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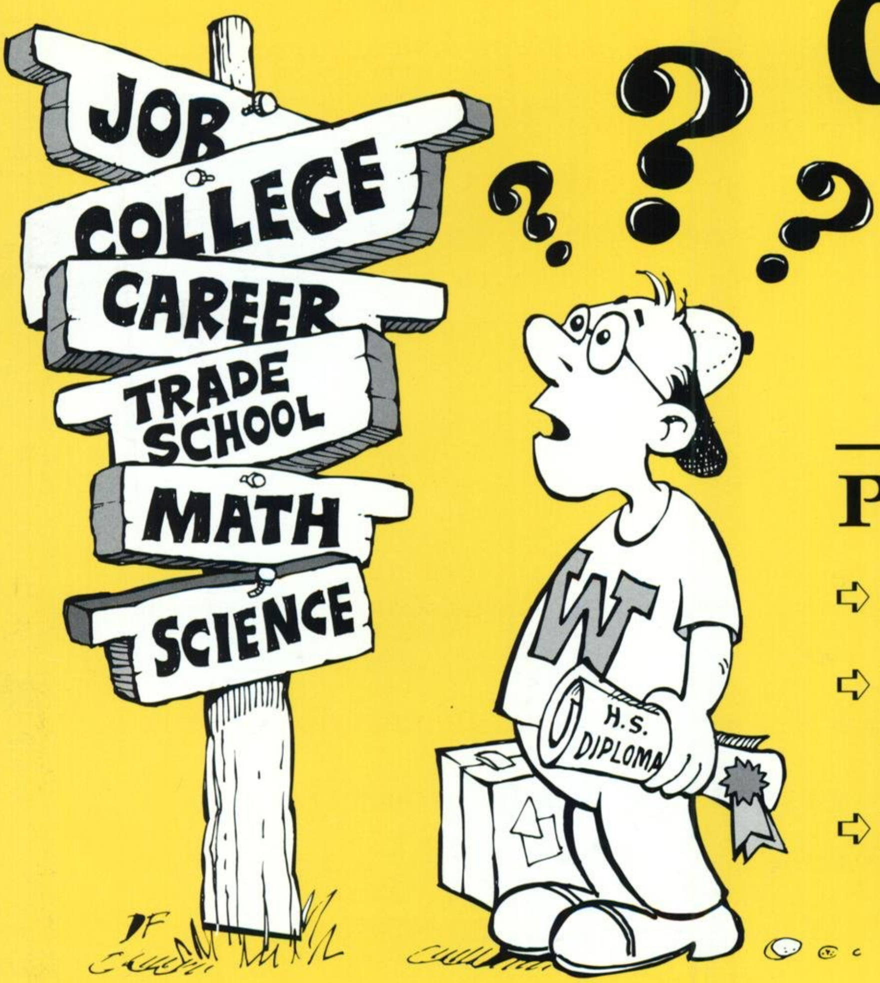
WISCONSIN ENGINEER

VOLUME 101, NUMBER 1 NOVEMBER, 1996

Special Issue!!!

Technical Careers



PLUS

- ➪ EXPO '97
- ➪ THE NEW ENGINEERING CENTERS BUILDING
- ➪ IMPROVE YOUR TENNIS

WISCONSIN ENGINEER

Published by the Students of the University of Wisconsin-Madison

ON THE COVER: Project X, an outreach program meant to be an eXchange of information about technical careers, is the focus of this issue. Artwork by Dick Furniss of Oshkosh, Wisconsin.

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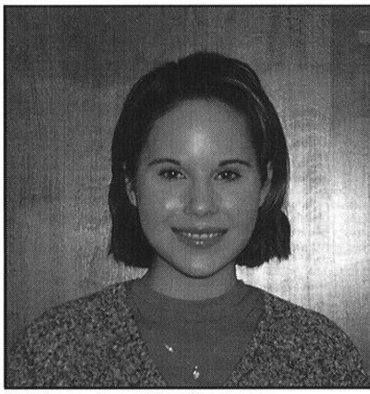
Editorial

Women in Engineering



Editor- Jennifer Schultz

"Really, we're tired of the astonishment produced when our answer to the old question, 'and what course are you in?' is engineering. The civil answer we give to this simple question usually brings forth a number of comments from 'Are you trying to take a man's place?' to 'That's one way to get a man.' ...we are interested in engineering and have hopes of becoming engineers." This quote came from the article "Women in Engineering: We're Here to Stay, Better Make the Most of It" written by Dorothy Miller for the August 1944 *Wisconsin Engineer.*

Despite the changing times, women in engineering today often hear some of the same comments. I know I've recieved strange looks when I state that I'm going into geological engineering. It's frustrating that engineering is still considered a "man's" career. Somehow, people believe that women aren't as good at math and science. I think this belief is absurd. Women are gaining numbers in engineering. More women are getting involved in organizations on the engineering campus.

