Wisconsin engineer. Volume 98, No. 3 May 1994

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

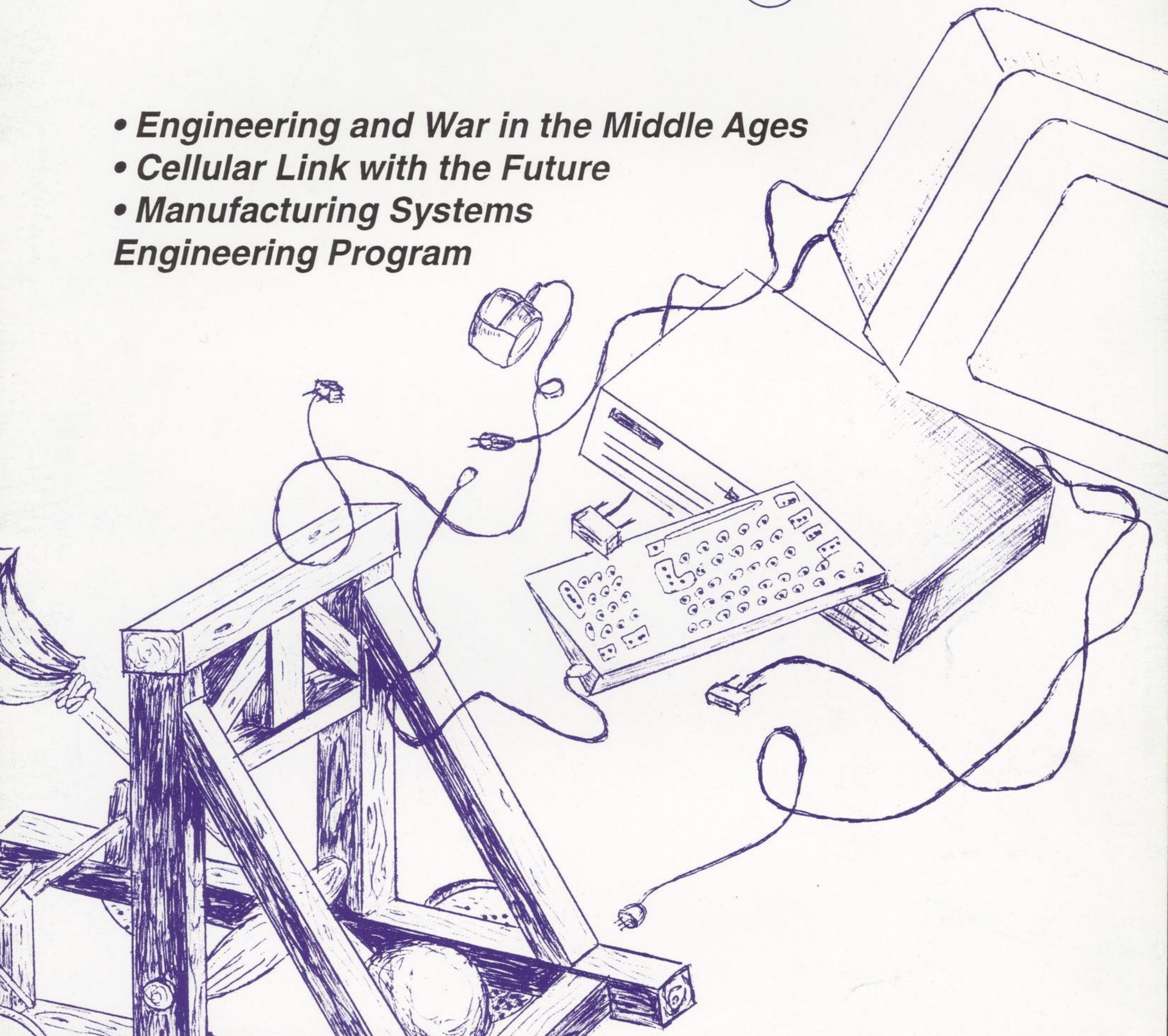
https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

Volume 98, No. 3

May 1994

wisconsin engineer

- *Engineering and War in the Middle Ages*
- *Cellular Link with the Future*
- *Manufacturing Systems Engineering Program*



Wisconsin Engineer Magazine
Mechanical Engineering Building
1513 University Avenue
Madison, Wisconsin 53706

Nonprofit Organization
U.S. Postage
PAID
Madison, WI
Permit No. 658

wisconsin engineer

Published by the Students of the University of Wisconsin–Madison, May 1994

Editors
Mariah Steele
Svetlana Zilist

Production Editor
Jennifer Wondergem

General Manager
Jim Webb

Business Manager
Pete Johnson

Advertising Manager
Craig Drugge

Circulation Manager
Alyssa Hunt

Writers
Ted Bohn, RJ Elsing, Emily Erickson, Dave Hubanks, Alyssa Hunt, Mark Mastalski, Carrie Michael, Robyn Ryan, Leslie Shalabi, Gina Wagner, Svetlana Zilist

Production
Eric Gentz, Chi Duong, Andy Johnson, Kristen Johnson, Rob Peterson, Deanna Schmidt, Roman Tivyan, Keely Wagner

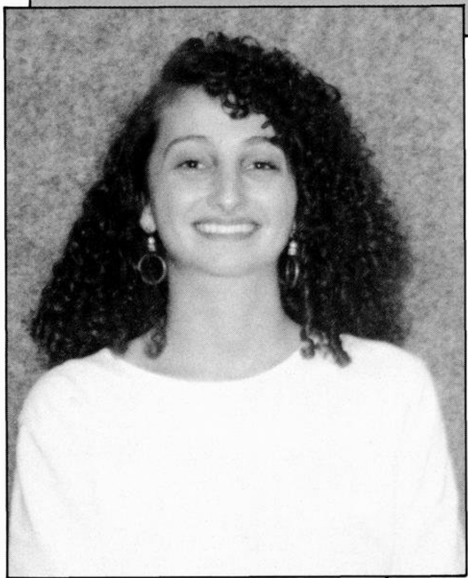
Cover
The cover was designed and drawn by Keely Wagner.

Table of Contents

Board of Directors: Michael Corradini, Gerald Duchon, David Malkus, Evelyn Malkus, Richard Moll, Tom Murray, Kenneth Potter, Thatcher Root, Karen Walsh.
Faculty Adviser: Ryn Etter.
The wisconsin engineer magazine, a charter member of the Engineering College Magazines Associated, is published by and for engineering students at UW-Madison. Philosophies and opinions expressed in this magazine do not necessarily reflect those of the College of Engineering. All interested students have an equal opportunity to contribute to this publication.
Publisher's Representative: CASS Communications, 1800 Sherman Ave., Evanston, IL 60201-3715. Phone (312) 475-8800.
Publisher: Community Publications, McFarland, WI.
ECMA Chairperson: Donald C. Woolston, 1527 University Ave., Madison, WI 53706.
Correspondence: Wisconsin Engineer Magazine, Mechanical Engineering Building, 1513 University Ave., Madison, WI 53706. Phone (608) 262-3494. The wisconsin engineer is published four times yearly in November, January, March and August by the Wisconsin Engineering Journal Association. Subscription is $10 per year.

Editorial

Engineering and Youth: Sparking the Imagination



Svetlana Zilist
Wisconsin Engineer Co-Editor

"Mommy, I want to be a doctor when I grow up!" declares ambitious five-year-old Susie after a visit to the pediatrician.

"I want to be a fireman", says little Tommy as the siren of a fire truck in action rages by.

Such are the births of career aspirations for youngsters. As Susie and Tommy grow, their visions may change. After her first ballet recital Susie firmly decides that she was meant to be a dancer, while Tommy's T-ball league fosters dreams of becoming the next Babe Ruth.

Several years later Tom is inspired by *L.A. Law* , and Susan decides to follow the path of her high school English teacher.

In this way we see how two imaginary but typical young people come to select careers, drawing from their everyday influences. Yet something is missing from the base of knowledge that Tom and Susan have acquired during their youth.

As children we learn through experience and the media that doctors cure sick people, politicians make laws, dancers perform, and firemen put out fires. Yet we seldom hear about who makes the cars we drive in, or why the lights in our house turn on at the flip of a switch. The role that engineers play in our society is largely under-emphasized to youngsters.

In fourth grade I told a classmate that my father is an engineer, and the boy asked in all sincerity, "Does he drive a train?" A fourth grader is certainly young enough to be excused for such a question, but the scenario gets worse.

In junior high I remember mentioning that my mother designs transformers (electrical transformers, of course). My classmates responded by inquiring with enthusiasm if I could get them some — the kinds that change from ordinary trucks to viscous teradactyls! To add to my disbelief a friend during my freshman year in college earnestly asked me, "Liz, what do engineers do?"

These simple comments are more than enough to make me realize that something is missing in our general education. It is cause for concern when children whose parents are not engineers believe that the term refers only to the man who drives a train.

Children see doctors, lawyers and firemen performing their jobs, in real life and on television. These interactions give them images of what is involved in such professions. But in spite of the fact that they use products made by engineers every minute of the day, kids never see the people behind the products. Thus, engineering as a profession is never introduced into the knowledge base of young adults, and never considered as a career option.

The natural question that arises out of this dilemma is "What can be done?" How do we educate young people about the meaning and value of engineering? Though the adventures of doctors, lawyers and policemen are portrayed vividly on television, no one can expect the new series on NBC to be "Engineers in Action" or "L.A. Engineering". Even we at the College of Engineering would have to admit that it would not make for a very popular sitcom. Therefore, the responsibility of educating the young public about engineering falls to those who are involved in the field — students, professors and professionals. Today at UW-Madison various facets of the College of Engineering are hard at work in this effort.

The Society of Women Engineers has an outreach committee which travels to junior high schools and high schools throughout the state, presenting aspects of engineering in which children and young adults can get interested.

The Pre-Engineering Department of the COE is also active in recruiting potential students by conducting an annual ESTEAM program. ESTEAM, Engineering Saturday for Tomorrow's Engineers At Madison, is a day long program during which faculty and student volunteers

continued on page 3

Editorial continued from page 2

invite high school students who have expressed an interest in engineering to spend a day on campus attending lectures and touring facilities.

Along the same lines, the American Society of Mechanical Engineers (ASME) holds a yearly outreach day during which approximately 100 high school students have the opportunity to spend a day full of learning on our engineering campus. Along with tours, demonstrations of technology and lectures, the high school students interact with ASME members, giving them an opportunity to get a more personal perspective on what it is like to study engineering at Madison.

The entire COE bans together biannually to hold EXPO, the Engineering Exposition, where student research and industry opportunities meet in a forum for all to see. EXPO devotes an entire day to bringing in hundreds of high school students, showing them the exhibits and the campus, and involving them in engineering related events and competitions.

To guide these and other outreach activities the COE has an outreach office, which provides assistance and information.

The outreach programs conducted on our campus by students and faculty are exceptional examples of the type of work that must be done if we are to introduce an awareness of engineering into the lives of young adults. The educational responsibility, however, lies not only with those involved in education. We should carry that responsibility with us into the professional world. In industry we are much less likely to find the plenitude of programs intended to educate the public. Yet it is in industry that some of the most exciting engineering and research occurs. Companies like Ford, Harley-Davidson and Cray Computers manufacture the products that spark the imaginations of young people, drawing them towards these fascinating fields. But high school students can only get a hands-on view of this kind of technology if engineers working in industry reach out through educational programs which encourage youngsters to become part of this tremendously broad and changing field.

