of protection is preparation, and in the past years, preparation has increased dramatically.

As the use of computers and related technology grows, meteorologists are able to better predict when tornadoes will strike. By monitoring a series of Doppler Radars evenly spaced throughout the country, scientists can watch as storms develop and keep an eye for the warning signs of a tornado. Whenever there is a chance for thunderstorms that may spawn tornadoes, a Tornado Watch is issued over an area of about 20,000 square miles. A watch only means that the conditions are favorable. However, the watch can be upgraded to a warning in two different ways. First of all, if an actual tornado is sighted and reported, then the Tornado Warning will be issued. Second, if the Doppler Radar shows a development in the storm known as a mesocyclone. The mesocyclone can be recognized by a rotation forming within the storm front. These are the first true stages of a tornado.

Analyzing the Doppler Radar is the key to finding these mesocyclones. Doppler Radar works by showing bands of color depending on how the wind is blowing in relation to the radar. Green means that the storm is moving towards the radar and red is away. When these bands of color are found next to each other, a rotation is forming in the storm, and by feeding this data along with differences in elevation, a program evaluates whether a mesocyclone is being formed.

Not all mesocyclones become tornadoes, and as such, not all Tornado Warnings turn out to be actual tornados, but with the warning system in place, more people can be aware of potential damage and take steps to protect themselves and their property in advance.

Water

In 1993, the Mississippi Valley experienced one of the worst floods in its history. Approximately $15 to $20 billion in property damage devastated people in nine states. As rainwater continued exceeding the average amounts, towns found themselves trying to protect their homes from the increasing water levels. Levees and dams needed to be fortified to block the water. Sandbags were filled, but at times it was a case of too little, too late. However, an existing technology, inflatable dams, is now being revamped so these problems may be avoided in the future.

N. M. Imberston of the Los Angeles Department of Water and Power devised the first of the inflatable dams in the 1950s. Built with a thin rubber approximately 1/8 inch thick, they were occasionally damaged along contact zones and, due to this damage, had a few failures. Over the past 50 years though, improvements in materials and design have given rise to stronger and more reliable dams.

At Virginia Tech, civil engineer Ray Plaut has researched the uses of inflatable dams. Through both computer simulations and models, the usefulness of inflatable dams has been confirmed. According to Plaut, "Inflatable dams could be constructed along a riverfront in place of levees, to be deflated and out of the way, allowing access and views, except when needed." This solution would appeal to towns such as Davenport, Iowa where a levee was forgone for the beautiful view of the Mississippi River, and where the threat of a massive flood is as much an annual event as the Fourth of July.

What would topics or subjects would you like included in each of these articles? What order would you like to see them in? Cast your vote by E-mailing us at Forum@vt.edu *today!*

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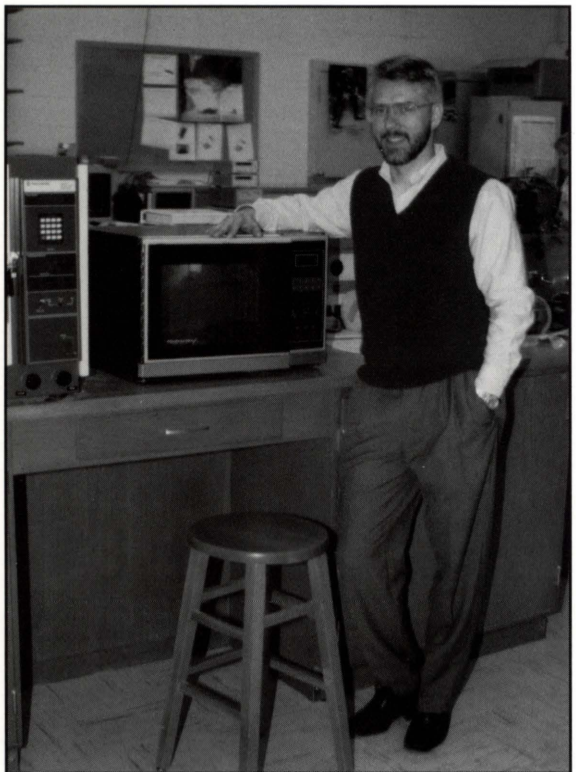
Stern Is Not Spurned, But Sporned

Story and Pictures
By Lisa Grogin

Why does Dr. Curtis Stern, Associate Professor of Mechanical Engineering, deserve the Sporn Award for Excellence in Engineering Teaching? Students praise his genuine concern and commitment to them.