In a Competitive Job Market...

The Manufacturing Systems Engineering Program (MSE) at UW-Madison has been training and retraining engineers in the rapidly growing field of manufacturing engineering for the last ten years. Rajan Suri, a professor in Manufacturing Systems Engineering and Industrial Engineering who heads the program explains its importance, "The face of manufacturing has changed drastically in the last 15 years. In order to stay competitive in today's world, companies need to rejuvenate their factories and organizations, using the latest technologies and management practices."

According to Suri, such projects span both technical and organizational boundaries. "Companies realize that for such work they need more than their regular engineers with disciplinary degrees such as BSMEs, BSIEs or BSEEs. The interdisciplinary aspects of the MSE Program create an ideal person to manage these rejuvenation projects," Suri adds.

MSE, an interdisciplinary program which began in 1983, was the result of a study done at the university to assess the need for education in manufacturing. Findings of the study indicated that UW-Madison was a prominent university in the field of manufacturing, but that courses and research in manufacturing were spread over many different departments. The MSE Program was created to unite these courses in manufacturing.

The MSE Program has a close alliance with the School of Business. According to Suri, the MSE degree can be considered a "technical alternative to an MBA," because it combines technical engineering courses with business management courses. The result, he says, is an engineer who is able to effectively communicate with middle and upper level management and across organizational lines. "In today's competitive job market, engineering need qualifications that separate them from the rest. Our M..S. degree in manufacturing systems engineering does just that," Suri explains.

To be accepted into the MSE Program students must have an undergraduate degree in an engineering or hard-science field such as physics or math, and have maintained a cumulative grade point average of at least 3.0. Students who received their undergraduate degrees in the United States are not required to take the GRE.

Once accepted in the program students can opt to take a 24 or 30 credit sequence. Those who choose the 24 credit option are required to write a thesis and those who take 30 credits must submit a less in-depth independent study.

Often the independent study projects offer hands-on expe ience with manufacturing firms. Jerry Holbus, a second year MSE student, spent last summer working with Greenheck Fan, a manufacturer in Schofield, Wisconsin. Holbus worked on reducing the lead time it takes to manufacture components for the exhaust fans that Greenheck makes. Holbus said that the experience of working in industry and applying the manufacturing techniques he has learned in the classroom was very rewarding. "You can put your education to good use by coming up with recommendations on how a Wisconsin manufacturer can improve," he adds.

In addition to either the thesis or independent study option, students can take the Engineering Management Specialization. This option emphasizes the management side of engineering and requires students to take a minimum of four courses in the Business school.

The MSE program is relatively small, with 57 students currently enrolled. Of those, roughly half are engineers returning to school after having worked in industry for several years. Returning students cite many reasons for coming back to school.

Steve Lacher, a second year MSE student, says defense cuts and the recession brought him back to school, "I wanted to come back to school because aeronautical engineering was not the field to be in when the cold war ended, and with the recession coming on, there weren't a lot of jobs designing airplanes."

Lacher, who has a master's degree in aeronautical engineering, was in the Air Force for seven years and worked on designing repairs for air-

The face of manufacturing has changed drastically in the last 15 years. In order to stay competitive in today's world, companies need to rejuvenate their factories and organizations, using the latest technologies and management practices

...MSE's StandOut

planes. He said that while stationed at Edwards Air Force Base near Mojave, California he saw commercial companies putting brand new airplanes in storage facilities at the base. "They were bringing in brand new passenger planes and moth-balling them," Lacher said.

He decided to come back to school for manufacturing so he could acquire more flexible skills that would apply in any manufacturing firm. "I wanted to be able to work for Rubbermaid making laundry baskets or an auto company making cars," Lacher said.

Bob Gustafson is another engineer who is back in school. Gustafson worked for Elco Industries in Rockford, Illinois as a quality assurance manager for seven and a half years before enrolling in the MSE Program.

...the MSE degree can be considered a "technical alternative to an MBA"...

Gustafson had worked his way up to a management position at Elco, but he felt that there were many "technical management tools out there that I wanted to know about and know how to use properly. I came back to school to improve my management skills."

Russell Beard, a first year MSE student and also a returning engineer says that after being out in industry, the courses he is taking now make much more sense and he can get a lot more out of them. "As an undergrad in class I would often find myself saying 'who cares, when can I use this' but now I say 'oh yeah I have done that out in industry'. I can also contribute more in class because I know more."

This contribution of experienced engineers is also a unique aspect to the MSE Program. Students entering the program directly from their undergraduate education benefit greatly from their fellow students' industry experience both in the classroom and in group projects.

AUTHOR

Leslie is a senior majoring in journalism and anthropology. Graduating in May, she has a huge case of senioritis and can't wait to get out into the real world.

HEV: DRIVING TOWARDS A CHALLENGING FUTURE

Ford Hybrid Electric Vehicle CHALLENGE

United States Department of Energy

SAE INTERNATIONAL®

Our toy cars run on batteries, so why can't the Mercedes in the parking lot do the same? Could it be possible for cars to run on those little bunny batteries? Not quite, but that is the idea behind the UW Madison's HEV project team. The HEV, or Hybrid Electric Vehicle, team is a group composed of undergraduate and graduate engineering students and a faculty advisor working toward a future of emission-free automobiles.

Rich Bonomo, HEV project manger and honorary fellow, has been heading the project since August 1993. The idea behind the HEV is simple, ". . . to have enough battery aboard to let you run around the city without having to turn on an IC [internal combustion] engine. But if you were to take a long drive then you [the on board computer] would turn on the IC engine," explains Bonomo. The group consists of approximately 40 students, most of whom are working for credit, while a few volunteer their time. Bonomo says that the tremendous amount of work and effort that the students have put into the car over the past year has definitely produced results. "On the street it performs well. We have a superior car as far as general design and philosophy goes."

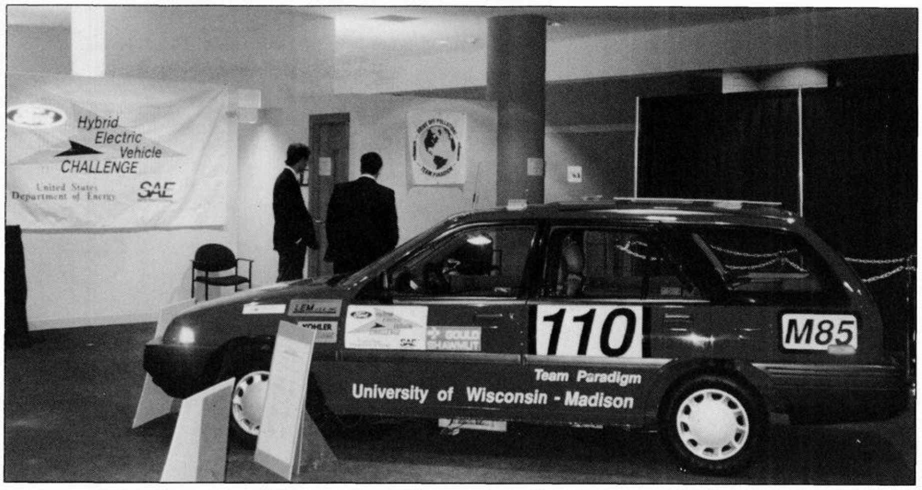
Photo courtesy of HEV

HEV project manager Rich Bonomo (left) and a fellow group member show off the Madison hybrid electric vehicle at last spring's Engineering Expo.

Why all this interest in an emission-free vehicle? As a result of the passage of the California Clean Air Law, by 1998 two percent of the sales of new automobiles in that state must be emission-free vehicles. Although the HEV is not totally emission free, Bonomo sees it as a stepping stone toward the goal of a practical emission-free vehicle. "The hybrid is a part-time zero emission vehicle. The auto makers are thinking that people will accept these as a compromise to cut down on pollution in urban areas."

The HEV has distinct advantages over present gasoline automobiles. Says Bonomo, "Even with the engine [turned] on you can use the battery to buffer the load seen by the gasoline engine so you can make sure the engine is running at constant speed and torque." This allows the car to optimize emissions, since there is no acceleration or deceleration of the engine. Disadvantages also exist, however. A trip to Milwaukee would probably be difficult since the range of the HEV is only 25 miles on one charge of battery. Also, should an HEV type automobile be sold in the future to consumers, a standard set of equipment should include an extension cord to recharge the battery for the next day's use.

With the increasing interest in electric vehicles and technology, contests or "challenges" are being held all over the nation to keep the technology from stagnating. In last year's challenge, which featured areas of competition such as acceleration, commuter race, emissions, and fuel efficiency, the Madison HEV team performed quite well, according to Bonomo. "We placed third in the acceleration test and were on our way to winning the commuter race until the motor drive controller blew up."



The Team Paradigm hybrid electric vehicle on display at last spring's Engineering Expo.

Photo courtesy of HEV

For 40 students fascinated by engine technology, the Hybrid Electric Vehicle is an opportunity to contribute to the automobile industry of the future

In the future, the HEV group plans to take their vehicle to a number of challenges, the first of which is in mid-March in Phoenix. The challenge will feature two 25-mile races for HEV types. Bonomo and his crew hope to have their vehicle in top racing condition, and to make sure of this, several hundred miles of road tests have been performed with no malfunctions. The team is also planning to attend the 1994 HEV Challenge. This year's Challenge, held in Southfield, Michigan during mid-June, will feature hundreds of students from "42 of North America's top science and engineering schools" competing in the following eight events:

1) Testing emissions to see if vehicles meet current EPA standards.
2) Commuter Challenge— a race simulating "real-life" driving conditions.
3) Testing of range and average speed of vehicle.
4) Efficiency of vehicle energy use during HEV Challenge.
5) Timed acceleration from standing start (Drag race).
6) Evaluation of design quality, safety and construction.
7) A "road rally" consisting of suburban and rural driving over a 100 mile circuit.
8) A technical report summarizing the powertrain, the control strategy, the design and the materials.

All competing vehicles will be HEV types consisting of an electric motor powered by batteries and a combustion engine powered by methanol, ethanol or reformulated gasoline. UW-Madison's HEV team uses a lead acid battery similar to that found in gasoline powered automobiles, with one major difference. This battery is made to have 70-80% of its power drained, whereas the batteries in gasoline-powered vehicles are only meant to be drained 20-25%. The engine used in the HEV is also much smaller than an ordinary car engine. Currently, a 20 horsepower Kohler engine with a 3-phase alternator is being used in the HEV.

For 40 students fascinated by engine technology, the Hybrid Electric Vehicle is an opportunity to contribute to the automobile industry of the future. The team continues to work on improving the technology and performance of the vehicle, while striving to win the upcoming HEV challenge.

If you are interested in helping out with the HEV project, contact Rich Bonomo at 262-6266 or e-mail to "bonomo@ece.wisc.edu. or check out one of the weekly meetings on Fridays from 3:30 to 5:30 in room 336 of Mechanical Engineering.

AUTHOR

Mark Mastalski is a senior in Mechanical Engineering. This summer he will be returning to Kohler to continue his co-oping term.

Hydraulic Car Paves the Way . . .

Some people say that Wisconsin 'has it all'; beer, brats, and Rose Bowl Champions. Unfortunately, Wisconsin also has air pollution. Like everywhere else on this continent we have automobiles that pollute. Unlike everywhere else we have a group of engineers working on a different type of solution. Professors Frank Fronczak and Norm Beachley are heading up an effort to create a new type of energy efficient vehicle using an old idea.

The project is called "The All Hydraulic Car", and its claim to fame is economy and performance through design integration. Today's production automobile's drive system is basically an engine, producing varying amounts of power, coupled to the wheels through a set of gears. Its only means of producing power is by converting gasoline from the fuel tank into heat and work using the engine; it has no means of storing energy.

The hydraulic car uses a different approach. Instead of gears directly transmitting power from the engine to the wheels, the engine uses a pump to convert its mechanical energy to hydraulic power. The integrated design of the hydraulic car allows for more flexible control of the flow of power. The hydraulic car's major components are shown in figure 1. In addition to the engine and pump the car has a hydropneumatic energy storage accumulator and pump/motor units on each drive wheel. The accumulator is a key feature of the hydraulic car. A hydraulic accumulator is much like a battery pack in an electric car; it stores surplus energy and returns it back the system when it is later needed. Since it is an energy storage device it provides many options in the flow of hydraulic power within the car's drive system. For instance, it allows for regenerative braking. Normally cars are brought to a stop using friction- dragging pads against a disk creating heat that is just thrown away. With regenerative braking the drive motors turn into pumps and slow the car by making the wheels pump up the hydropneumatic accumulator. That stored energy is then released back to the drive motors when the car needs to accelerate again- much like the start-stop-start cycle found in urban driving. This saves a lot of gasoline, considering the number of red lights one can hit when driving between campus and East Towne Mall.

Another feature that is made possible by integrating a hydropneumatic accumulator in the design is the size and style of engine used to convert gasoline into hydraulic power. It is well known that little, efficient cars have little , efficient, and gutless engines. Excessively large engines are put in "muscle cars" so that they can accelerate quickly. Most of the time cars drive at a steady state speed- requiring only about 15hp at 55mph. This is where the hydraulic car has an edge; it uses energy stored in the accumulator when extra power is needed during acceleration. This means that it can use a very small engine that runs at a steady speed all the time, storing up energy when it is not in great demand. This idea, called load balancing, and it increases the economy and performance of

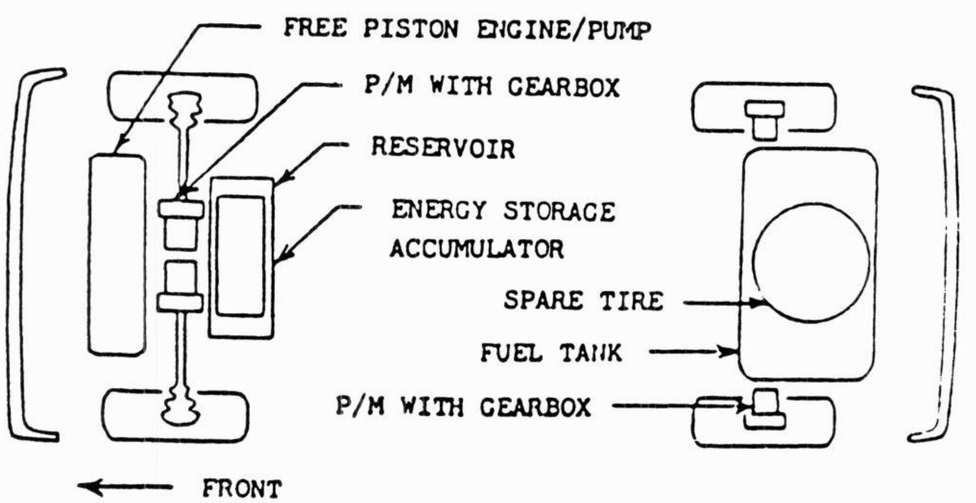


Fig. 1 Proposed layout of the "All Hydraulic Car"

. . . to Energy Efficient Transportation in the Future

a vehicle. In addition, the low power engine could be made quite compact. Professors Beachley and Fronczak published a paper, presented at the 1988 National Conference on Fluid Power, that proposed using a free piston engine for an all hydraulic car. Instead of valves, springs and crankshafts the engine has one moving part — the piston. Figure 2 shows its functional parts. It is the same basic piston-cylinder-rod assembly as a conventional 2-stroke engine, except that the hydraulic piston pump is directly connected to the combustion piston. The accumulator even provides the energy to start the engine — no battery or starter motor is needed.

A hydraulic accumulator is much like a battery pack in an electric car; it stores energy and returns it back to the system when it is needed later

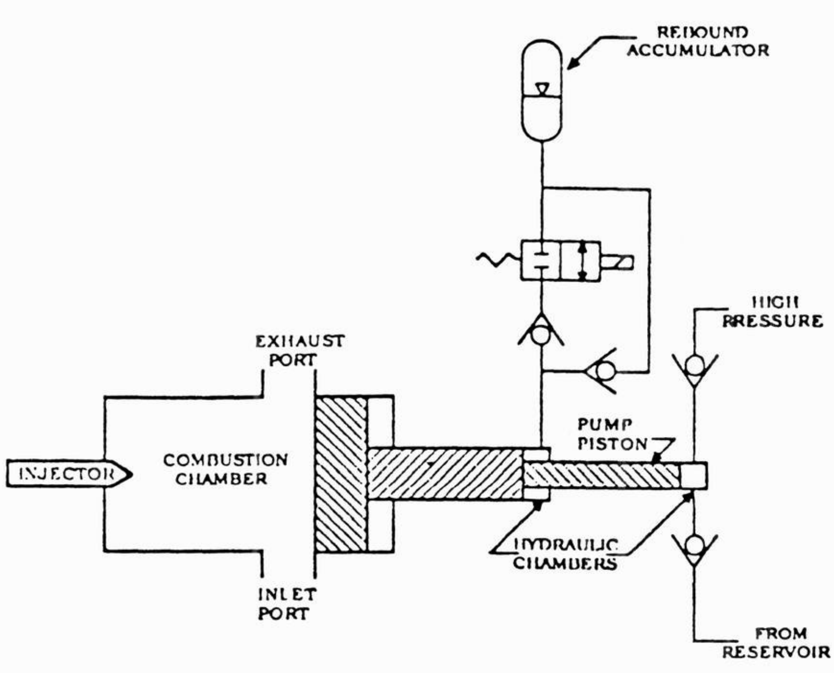


Fig. 2 Schematic representation of the free piston engine/pump

It is clear that these basic parts combined in an integrated design could be the makings of an economical and high performance vehicle. The EPA believes in this idea as well, consequently they are funding a research project here to build a prototype car of the future. In the basement of Mechanical Engineering graduate students are assembling and testing components that will very soon be used to build a hydraulic buck. A 'buck' is the business end of a car under development; just a frame and power system. A fully tested, street ready car is planned for next year. Professor Fronczak thinks that the "All Hydraulic Car", with built in features such as four wheel drive, low maintenance engine and regenerative braking, is a viable approach toward energy efficient transportation in the future. ▮▮

AUTHOR

Ted Bohn is a senior in Electrical Engineering in power electronics. He keeps busy by working on the UW Hybrid Electric Vehicle. He hopes to make a career of working on energy efficient vehicles.

Powertrain Control Research Lab

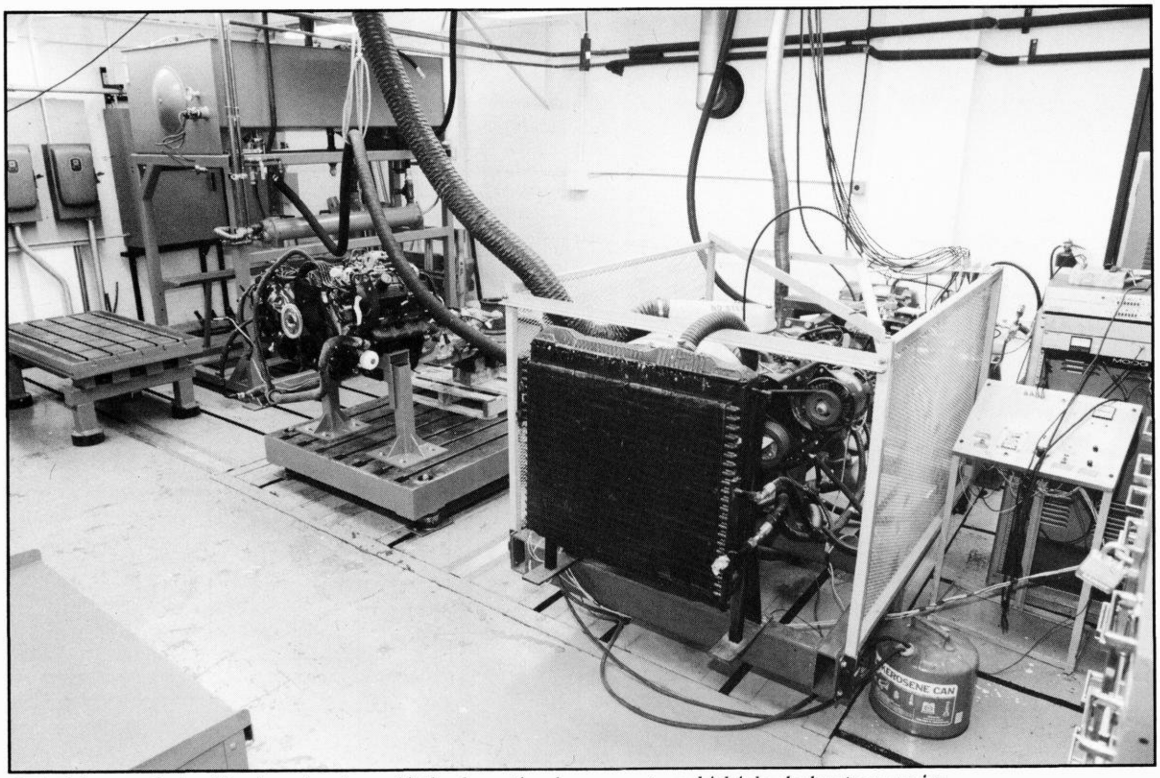


Photo by Professor John J. Moskwa

In the lab room, the boxlike piece of equipment is the absorption dynamometer, which is hooked up to an engine.

Almost everyone has seen or played the video game where a person sits inside a "car" with a steering wheel and a gear changer that simulates driving. Unfortunately, the only experience a player gets is visual. At the University of Iowa, however, the U.S. Department of Transportation and the National Highway Safety Association (NHTSA) are developing the National Advanced Driving Simulator (NADS), which simulates the complete motion of a car. The $32 million motion platform, which resembles a flight simulator, is a virtual reality machine with high fidelity visuals and real-time simulation (three-dimensional motion) of all road and vehicle dynamics. According its proposal, the NADS is used to "study basic human factors issues associated with the vehicle-operator-environment-interface, evaluate cueing approaches (motion, visual, auditory, tactile), and exploit human interface technologies emerging from the virtual reality field." The results of these studies are used to improve the safety of roads and vehicles.