Dr. Stern includes such props as microwaves and popcorn to demonstrate various concepts in class.

Dr. Stern's concern for his students is shown by the time he commits to his students in making sure that they understand the material. One impressed student stated Dr. Stern "always has time for his students to discuss homework and concepts outside the classroom." He is also known as a professor who will happily explain a concept repeatedly until the student understands. Dr. Stern carries this philosophy into the classroom.

"I will answer any and all question that are asked in class," he says. "If that takes the whole period, so be it." Dr. Stern makes it a joy to go to class.

"His teaching style makes the class exciting and interactive," felt one student. On the Friday before Spring Break he wheeled in a microwave oven from his lab and popped popcorn in class to demonstrate microwave processing. An unusually large class can attest to one of his most recent acts of concern. According to Scott Chaney, "He split up one of his Thermodynamics classes into two sections because the class was so big that there were not enough chairs to fit everyone. He took the initiative and split the class in half and made sure that his students could attend at least one of the sections. He did this in order to create a better learning environment with more individual attention for his students." Dr. Stern's outlook on teaching can be appreciated by any student on campus. "I try to teach the way I would want to be taught."

How did such a valuable asset make his way to Virginia Tech? Dr. Stern grew up in Lancaster County, Pennsylvania. He enrolled in the Massachusetts Institute of Technology to study his life long interest in solar energy. After graduating with a Bachelor's degree in Mechanical Engineering in 1982, Dr. Stern left the east coast to pursue his education at the University of California-Berkley. While there he translated his interest in solar energy to the study of heat flow. Working under Dr. Ralph Greif, Dr. Stern used "a National Science Foundation grant to study a big donut 3 feet in diameter, [where] we heated one half and cooled the other half and looked at the flow circulation patterns of the loop."

With such interesting research under his belt, Dr. Stern arrived at Virginia Tech in 1986 to take a position as Assistant Professor in the Mechanical Engineering Department. While here, Dr. Stern has continued his research into heat flow through studying "microwave processing of materials and food, monitoring emissions and efficiencies of wood-burning appliances, and predicting the infrared image of aircraft." He also began teaching the Thermodynamics and Heat Transfer classes. Stern has taught these classes semester after semester, and it was these mechanical engineering classes where his reputation as an excellent teacher was built.

Dr. Stern also has interests outside of the classroom and laboratories in Randolph Hall. He is an active member of the Virginia Tech Honor System as a faculty representative on judicial panels and is an advisor for Tau Beta Pi, the National Engineering Honor Society. Dr. Stern and his wife have four children, with the youngest just 4 months old. When asked what his favorite hobby is Dr. Stern professed that "playing with the kids" was what he loved to do the most, but he also is an avid hunter. He loves to watch wildlife, and with a house on Brush Mountain he gets a chance every day. EF