How is this research relevant to UW-Madison? The NADS is of great importance to four graduate and two undergraduate engineering students at the College of Engineering, who are currently researching the development of dynamic engine models for the NADS. Their research is being conducted in the Powertrain Control Research Lab which came into existence in 1989. The founder and director of this lab is Professor John J. Moskwa.

Moskwa began his career as a professional trumpet player. He studied at the Cleveland Institute of Music, and at one time was principal trumpet for James Levine, the artistic director and conductor of the Metropolitan Opera in New York City. Moskwa got his first experience in the university atmosphere when he worked as a professor of trumpet at the Universidad Autonoma De Guadalajara. After a time Moskwa entered the University of Michigan to obtain a Bachelor's Degree in Mechanical Engineering and a Masters Degree in Dynamics and Vibrations. He followed up his studies by working for Cummins Engines and later went to the Massachusetts Institute of Technology, where he earned his Ph.D. in Mechanical Engineering Controls. His career then moved to GM Research Labs, and at last brought him to

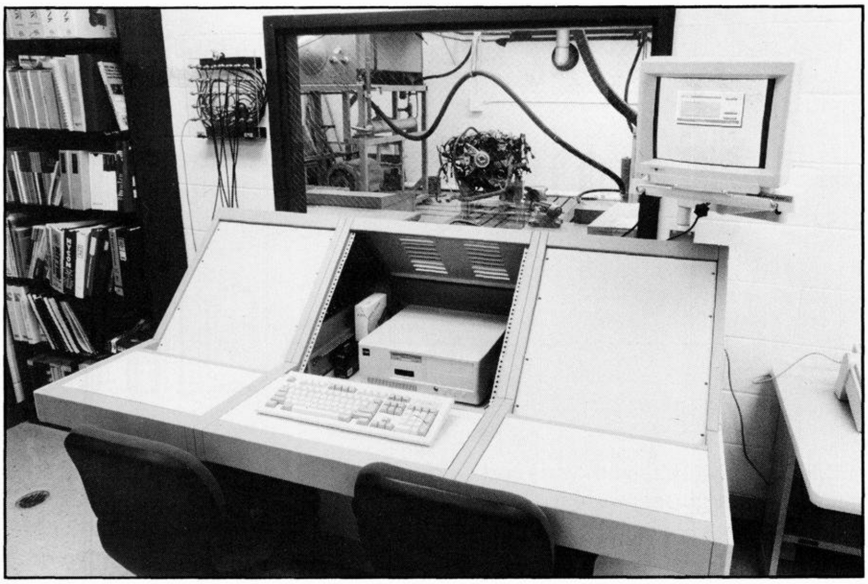
UW-Madison, where he has been a professor since 1988.

To use his specialized skills beyond the classroom, Moskwa decided to form the Powertrain Control Research Lab. His first challenge creating this lab was finding the space for it. After much searching, he found the lab's current location, in the east wing of the Mechanical Engineering Building across from the Nuclear Reactor. Inside the lab, a 250 sq. ft. space holds the electronic instrumentation and dynamometer control room, while the remaining 950 sq. ft. space is used for the experimental laboratory.

The lab receives funding and equipment donations from various companies including Ford and Cummins Engines, who are interested in the developments that result from engine research. According to Moskwa, "The mission of the lab is to conduct research and train engineers in dynamic modeling and analysis, control, and fault diagnosis of vehicular powertrain systems." The powertrain for a vehicle is composed of a system of components which control the power in a car and includes the engine, transmission, braking, steering and suspension.

The research in the lab is performed in two stages. First a theoretical system is modeled using a computer. The parameters in the system are changed on the computer model. The computer then produces a theoretical response of the system to changes in the parameters, such as the response of a transmission to changes in gears. Then the actual system is set up in the lab and tested, in order to determine how the experimental data compares to the theoretical data generated from the computer model. Such experiments are performed in order to develop diagnostic systems for engines. Diagnostic systems should quickly indicate component or operational failure within an engine, such as low cylinder pressure from misfires or partial burns (when some of the gas is not ignited and thus blown out the exhaust) which can raise emission levels.

The development of such diagnostic systems is a crucial and rather timely issue. At present, there is pending legislation, known as OBD II (On-Board Diagnostic II), which will require cars to have built in diagnostic systems. Such systems will immediately alert a driver to problems occurring in the vehicle and display the cause of the problem without any extensive testing or "shop work". Identifying hazards in such a timely way will help keep automobiles in safe driving condition and decrease air pollution.



The computer room, with a view of the lab room from the window.

The lab equipment also includes an absorption dynamometer and the beginning of what will be a high bandwidth dynamometer that will be able to function as absorbing or motoring and switch between the two very quickly. An absorption dynamometer measures torque by absorbing the force produced by an engine. For instance, when a car goes up a hill its engine puts out a torque that forces the engine shaft to move in a clockwise direction. The absorption dynamometer then puts out an opposing torque. In an actual car, if this opposing torque becomes greater than the engine torque, the car will slow down. If this situation continues, then eventually, the car will stall.

The motoring dynamometer is the opposite of an absorption dynamometer and produces torque in the direction of rotation. In other words, as an engine puts out a torque that moves the engine shaft in the clockwise direction, the motoring dynamometer will produce a torque in the clockwise direction as well. This addition of torques to create a larger torque causes the engine to rev faster and simulates what a car engine experiences as a car goes down a hill.

The new dynamometer has the potential, according to Moskwa and graduate student Scott Seaney, to be the fastest or most responsive dynamometer in the world due to the extremely high power density and low inertia of its hydraulic system. This is important because quick response is needed to carry out the transient simulations of this "hardware-in-the-loop" system. "Hardware-in-the-loop" is a generic, but widely used term which explains how the computer interacts with the engine so well that it appears to the engine that it is connected to the rest of the car, when in actuality, it is only connected to the computer. The information gathered from this research can be used to develop and test transient algorithms for engines and powertrains. A transient algorithm, in this sense, is a program or set of programs (algorithm), which can effectively control or diagnose the engine when its speed and torque are varying (transient). One example is to dynamically change the fuel controller in order to maintain a fixed air/fuel ratio to minimize emissions.

This field of study, although quite new, is growing rapidly. Many exciting things are taking place in the Powertrain Control Research Lab that could affect the future of engines. By the year 1996, diagnostic systems will be seen on cars and they will be aiding in the trouble-shooting process, along with decreasing vehicle emissions. Also, as a result of the studies done on the NADS, more things will have taken place to increase road and vehicle safety. So, the next time you drive a car, think about all the research and experimentation it took to make it what it is.

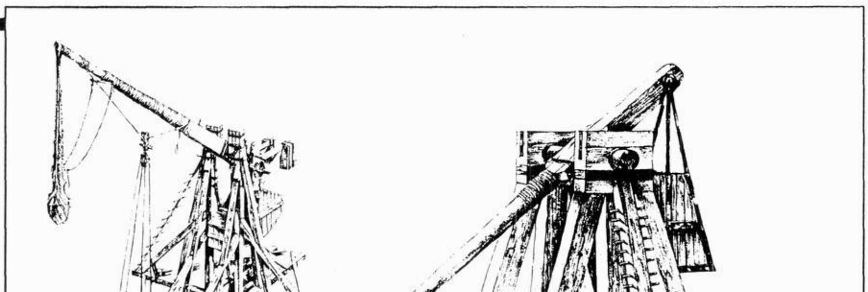
AUTHOR

Gina Wagner is a fifth year student majoring in Mechanical Engineering and French. She is interning at John Deere this summer.

Engineering and War in the Middle Ages

The middle ages were rife with wars and altercations, and engineers were frequently called upon to use their ingenuity to increase the chances of a favorable outcome for at least one of the parties involved. Because places of fortification, such as castles or walled cities, controlled the surrounding land, war in the middle ages involved seiges much more often than open battles. To be safe, an army had to capture any fortified place that it passed or it risked leaving behind an opposing force that would constantly threaten lines of supply and communication. If the attackers had time, one of the more effective strategies was to surround the city or castle and starve the occupants out. Since neither side could usually afford a lengthy siege, however, other methods were needed to hasten things. Although ruse and treachery sometimes unlocked the gates, engineering and ingenuity were often found to be a more reliable combination. There were rarely easy solutions, and the stroke of engineering genius required to tip the scales might mean designing and building a machine or simply using scientific knowledge to the best advantage.

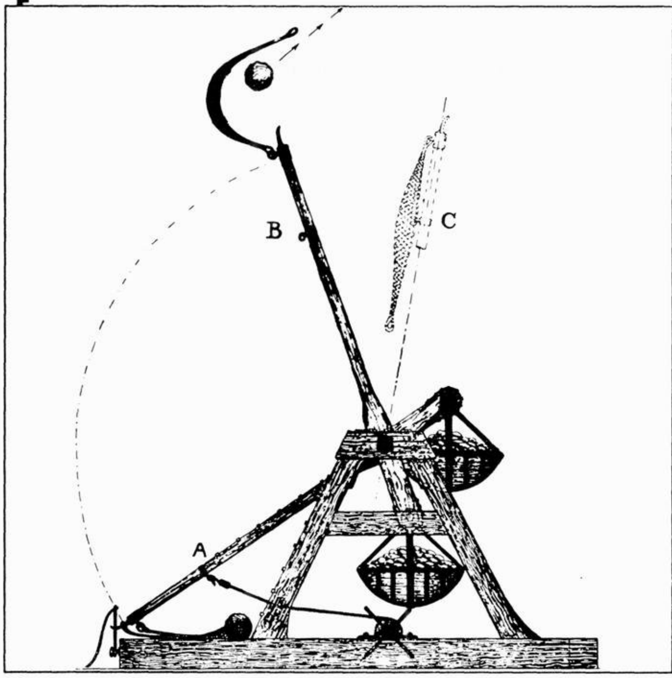
One recorded case of a very simple, yet ingenious, engineering feat occurred at the siege of Rhodes. A 175 ton, 125 foot tall siege tower built by the besiegers was causing the Rhodesians a bit of distress. If the attackers were able to roll this 125 foot behemoth next to the wall, they would be able to shoot down at the defenders because of the tower's great height advantage. The tower's height also allowed the attackers to see over the city wall, leaving the defenders of Rhodes nowhere to hide. When missiles started raining down from the tower, the defenders would be forced off the wall, leaving it unguarded. Once the wall defense was softened in this manner, a drawbridge could be dropped from the siege tower onto the wall, giving the attackers access to the city. Callias, the engineer of the city of Rhodes, resigned because he was unable to deal with the threat. Desperate, the city council pleaded with another engineer, Diognetus, to save them. This plea was ironic since they had dismissed Diognetus not long before in favor of the inept, smooth talking Callias. After much pleading, Diognetus agreed to save the city on the condition that he would keep the siege tower should he capture it. Rather than trying to destroy the tower, Diognetus took what seemed to be a huge risk, and made a breach in the wall under cover of darkness. He then set the Rhodesians to pouring water, mud, and sewage beyond the breach. When the opposing force attempted to roll the tower through the newly made hole in the wall the next morning, it became stuck fast in the mire and was captured. Upon losing their greatest weapon, the attackers lifted the siege and sailed away, leaving the triumphant Diognetus his 125 foot trophy.



Large Trebuchet

Engineers have also used their knowledge of mechanics to build an array of machines collectively referred to as siegecraft, or siege engines. Some of these devastatingly effective siegecraft could be used for hurling huge stones and other projectiles. Often when other forces were equal, siege machines meant the difference between life and death.

The trebuchet, perhaps the most popular of the medieval siege weapons capable of launching projectiles, operated on the counterweight principle. The counterweight usually weighed around 10 tons, though some gargantuan specimens able to hurl 600 pound boulders used counterweights of close to 50 tons. The trebuchet's arm was generally about 50 feet in length. Trebuchets arrived on the battlefield around 1100 A.D., replacing less powerful torsion powered catapults. The trebuchets popularity was due to its great power and simple design. A typical trebuchet could launch a 200-300 pound stone 600 yards, while average catapults could only loft a 50 pound stone about 500 yards.



Trebuchet in action.

In addition to their stone throwing capabilities, trebuchets and other large siegecraft were sometimes used to psychologically unnerve the enemy. In many instances, whole dead horses and cartloads of manure were substituted for stones and lobbed over the walls to encourage the outbreak of disease. There is even one recorded instance of a captured messenger and his letters being tied up and shot back over the wall via a trebuchet.

In many instances, whole dead horses and cartloads of manure were substituted for stones and lobbed over the walls to encourage the outbreak of disease

This type of psychological warfare was used during the siege of Scottish Stirling castle by King Edward I in 1304. Edward designed a colossal trebuchet, which he affectionately named "War Wolf," and had it constructed at the site of the siege. The defenders of the Scottish castle were so intimidated by the great machine that they unconditionally surrendered to the king before he had a chance to employ it. Edward was so excited about his machine however, that he refused to allow the defenders to surrender until he had a chance to try it out! He accepted the castle's surrender only after using his War Wolf and watching the Scot's futile attempts at defense.

A great engineering design can be timeless, and even after the machines perfected in the middle ages had been replaced by cannons and faded from the battlefield, they could still be useful in capable hands. In 1480, Rhodes, under attack by Turkish cannons, was once again saved by an engineer. This engineer, perhaps an ancestor of *MacGyver* , constructed a trebuchet which was able to knock out the Turks' cannons and prevent them from advancing. Not everyone was successful in building these devices however. For example, when Cortez was attacking a town in Mexico in 1511, he ran out of ammunition. One of his soldiers,who thought he had a knack for engineering, convinced his cohorts to build a trebuchet in hopes of causing the city to surrender. Unfortunately for the Spaniards, the soldier's theoretical knowledge was not as good as his practical knowledge, and the trebuchet was destroyed by its own missile on the first launch. Almost six centuries later we can learn from the ingenuity of our predecessors, and remember to check our calculations twice when revamping an old design! ▮▮

AUTHOR

In constant pursuit of new challenges and adventures, R.J. Elsing still finds time to moonlight as a senior in Mechanical Engneering.


Rolling Siege Tower

STRESSED?

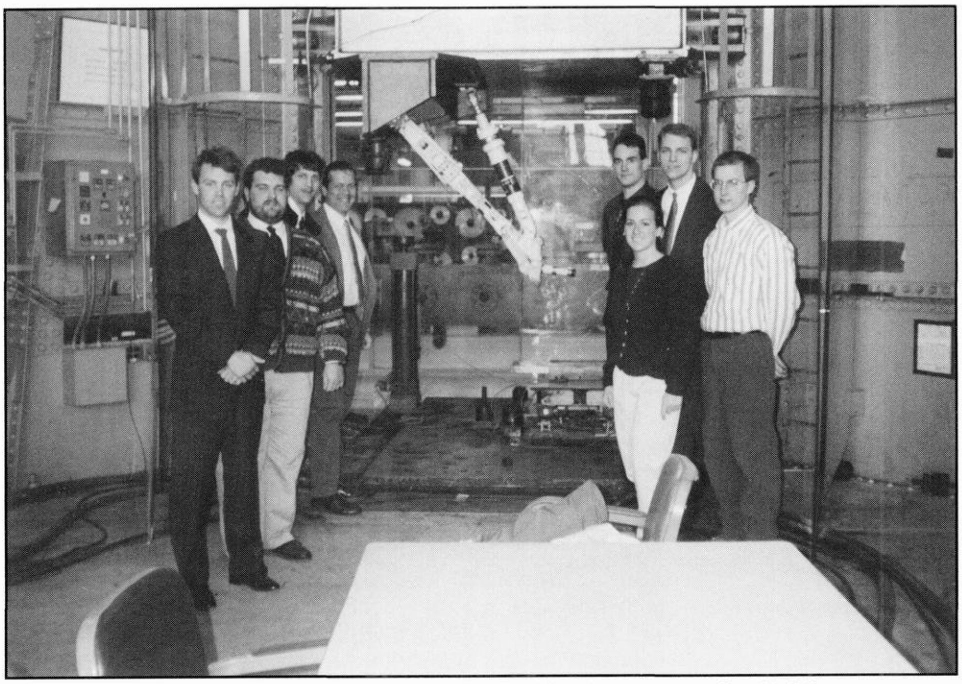


Photo courtesy of Ryan Roloff

In the Air Force Museum's Tire and Landing Gear Test Facility, the group poses for a Kodak moment. L-r: Mark Fleming, Dan Bazile, Peter Onesti, Rob Yetka, Ryan Roloff, David Corr, Cheryl Martin, and Dan Hilbelink.

The first thing you notice if you venture down to the basement of Engineering Hall is that it is a dismal world of windowless, cement corridors and looming wooden doors. Behind one of the those formidable doors however, innovative new technology is being developed through the combined efforts of industry and the university, in the Mesomechanics laboratory.

What is mesomechanics? American Heritage Dictionary defines: Meso as "middle" and mechanics as "analysis of the action of forces on matter or material system." In the mesomechanics lab on campus, researchers analyze how various forces cause stress, fatigue, and fracture on engineering materials. The results of such analysis are applied not only in academics, but also to automotive, aerospace and electronic industries.

The lab was started in 1968 by Professor Bela Sandor who continues to oversee its progress. It is run primarily by seven graduate and two undergraduate Engineering Mechanics and Astronautics students. Some of the students are enrolled in the Engineering Mechanics and Astronautics 611 or 699 courses, which use the lab extensively. The students can earn credits while working on research for Ford, Boeing, and local hospitals, as well as their own projects.

The students are limited only by their own creativity - Rob Yetka

Student projects vary. Mark Fleming, a graduate student in Civil and Environmental Engineering and Engineering Mechanics and Astronautics, is working on crack detection in welded steel bridges using forced diffusion thermography (See sidebar). Cheryl Martin, a junior in Engineering Mechanics, is currently proposing a project to research measurements of density using thermographic techniques. Rob Yetka, senior lab technician, comments on the nature of student projects, "The students are limited only by their own creativity."

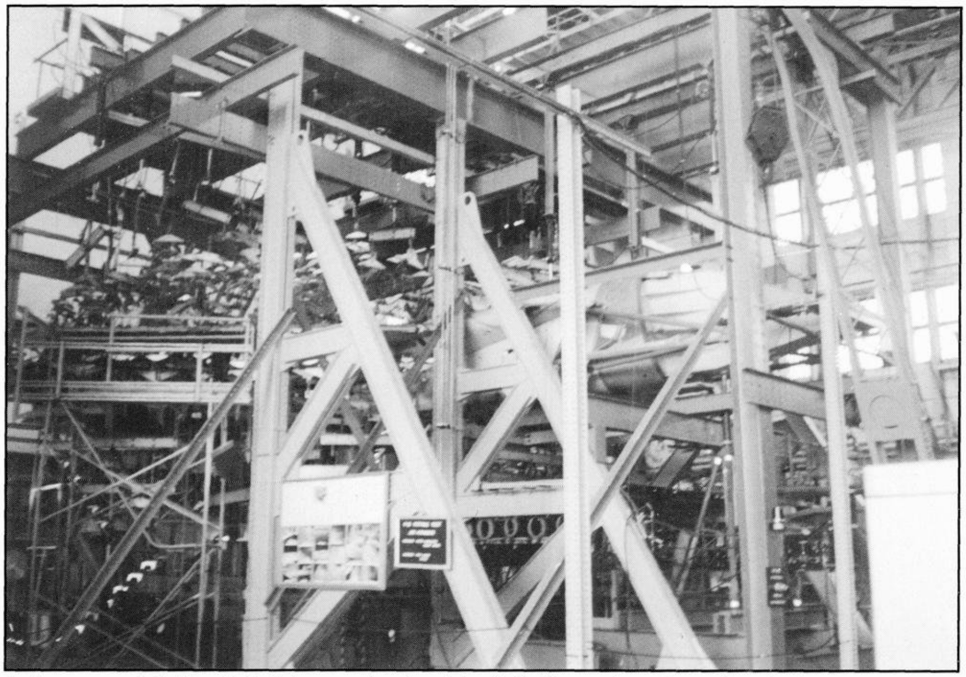
Currently a number of students are finishing a three-year project for Ford, in which they have been doing advanced research with SPATE (Stress Pattern Analysis by Thermal Emissions), to expand its capabilities. SPATE is a camera that uses infrared technology for stress analysis. The camera is set up in front of a specimen that has a cyclic load applied to it. When the specimen is put into compression or tension, its temperature changes. This change may be very small(0.001° C), but SPATE can detect and analyze the change point by point. The temperature change is multiplied by material constants in order to calculate the sum of principal stresses on the specimen. The SPATE camera on campus is one of 200-300 world-wide and one of only three in American universities. Professor Sandor states, "We are in the forefront in the world in use of SPATE and of training students in its use."

We are in the forefront in the world in use of SPATE and of training students in its use - Professor Bela Sandor

The technology developed in the lab has even been known to give rise to industry. In the late 1980's a number of former mesomechanics students rewrote the software used in SPATE. They then founded Stress Photonics, Inc., a local company which is closely associated with the Mesomechanics lab today. Every Wednesday afternoon, students from the lab and employees from Stress Photonics meet to discuss current projects and potential new ideas. Presently, the company is in the first phase of developing a new camera which uses the same basic technology as SPATE, but instead of analyzing a specimen point by point it will view the entire specimen at one time. The new camera, Deltatherm-1000, is perhaps 1000 times faster than SPATE for scanning an entire specimen. It can see the effects of a load immediately, such as "real-time" crack growth. The Deltatherm can also detect changes in temperatures as sensitive as 1/1000th of a degree Centigrade. This emerging technology is funded by a grant from the Air Force.

From time to time, students and faculty associated with the Mesomechanics lab are invited to attend seminars, technical presentations, and meet with industry representatives. On February 4, 1994, eight students were invited to Wright-Patterson Air Force base in Dayton, Ohio, to listen to Stress Photonics' technical briefing on the Deltatherm's progress. The students were introduced to representatives from NASA, Boeing and Pratt & Whitney who were interested in their research with the new prototype. During the trip the students were given the opportunity to tour the Air Force engineering mechanics laboratories and the Air Force Museum.

The mesomechanics lab is a place where partnerships are formed between industry and the university, and where students work together on team projects and individually on their own areas of interest. Martin comments, "The lab opens the door for a lot of opportunities, especially for those who apply themselves." And so once again UW-Madison plays a key role in the development of technology, thanks to the work of a professor, the dedication of the students, and the support of industry. ▮▮▮



Photocourtesy of Ryan Roloff

In the museum's Fatigue Lab, this apparatus simulates the loads experienced on a plane during flight. An F-15 is being tested here.