Earning Your Wings

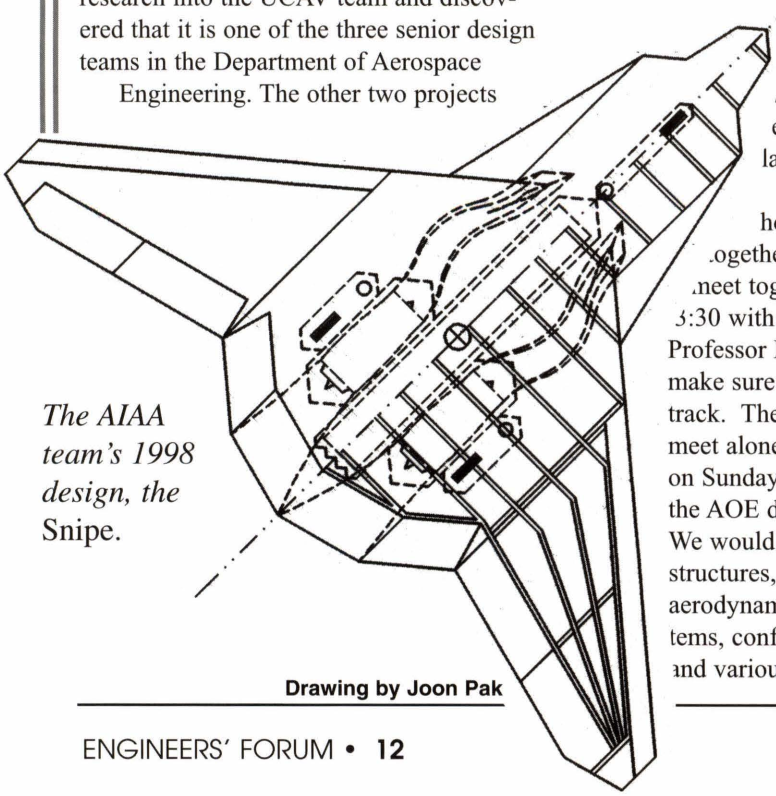
BY CHRIS THAISS

Rising to the level of college freshman from high school senior is a strange and enlightening experience analogous to a small child going to Disney World for the first time and accidentally seeing Goofy without his costume head. Another equally shocking experience may be a college freshman who suddenly realizes that a night at Pedro's does not constitute an extracurricular activity.

I feel that a big part of college life is seizing the opportunities presented to me. Doing this not only shows a prospective employer that I am self sufficient, willing to accept a challenge, and capable of applying my thoughts and feelings to practical applications. One such opportunity was given to me by my Engineering Fundamentals professor, Patrick Devens. My brain power would help design either an uninhibited combat air vehicle (UCAV) sponsored by the American Institute of Aeronautics and Astronautics (AIAA) or a general aviation project in which I would have been designing a commercial aircraft. I did a little research into the UCAV team and discovered that it is one of the three senior design teams in the Department of Aerospace Engineering. The other two projects available to the seniors in my group were a general aviation project that involved designing a commercial transport and a space design project. These other two, while being interesting, did not fit my schedule, so I knew that I would work with the UCAV team, a mystical experience that I encourage anyone enrolled in Aerospace Engineering to duplicate.

Here I was, a tiny freshman on a team of seniors,...

Something told me that I had stumbled into a golden opportunity. Here I was, a tiny freshman on a team consisting entirely of seniors, designing a part of this UCAV to be entered into a national competition with other colleges from around the country. To complete the project, the team needed open-minded individuals that knew how to design subsonic aircraft. The people chosen to accept this task and their respective positions within the group were Jason Romero, leader/propulsion systems; Joon Pak, configuration designer; Rich LaSalle, stability and controls; Jeff Thurman, structural designer; Jeff Galloway, aerodynamics; Alex Sang, avionics and systems; Chris Thaiss, main landing gear; Jeremiah Hansen, nose landing gear.



Drawing by Joon Pak

The AIAA team's 1998 design, the Snipe.

I was fascinated with how this team worked together. We would officially meet together on Thursday at 3:30 with Dr. Mason and Professor Kirchbaum, who would make sure we were on the right track. The group members would meet alone without the advisors on Sunday and Tuesday either in the AOE design lab or the library. We would go over such things as structures, stability and control, aerodynamics, avionics and systems, configurations, propulsion and various other things that would cause me to wonder if I should have become that person in the sweaty Goofy suit instead of joining this design team.

The Snipe is a wonder to look at and even more impressive when it performs. It is a strike aircraft capable of flying into an area under the cover of stealth, dropping a 1000 lb. bomb and flying out undetected. The aircraft will cruise at over Mach 0.7 or 7/10 the speed of sound (about 750 mph). It is small enough for eight to fit on a C-5 Galaxy but big enough to have the lift required to hoist a 1000 lb. bomb to an altitude that will be sufficient enough to fly at near supersonic speeds. The entire operation is a great example of interaction and ideas being thrown around into a whirlwind that will ultimately plop a 100-page report down on top of Dr. Mason's desk.

Having joined the team a few weeks into the second semester of the design, I was a rookie when the seniors were already veterans of the design process. But even after spending a semester on it, the aircraft design was changing as rapidly as Michael Jackson during the 90's. After going through and playing with different configurations, the design was nearing a conclusion around midterm, culminating with a midterm presentation from the different designers in front of the professors and the group.

...designing an unmanned strike aircraft capable of flying into an

Since the semester is still not over, the aircraft has not been completed yet. My main landing gear is coming along nicely, as is my Engineering Fundamentals partner Jeremiah's nose gear. It will soon be time to integrate the gear directly in with the main aircraft structure.

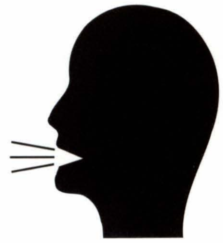
...dropping a 1000-pound bomb, and getting out undetected. Something told me I was into something good.

I have learned a lot in the time that I have been with the team. Pursuing my interests has given me exposure to the functioning of a team in the real world, the experience required to get the job that I want when I graduate, the ability to apply my knowledge that I have acquired in the classroom to real applications, and the opportunity to collaborate with seniors in my major about aircraft, which I really enjoy.

Well, I have had fun telling you about my semester with this team, and I hope that you will all seize the opportunities when they arise, lest you spend your life being something that causes people to think, "Where did that person go wrong?", i.e. Goofy. EF

Reversed Engineering

[1] You Don't Say!



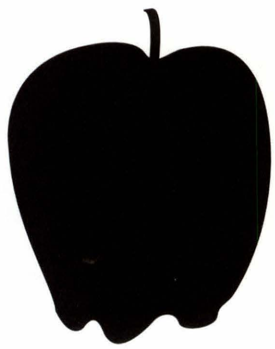
"Why, I thought you were a gentleman!" -Woman to Herbert Hoover, upon learning he was an engineer.

"Wild for adventure, keen for achievement, eager, ardent, bronze-faced, and keen-eyed. A man who had been seized by the spirit of some great thing to be." -Description of the engineer-hero of Zane Grey's "The U.P. Trail", published in late 1800s.

[2] Second Thoughts:

In the 1940's, William Sears and Irving Ashkenas, two aeronautical engineers working at Northrop Aircraft Inc., developed an appendix to an Air Force report which stated that the maximum range for an aircraft would occur when it has no fuselage, i.e. when it is a flying wing like the B-2 bomber. The engineers found the maximum range just as we would, by taking the derivative of the range equation and setting it equal to zero. After the report was published, Joseph Foa, an engineer working at Cornell, claimed that while Sears and Ashkenas did find where the slope of the graph was zero, they did not notice that the second derivative at that point was positive and therefore minimized the range! Ashkenas responded to Foa in another paper, and the debate began. Even to this day, after 50 years of controversy, neither school of thought has prevailed over the other, and some professional engineers, upon learning that others at a meeting support the opposite position, will actually leave the room in disgust!

[3] What's in a Name?



One day in the late 1970's, two guys by the names of Steve Jobs and Steve Wozniak were trying to think of a name for their upstart computer company that would sell the personal computers they had been designing in their garage. They were having trouble coming up with a name, and one of them happened to be eating an apple. They decided that if they didn't think of a name within the hour, they just would call the company "Apple." The rest is history.