The Things Students Do

Forced diffusion thermography is a method of non-contact crack detection. Mark Fleming is currently studying the feasibility of using the SPATE camera on welded steel bridges. At a site, the camera would be mounted, and a dynamic heat source would be projected onto the specimen through a grating. The source generates a heat flow direction through the specimen, however, if there is a crack, a concentration of heat occurs which the camera can detect. The grating is then rotated to completely analyze the whole specimen. This method would allow engineers to find small cracks and voids and remedy them before they become dangerous. ▮▮▮

AUTHOR

Robyn Ryan is completitng her third year in Engineering Mechanics. She is keeping busy this summer by working at the biomechanics lab at the hospital and helping out with SOAR.

Teachers Getting Taught

How many times have you come out of a lecture saying, "That professor needs to learn how to teach?" A program in the UW College of Engineering has been implemented that does just that — it instructs faculty members how to teach themselves and each other to improve their teaching skills. Katherine Sanders, a Research Associate for the Center for Quality and Productivity Improvement, realized that the root of this problem lies in the fact that professors rarely get an opportunity to analyze their approaches towards and beliefs about teaching. With this in mind, she developed a program designed to provide a framework for faculty in the College of Engineering to improve undergraduate teaching.

How many times have you come out of a lecture saying, "That professor needs to learn how to teach?"

This program starts with volunteers participating in two two-hour Effective Teaching Seminars with professionals from Engineering Professional Development and the School of Education. The seminars focus on teaching and learning theory and prepare the volunteers for group discussions on their own.

In the next phase the participants break into teams of five or six which meet once a week. The teams come up with a problem they think is salient — for example, the first group decided that students were learning the material professors taught just so they could pass exams.

Photo by Carolyn Curley

Left to Right: Catherine Hajnal and Katherine Sanders coordinators of Teachers Being Taught.

These teachers decided that they wanted to create an environment which would produce motivated, life-time learners.

Once a problem has been singled out, the teachers identify the issues involved in the problem and figure out an aspect of it they can affect. Usually the teachers decide that if they modify their teaching in some way they can help solve at least part of the problem.

Sanders is present for all the team meetings and provides structure for the teams. However, she never tells them what to do. "The key factor is that they come to conclusions on their own," she points out. Instead, she directs them by asking questions, such as "What is teaching?"

Sanders also has the faculty construct flow charts of how they teach. The goal of this exercise is to try to incorporate variety into their teaching methods. "One thing the faculty do not realize is that they have options on how they organize a class," Sanders explains. Usually, when teachers are assigned to classes they are handed the syllabus and notes from the previous instructor. The new professor usually uses the same format because he or she assumes that there is no other way to conduct the class.

This program started with Sanders' dissertation, titled *The Effects of a Participatory Process to Improve College Teaching*. She used the method on a group of volunteer teachers in the UW College of Engineering and used her research in her

It completely changed the way I thought about teaching – Professor John Mitchell

dissertation. Two faculty members from the first group to go through the program, Professor Michael Corradini and Professor John Mitchell, were so impressed that they recommended to the Dean of Engineering, John Bollinger, to fund the program for two years with part of an IBM grant. The IBM grant money is used in the program to conduct research in improving the quality of classroom teaching in the College of Engineering.

All of the professors who got in-

You need to find a style of teaching that you are comfortable with that lets the student learn. For each class and for each subject this style will be different – Professor Michael Corradini

volved with program did so for similar reasons. First, the idea that someone was doing an engineering dissertation on improving the effectiveness of teaching intrigued them. Second, they wanted to help students get more out of their classes.

Once in the program, both Mitchell and Corradini were very impressed. "It completely changed the way I thought about teaching," comments Mitchell, who says he became aware that the traditional ways of having students learn has not been effective. "We realized that we don't teach the way we learn," he adds. The team had discussions about how they learn and decided that more often than not, the best way to learn does not include all explanation, or lecture, as they had been teaching. The group discovered that students need to be active in the learning process. Corradini compared his new perspective on teaching to a parent trying to teach a child something, "If the parents always told the child how things were done, it would be faster, but the child wouldn't learn the lesson. Instead, you need to know when to lecture, when allow for discussion and when to be a mentor."

After being in the program, Corradini felt that he did not improve his teaching skills, as much as he improved his awareness to different styles of teaching, which in itself is a big step. "You need to find a style of teaching that you are comfortable with that lets the student learn. For each class and for each subject this style will be different," he notes.

Both Corradini and Mitchell realized that variety was needed in the classroom for effective learning. As a result of participating in the program, Mitchell tried new techniques in his classroom and encouraged students to participate more. Changing to this style of teaching has not been easy. Says Corradini, "A style of teaching is like a bad habit; it's very hard to break."

Currently, there are 22 instructors participating in Sanders's program, a significant increase from when it first started last year. Since the program is voluntary, it has relied on people enrolled in the program to motivate others to join. Once active in the program, participants tend to be self-motivated to continue.

Sanders cautions that the program is not for everyone, "In order to make a significant improvement, the faculty need to change. This happens by knowing what to change, how to change it and having the direction and motivation to change. If they don't want to change, then I can't help them with the other two objectives — that is why working on a volunteer basis is so important."

At present the program does not consider any student input. However, starting next semester the professors in the program will organize a way to solicit student input to help define content and process in the classroom.

Sanders' long-term goal for the program is to make it a permanent part of the UW campus, not just the College of Engineering. Her personal goal is to continue the research she started with her dissertation and to modify the program so that it achieves diversity in teaching and the willingness to experiment in the classroom.

Sanders' philosophy regarding improving the quality of teaching in the classroom is that the faculty must identify the existing problems, examine the possible causes for them, form potential solution plans, implement them and evaluate their usefulness. The intent of the program is to provide a structure and resources for faculty to address these issues and to create solutions. ▮

AUTHOR

Emily Erickson is a junior majoring in Public Relations and Advertising. She is spending the summer enjoying Madison.

Engineering Students Find Fun During Dilbert Days

As the world was coming together to share for a moment the peace of friendship and goodwill in the Olympic Games, the students of the College of Engineering took time out to relax from the rigors of academia and enjoy smiles and laughter in this year's Engineers' Week. The theme for Engineers' Week '94 was "Dilbert Days" named after the cartoon Dilbert by Scott Adams. As the official guide to the week's festivities put it, the week was a chance for students to, "boycott the computer labs, drag your friends out of the library, put away your calculator and join your fellow geeks for some true engineer bonding."

Engineers' Week was coordinated by Polygon student council. The individual events, however, were sponsored by various engineering organizations. The American Society of Mechanical Engineers sponsored an outreach day allowing area high school students the chance to get an inside view of opportunities for an engineering student at the University of Wisconsin.

One of the organizers of the event, Dan Neitz, hoped that this type of outreach program would help to foster interest in and awareness of engineering for students who otherwise may not have such opportunities. This was the first time that the American Society of Mechanical Engineers had sponsored such an event, and due to the positive response from students, the society plans to offer the program more than once a year. Commented Nietz, "In the future we would like to see participation from all areas of engineering to show high school students the different specializations that the engineering school has to offer."

As event that drew much attention was Engineering Jeopardy. the tournament, which occurred daily throughout the week, was sponsored by Electronic Data Systems and the Kappa Eta Kappa Fraternity. Participants were given the chance to demonstrate their knowledge of calculus, physics, chemistry and general trivia on the College of Engineering

Photo by David Hubanks

Noam Shendar (left) and Dan Sonnen (middle) wait in anxious anticipation for the next grueling question during the Engineering Jeopardy Championships.

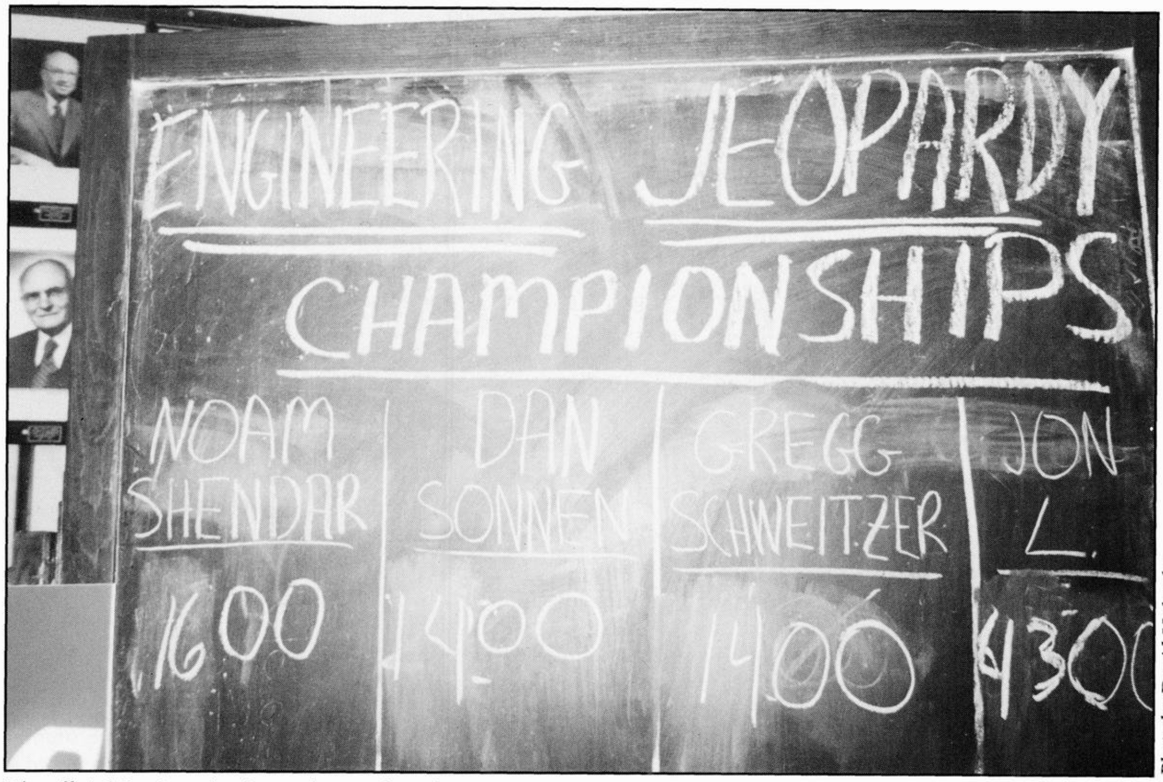


Photo by David Hubanks

The official Engineering Jeopardy scoreboard.

as well as their ability to think under pressure for the category "story problems from hell."

The week's end brought about the "tournament of champions" where the four individual champions from the week were given a chance to compete against each other, and in some cases against themselves, for the grand prize of $750, or a chance to share in the $600 for 2nd, 3rd and 4th place winners. Noam Shendar, tournament of champions participant commented, "I really liked the atmosphere. There was friendly competition and it was well organized."

Other events that took place during the week included a paper airplane design contest, a scavenger hunt, a volleyball tournament, a Monty Python movie night, and a happy hour at Jingles. Engineering organizational sponsors of these events included IEEE, Pi Tau Sigma, Triangle Fraternity, the American Institute of Chemical Engineers, and Tau Beta Pi.