[1] Taken from "The Existential Pleasures of Engineering", by Samuel C. Florman, 1996, St. Martin's Griffin, New York

[2] Information from "Stories From a 20th-Century Life," by William Rees Sears, 1994, Parabolic Press, Stanford, and Professor William Mason's homepage: www.aoe.vt.edu/Mason/ACiFlyWngs.html

[3] Absolutely unsubstantiated.

Want to Know More?

Breaking the Bridges to Their Futures (Page 2):
http://reserve-old.lib.vt.edu/instructors/esm_05/DesignCompetition/des_comp.htm

Student Projects Make Their Move (Page 6):
http://www.hort.vt.edu/AVT/

Engineering Versus the Elements (Page 8):
Earth: http://nisee.ce.berkeley.edu/
Fire: http://userwww.sfsu.edu/~lewis/hotshot.htm
Wind: http://www.sciam.com/explorations/052096explorations.html
Water: http://www.fema.gov/DIZAS/ws96.htm

Stern Is Not Spruned, But Sporned (Page 11):
http://www.vt.edu:10021/eng/mech/home/people/faculty/stern.html

Earning Your Wings (Page 12):
http://www.aoe.vt.edu/aiaa/aiaa.html

Check us Out: The *Engineers' Forum* online
http://www.vt.edu:10021/eng/forum

APRIL SHOWERS BRING MATH FOR HOURS?

Okay, so I'm out one day strolling along in a moderate cloudburst when two people charge past me from behind, almost falling over themselves to get under cover a few seconds earlier. We all ended up under the protection of the same awning, except they arrived panting for breath and I didn't. Since they didn't seem any less drenched than I did, I began to wonder if it was really more practical to run in out of the rain.

Sure, the runners spent less total time under the downpour, but they would also seem to catch more water on their front surface than their walking counterparts. If you've ever driven a car through a light drizzle and noticed you had to turn the windshield wipers to higher settings the faster you went, you know what I mean. Looking at the exhausted people, I kept asking myself: was there a scientific way to tell which kept you dryer, running or walking in the rain?

A siren went off inside my head. *Aha! This was a job for an engineer!* I started my quest with a strict adherence to the great traditions of engineering problem solving: I made simplifying assumptions to assure that my final answer would be, at best, only marginally applicable to everyday life. I assumed that raindrops fall vertically at a constant terminal velocity **V** through the air and are distibuted uniformly throughout its volume with a density **Ro**. I modeled a person in the rain as a rectangular prism of height **a** with a square base of dimensions **b** by **b**. This person walks with a constant velocity **M** over a level surface with perfect drainage, and has to travel a distance **D** before reaching cover. Looking at my model, I saw the solution to this problem contained two parts: the block's top surface, and its front.

A siren went off inside my head. This was a job for an engineer!

Sparing everyone the math which only interests me, the final mass of rain which strikes the block's top surface is **(Ro*V*D*b^2)/M**, while the front surface receives **Ro*a*b*D**. This answer makes sense, since it predicts that as the block slows down (as **M** becomes smaller), it receives more rain on its top, and that a block travelling instananeously, (**M** = infinity) would only wet its front surface, since the rain would have no time to fall on it. Surprisingly, the rain on the front surface is independent of speed.

Hoping to jump from the realm of giant, moving blocks to the one of real life, I called the National Weather Service to find hard values for **V** and **Ro**. After being redirected three times I eventually talked to a researcher who, while she couldn't help me, "did remember doing something like this in graduate school." I finally looked up the values for **V** and **Ro** in a high school science book and made some estimates for **D**, **a**, **b**, and **M**.

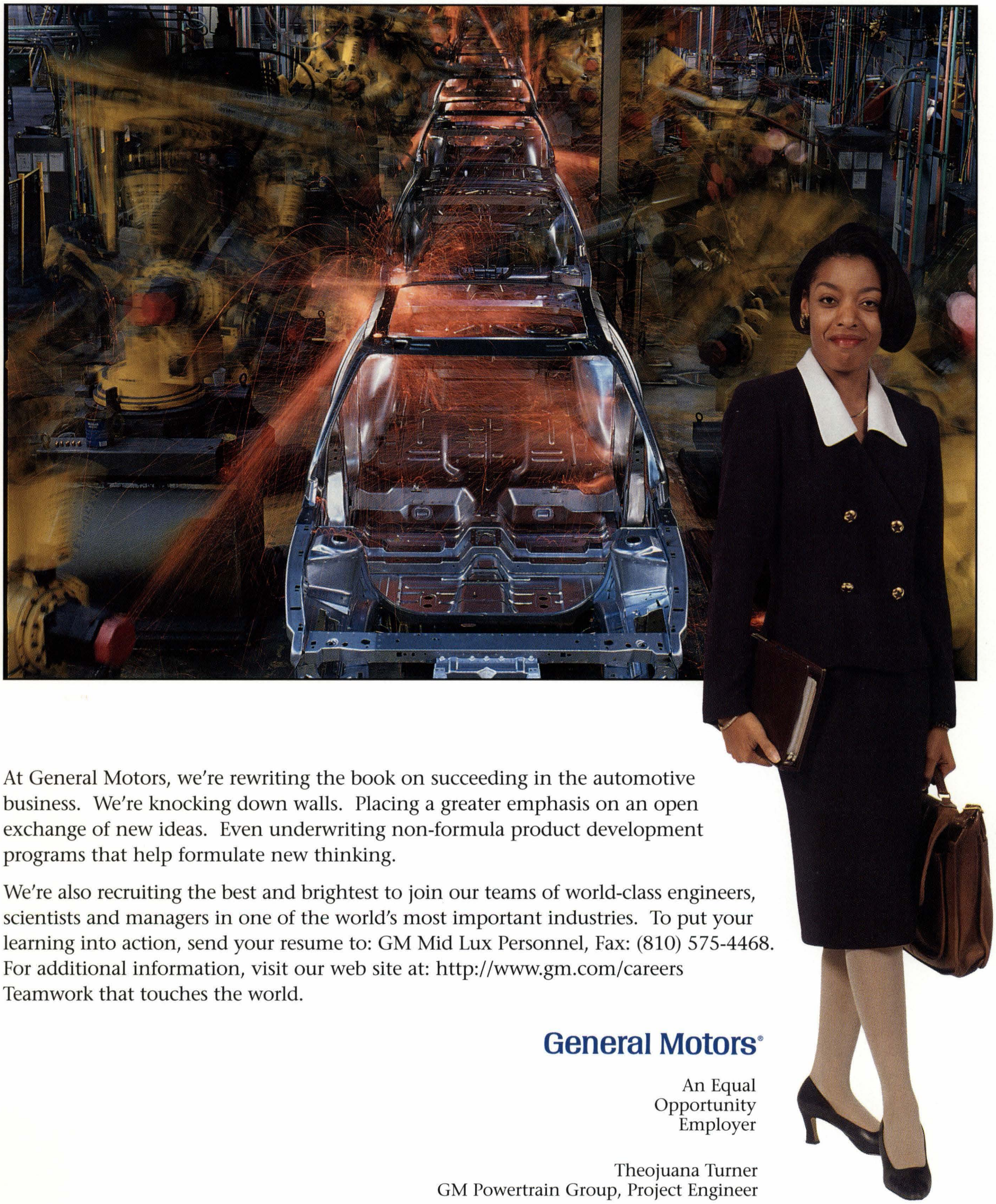
My final conclusions were just as I had expected: during a moderate rainfall, running across the Drillfield four times faster than you would normally walk keeps you a meager six percent dryer than if you had strolled along.

Right now, some of you may be asking why I spent over four hours of my free time to do extracurricular math. My satifaction will come the next time the sky opens up and I go outside, secure in the knowledge that science predicts walking will keep me almost as dry as possible.

And at that time, I will, rationally and scientifically, duck my head and sprint for cover.

Shuvom Ghose

"What I've learned in the classroom; I'm perfecting at GM."