A factor that was seen as an aid to participation in this year's engineering week was the ability of event organizers to confidently notify all students of the times and locations of the events using e-mail. In the past students may have missed an advertisement for an event and wished that they could have participated, but this year all engineering students who read their e-mail were kept up to date on the events occurring.

The week was a chance for students to boycott the computer labs, drag their friends out of the library, put away their calculators and join their fellow geeks for some true engineer bonding

Linda Kensler, this year's Engineers' Week organizer, stressed the need for a balance between work and play. "I think that it is important that people can take time away from their books," said Kensler. When asked if she thought that Engineers' Week was a success, Kensler replied, "if one person got involved that may not have gotten involved in the past, I think that it was a success.

AUTHOR

Though new to the Wisconsin Engineer, Dave Hubanks is often seen in the lobby of the Mechanical Engineering Building, where the acclaimed Engineering Jeopardy took place.

Society Spotlight

Engineering Your Future:
ASME's Day on Campus

It's 11:48 a.m, Monday morning, February 21, 1994. Dynamic Systems lecture is almost over...

The bell rings. I make my way out of room 159 Mechanical Engineering, and step into the ME lobby. But wait- what is happening here? Where are our usual mechanical engineering students, staring diligently into books or chatting over lunch? These fine representatives of the School of Mechanical Engineering are nowhere to be found. Instead the lobby is filled with- no, it couldn't be- why yes, it is- high school students!!!!

Instantly I panic. Am I experiencing a time warp? Did my fellow engineering comrades go through age reversal? Is this all just a bad dream? For a moment I stand in wonder. Then to my relief I realize that the unusual and slightly alarming sight before my eyes is the American Society of Mechanical Engineers Outreach "Day on Campus".

It began as an idea — to fulfill ASME's role in National Engineers Week, a week which promotes public knowledge of engineering.

Dan Nietz and Bryan Hutchinson, ASME's Outreach chairs, promptly went to work. Their goal was to organize a day long introduction to engineering for high school students. They visited area high schools and discussed ways to promote this type of outreach program with math and science teachers. Hutchinson and Nietz decided to target junior and sophomore high school students who showed an interest in engineering, as well as a few seniors who had already selected UW-Madison for their undergraduate careers. Once the list of participants was arranged, Hutchinson approached the engineering faculty. To dazzle and mystify the high students, he selected a number of facilities for them to tour. Many professors were more than willing to take time to give young, inquisitive minds a glance into their research facilities. In planning the event the two co-chairs wanted to involve as many ASME members as possible in order to give them a chance to gain leadership experience.

"We wanted to try to find something for everyone to do so that everyone could take ownership in the event," explains Nietz. "This semester ASME has become very strong and when a lot of people get together to help it adds to the inertia that we are trying to create."

Nietz set up committees to work on different aspects of the day. The response of the members was tremendous! "They really came through for us. They were fantastic!" comments Hutchinson in describing all of the volunteers who helped bring this day together and provide for a smooth flow of events. After months of brainstorming, planning and organizing, the scene was set for the high school students to arrive.

On the morning of February 21st, one hundred high school students and several teachers crowded into 1800 Engineering Hall, situated themselves in the

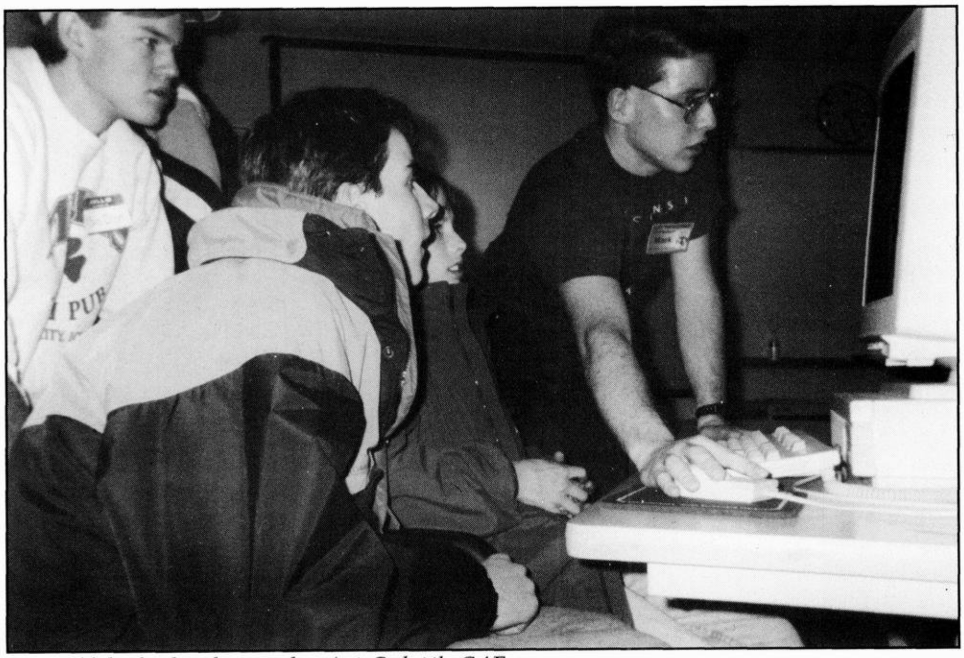
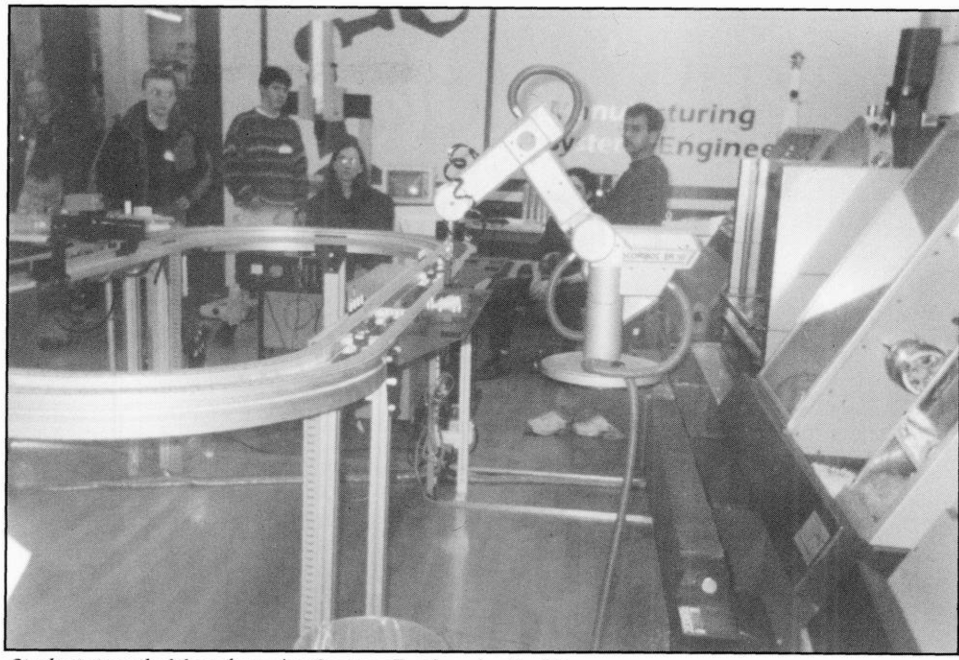


Photo by Bryan Hutchinson

Several high school students explore AutoCad at the CAE.

auditorium's ergonomically designed chairs, and listened as the ASME bunch welcomed them. The theme of the day was "Engineering your future", which focused on opportunities in college and beyond. ASME volunteers held a quick ice breaker to create a less formal atmosphere. To give them a prospective from the academic leadership of the College of Engineering, Dean Bollinger addressed the students. He spoke of the many opportunities that an engineering education offers after graduation. Since ASME wanted to present a variety of view points within engineering, Bollinger's speech was followed by three other speakers, who discussed the coop experience, engineering in general, and the students' view of life on campus.

For a taste of true engineering education, the high school students sat in the forum of our latest multimedia technology and interactive learning in room 1800, while listening to the well-known statics lecture that every engineering student fondly remembers as their very first official engineering class.



Students tour the Manufacturing Systems Engineering Facility.

Photo by Bryan Hutchinson

After deciphering what they could from a college level lecture, the "kids", as Nietz and Hutchinson fondly call them, shuffled into the ME lobby for lunch. Here they got the opportunity to sample some of Madison's finest cuisine in the form of Gumby's Pizza. The elegant meal was served on the lobby's fine wooden tables, where the high school students got a chance to relax and chat with engineering students. Nietz and Hutchinson recruited students from various disciplines of engineering to mingle with the high school students at lunch, and offer to them bits of academic experience and perhaps some wisdom gained over the past several years. The information exchange was a success.

Next on the agenda was a series of tours of points of interest on the engineering campus. The students were divided into four groups of 25 and led by ASME volunteers through facilities intended to spark their interests and imaginations. The Computer Aided Engineering Center (CAE) staff opened their doors to give the kids an overview of the computing capability available on campus. They also saw the CAD lab and its solid modeling facility, which creates plastic models of parts straight from a CAD drawing, without ever having to machine an actual piece. The students also toured the ME 368 Measurements lab, where they saw some of the common equipment used by ME students during their senior year. The staff of the polymers lab, one of the most advanced facilities of its kind in the nation, gave demonstrations of injection molding and blow molding. After the tour each student walked away with their very own injection mold of Bucky Badger. Last on the list was a tour of the formula car, intended to demonstrate the experience of group work combined with engineering ingenuity, and the product that can result.

When the tours were completed, the students, teachers and ASME volunteers gathered once more to thank each other, and the Day on Campus came to a close.

Hutchinson and Nietz asked the students and teachers to evaluate the day. The response was very positive. Hutchinson explains that the kids especially enjoyed the interaction with engineering students in a casual setting. The tours were successful in that "They [high school students] had a lot of interest in the tours because all they have seen in classes so far has been pure physics and math. The goal of the tours was to show them what engineering actually was, to tie in the math and science. "

Now that it is over, Nietz and Hutchinson look to the future of Day on Campus. They would like to see it become a semesterly event, done on a somewhat smaller scale. "I think one hundred people was ambitious", comments Nietz, "We had actually wanted to do fewer, but there was enough interest and we did not want to turn people away". Continuing this event, according to Hutchinson and Nietz, is tremendously important in order to keep the UW Madison College of Engineering well publicized to high school faculty and students. This kind of program opens the students' eyes to the possibilities ahead of them and gives them a better understanding of UW Madison's atmosphere and engineering opportunities. "It can't do anything but benefit engineering" says Hutchinson.

Hutchinson, Nietz and all of ASME extend their gratitude to the Outreach Office for their support, and a huge token of thanks goes out to all of the tour sponsors, who went above and beyond what they were asked to do. At the end of Day on Campus one student approached Hutchinson and said that the day turned out to be " a lot more than she had expected. It opened her eyes to a lot of things that she didn't realize", Hutchinson explains. On that note Nietz and Hutchinson concluded their Day on Campus, a complete success. ▮

AUTHOR

Svetlana (Liz) Zilist is tackling yet another semester of Mechanical Engineering. Her latest accomplishment is learning to use a jigsaw in the Engine Research Center.

UW-Madison's Efforts To Promote Women in Engineering

Documented for decades, the low number of women in engineering fields have been recognized as a national problem. As a reflection of this trend, only16.6 percent of engineering majors on this campus are female.