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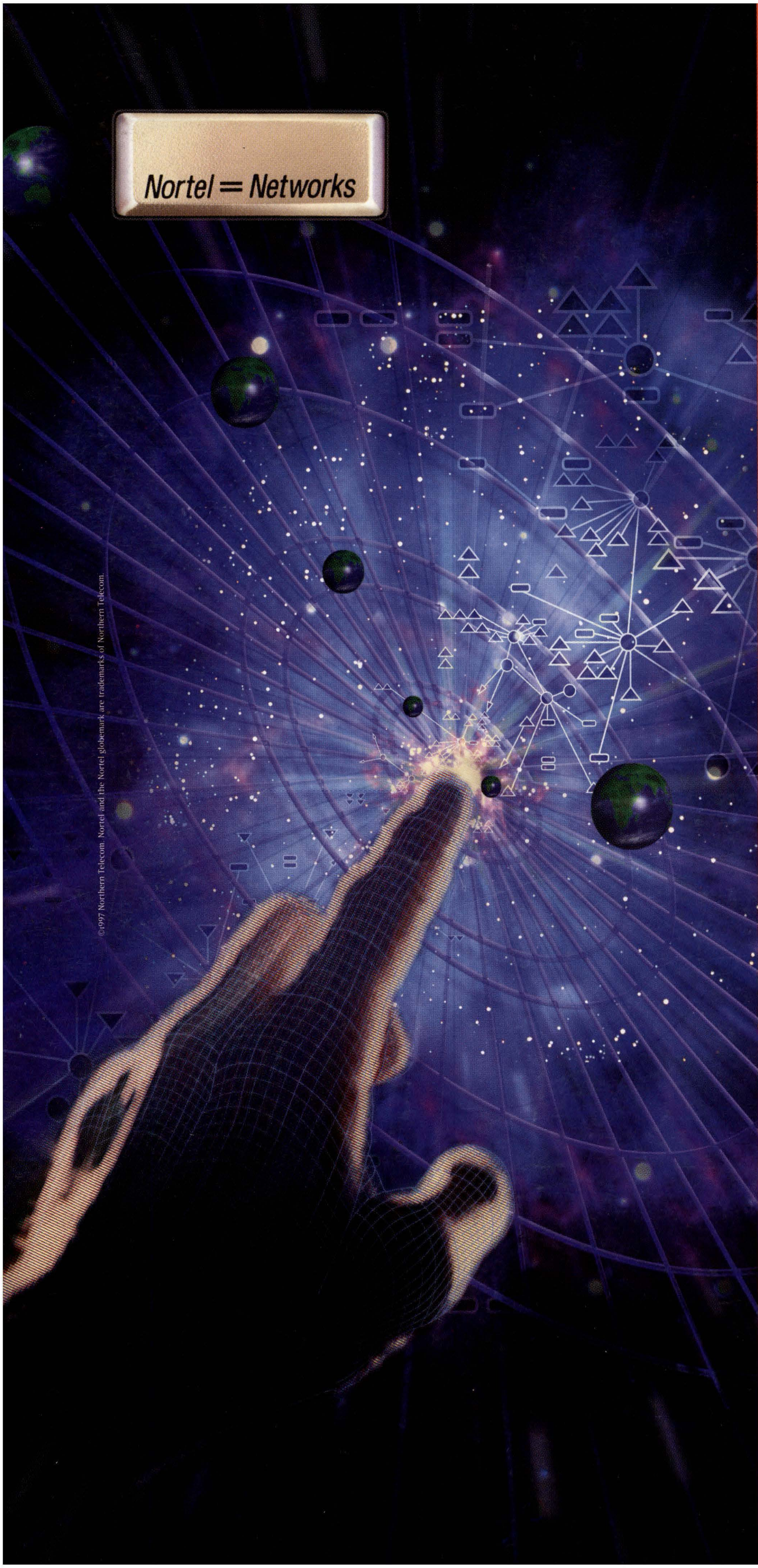
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