Some wonder why so few women enter engineering fields. Vicki Bier, an assistant professor in the college of engineering, says that many women weed themselves out of engineering programs before they have had a chance to decide if they enjoy the classes. She states that most of these women do not wait to find out if they would succeed in these classes—they quit before they have even given themselves a chance.

An uncomfortable environment is created when a women enters a classroom where she is surrounded by a sea of men

Bier, a graduate of Stanford University with a Ph.D. in Operations Research from the Massachusettes Institute of Technology, says that these women do not differ from male engineering students in terms of ability and performance. Yet, she explains that more women drop out of engineering programs than men. Bier has a number of theories that may help to explain this phenomenon.

One of them focuses on the idea that being part of a small minority discourages most women. She says that an uncomfortable environment is created when a woman enters a classroom where she is surrounded by a sea of men and only a few other women. According to Bier, this scenario can give women the feeling that they do not belong to that particular group. Such feelings of isolation can discourage a lot of women who might be considering engineering as a career.

Bier points out that efforts to increase the numbers of women in engineering are sometimes perceived as extra pushes and unfair advantages. But, she explains that these initiatives are mainly attempting to give women the same experience that men have in engineering.

A report drafted by the Consortium on Institutional Cooperation/UW-Women in Science Planning Group in June of 1993 described the problems that women engineering students face in the classroom. Given to Chancellor David Ward and other universities, the report states that some women are turned off to engineering due to feelings of isolation and a lack of role models. It also shows that women are more likely to be shut out of study groups and other lines of communication.

The report contends that these problems are rooted in attitudes and behaviors surrounding gender stereotypes. It also says that communication techniques, such as the tendency to refer to a scientist as "he", start forming in early childhood and cause some women to turn away from engineering as a career.

Several initiatives have been developed by the university to combat this under-representation of women. Numerous groups have made efforts to reach out to students at the grade school and high school level, to inform them of opportunities in engineering and to provide them with female role models in this occupation.

A $2.4 million grant, designed to improve the education and industrial competitiveness of Madison' s engineering graduates, may help to increase the number of women who enroll in engineering programs. Directed by the Engineering Research Center (ERC), the grant money will be used for a three year project in the Manufacturing Engineering Department. Parts of the project will be set into motion next fall.

The goals for the program are multifaceted. Denice Denton, an associate professor in the Department of Electrical and Computer Engineering, says that one of the goals of the project is to create more diversity in the engineering fields, by increasing the number of women and minority students in the school.

Women are more likely to be shut out of study groups and other lines of communication

In order to do this, Denton says that the numbers of students entering engineering programs must increase, as must the number of students staying in engineering departments. It is known that many students, especially women, drop out of engineering after their freshman year. The program will put emphasis on reducing these numbers. "We want to bring up the numbers in the pipeline and the numbers of people we retain in the program," she says.

One of the strategies for helping women stay in the College of Engineering will be the formation of what Denton call "bonding groups" for female engineering majors. These groups would serve to inform women of career opportunities and campus resources, thus helping women be a part of communication process within the engineering campus.

"We'd like to open their eyes to the free resources waiting to be used," Denton says.

SWE, the Society of Women Engineers, is also doing its share to help women in engineering. SWE has promoted a mentor program for in-coming female engineering students, to ease the feelings of anxiety that may result from belonging to a small minority in the classroom. The "Big Sib/Little Sib" is a kind of mentoring program that matches younger students with sophomore, junior or senior SWE members who help them adjust to the new environment.

Valerie DuFore, president of SWE, explained the necessity for such a program, "It's awfully daunting to come in when you're the only women in the room." She says, "UW is such a big organization—it's nice to have an upperclassmen to talk to."

"Day on Campus" is another SWE program that attempts to encourage women to stay in the engineering program. Female high school seniors, already admited to the Pre-Engineering program, are invited to spend a day on the Engineering campus and meet other engineering students.

"They meet other women, so they know other people before they even start here," explains DuFore.

Attempting to counter gender stereotypes, SWE members make trips to elementary and secondary schools around the state. Accompanied by a professional female engineer, the SWE members put on demonstrations and give short presentations about the world of engineering, as a way introduce young students to the field.

"When we go places, we find that most people don't know what engineering is," DuFore says.

Another program that tries to inform young women about the field of engineering is a week-long summer camp called "Engineering Tomorrow's Careers." About 45 female juniors and seniors in high school participate in this program, which is organized by SWE and partially funded by John Deere Co.

Cally Schmidt, a SWE co-coordinator for the program, says every public and parochial high school in the state is invited to send female students to the summer camp. She mentioned that the presentations during the week are more hands-on or lab-type exercises.

"We're running it more like a summer camp with a lot more activities, instead of lectures, since high school students haven't been exposed to lecture-style presentations. We're trying to make it really interesting," Schmidt says.

The central goal of SWE's outreach program is to make women engineers visible to the young students, according to Linda Schilling, a counselor for the College of Engineering. Schilling believes that this program could encourage more women to pursue engineerng as a career, since the all-female presentation counters traditional gender roles.

When we go places, we find that most people don't know what engineering is. -Valerie DuFore

"The role modeling is really important," Schilling states.

Schilling also talks about a fall program, called "Expanding Your Horizons", put on at Union South for approximately 250 young women in the Madison area in grades seven through10.

The one-day workshop attempts to encourage these younger women to explore careers in science and engineering by increasing their awareness of the range of job opportunities in science. The program also tries to inform the students about the importance of math classes.

Schilling says that since women are traditionally left out of engineering careers, these types of programs that feature female speakers are necessary in order to increase the number of women in engineering fields.

"Women are not supported in the same way men are," she says.

Schilling adds that surveys were taken by the young women before and after the program. The responses show that the participants have more of an interest in science after the workshop than they did at the start of it.

Noting that engineering has been one of the slower disciplines in science to show an increase in female representation, Bonnie Schmidt, an advisor for Pre-Engineering students, says that more programs are needed to boost the numbers of women in engineering careers.

She expressed enthusiasm towards the iniatives that are in place. "Women need to understand the opportunites that will help them succeed," she says.

Schmidt is involved with "Project X," a two-week workshop for Wisconsin middle and high school counselors and teachers that attempts to address this issue. This summer program provides educators and counselors with knowledge about technical fields that students can pursue.

"It gives them a sense of the options available for technical careers," Schmidt says.

In its second year, Project X tries to make school counselors more informed, and therefore more skilled, in helping students make career decisions. The program plans to develop new classroom materials and improved literature on technical careers that will provide students with up-to-date information about careers in engineering. Planned to go through 1995, this three-year program is funded by a grant from the National Science Foundation.

Carol Welsch, a learning coordinator at Tokai Middle School, says that participants in Project X build a team of counselors and teachers within a school district and work together to share the information about technical careers.

"They're trying to build a network inWisconsin to expand the program," Welsch says.

According to Bonnie Schmidt, the number of freshman women enrolling in the Pre-Engineering program for the fall of 1993 increased by 7.8 percent. Both she and Schilling are very excited about this statistic.

"There is some evidence that some of the things happening are making a difference," Schilling says.

AUTHOR

Carrie Michael is a junior at UW-Madison. She is majoring in journalism with an emphasis on news writing.

A Cellular Link With the Future

KNOCK 'EM DEAD! You probably heard this from friends and professors as you started the arduous interviewing process for a co-op or summer job. Industrial Engineering students will able to "wow" prospective employers after working with the new Flexible Manufacturing Cell in the required *Intro to Manufacturing Systems* class. Last fall, the IE Department welcomed the new teaching laboratory to the lower level of the Mechanical Engineering Building. This cutting edge facility teaches students about small-scale factory operations. The Cell allows students to convert CAD/CAM designs into tangible objects with the push of a button. Tom Kondzela, the spring semester teaching assistant for IE 415, explained how the system operates. First, a student downloads a CAD/CAM design onto a computer. The computer requests a program from its companion workstation that will convert the design into a machine part. The information travels to a third workstation which delivers messages to the robots and the machinery in the Cell. "Then you just sit back and watch," says Kondzela.

The robots can choose a block of material from a table and send it along a conveyor belt to be transformed into a useable object. Connected to the system are a

Photo courtesy of Engineering Publications

Industrial Engineering Professor Jerry Sanders looks on as MSE student Pat Galecki commands the IE/MSE Computer Integrated Manufacturing Cell from the master-cell controller.

lathe and a machining mill which robots use to cut the material. "The basic idea is that the system would run 24 hours a day, 7 days a week with minimal operator attention," says professor Jerry Sanders, the IE professor who was instrumental in bringing the Cell to campus. Kondzela adds, "That means that in industry this system could be in one room and someone could be monitoring it from the other side of the building by using the three computers."

The robots and equipment are highly sophisticated. One robot actually has vision capabilities. It can use up to six cameras, and can decide on an appropriate solution should a problem occur.

"I don't know of any other university in the United States that has undergraduate teaching laboratories as sophisticated as this," confides Sanders, "Other universities have demonstration facilities but very few universities with the stature of Madison have this kind of sophistication for undergraduate students."

According to Sanders, students using this laboratory will be modelling what some industrial engineers do every day. In fact, one IE graduate student who has extensive experience with the Cell is planning to work in a business that uses a system very similar to UW-Madison's Cell.

When we talk to recruiters about the experiences our students get with the Flexible Manufacturing Cell, the recruiters are in shock

- Professor Jerry Sanders

Recruiters and industry members say the Cell is very impressive, says Prof. Sanders. "When we talk to recruiters about the experiences our students get with the Flexible Manufacturing Cell, the recruiters are in shock," he explains.

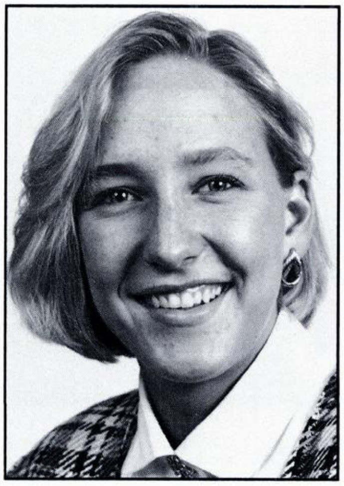
Earlier last summer, Georgia Tech sent faculty to UW-Madison to see the lab and to learn how to build a similar facility at their university. And at the end of February a group of faculty from the University of Monterrey, Mexico, toured the lab. They, too, are interested in mirroring UW-Madison's efforts at merging the technologies of industries with the capabilities of universities.

The IE department recently added a new robot to the year-old Cell. As the Cell continues to grow and more graduate and undergraduate students become familiar with it, the IE department hopes to expand the Cell's accessibility. ■

AUTHOR

This summer will be Alyssa Hunt's last hurrah in Madison. After biking around campus for one more season, she will join a Fortune 500 firm and pursue a career in journalism and graphic arts. Then again, she might end up staying in Madison, doing mass mailings of her resume forever.

Congratulations to ex-Wisconsin Engineer staff member Val Dufore!



Val was one of 21 interns who received Student Intern Contribution Awards for their outstanding work at GE businesses last summer. Val was part of the Anode/Cathode DFT Implementation team. She was honored in a ceremony last November where she received a certificate of achievement and a $500 cash award. Keep up the good work Val!