Who was the first woman engineer? Looking at history, one might say that the first woman engineer was the Egyptian goddess Isis, the deity of science. Legend says that Isis' mathematical genius was the key to the founding of Carthage. Another early woman engineer was Hypatia. She lived around 370 AD, and was killed by Cyril, Patriarch of Alexandria, for being an engineer.

Women engineers at the University of Wisconsin - Madison seemed scarce in the past. Emily Hahn was among the first women engineers to graduate from Madison. Hahn graduated in 1926 with a mining degree. A professor at Customs College in Shanghai, China, Hahn wrote in her free time. June Hartnell became the editor of the Wisconsin Engineer in August 1944. Three other women joined Hartnell on the staff of the Wisconsin Engineer, including Dorothy Miller who wrote the article "Women in Engineering: We're Here to Stay, Better Make the Most of It."

The 1940s was the time for women to be involved in engineering. The impact of W.W.II on the work force left gaps in technology driven fields. A September 1943 issue of the Wisconsin Engineer contained the article "The Gals Invade the Engineering School" written by Lou Niles. The article consisted of interviews with ten women who were enrolled in the College of Engineering at UW- Madison. Eight of the ten were given scholarships by Pratt and Whitney in order to learn how to design and construct airplanes. None of the eight women had been in engineering previous to their acceptance of the scholarship. Some were math and chemistry majors, but others had degrees in English, psychology, and journalism. The consensus among the women was that they would be engineers until the war was over. When the men returned, they would either find other work or become housewives. The remaining two women were enrolled originally as engineers and had the intentions to make engineering a career. The predictions of the women not remaining as engineers were evident in the 1950s. Only three women were on Madison's engineering campus in 1952.

Women in engineering had to overcome many obstacles. Discrimination faced them along the way as established stereotypes made their ambition seem strange. "Answer to Women in Engineering" was written by John Hommes for the December 1944 issue of the Wisconsin Engineer as a response to Dorothy Miller's article. The article reflects the sexist views toward women engineers. Hommes stated that women may have the potential to become engineers, but they shouldn't. His reason being included that most men wanted a "good, truly feminine, type of wife" and that no one, not even a male, could handle a full-time job as an engineer and take care of the household and children. He followed this last comment with "It is too much to be expected of any human (or are women engineers human?)."

More recently, discrimination against women in engineering occurred December 6, 1989, at the University of Montreal's school of engineering when fourteen women engineering students were murdered by one gunman. The killer had told them that they were feminists, he hated feminists and that was why he was there.

Discrimination isn't as evident today as it was in the past. The number of women in engineering is growing each year as more girls in high school are encouraged in math and science. It's getting better, but with only 17% of the engineering students at the University of Wisconsin - Madison being women, there's room for continued growth. I always wonder where all the women engineers are when I'm working in Computer Aided Engineering (CAE) surrounded by men.

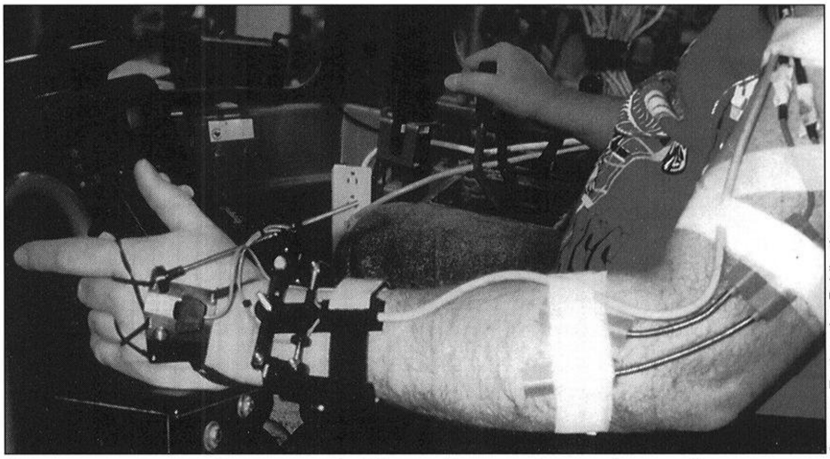
Women in engineering have had a long history of struggle and sacrifice. Today, I feel grateful to all the Dorothy Millers who succeeded in engineering and proved that women can be engineers. Women can succeed in science and technology, a so called man's field.

Author Bio: Jennifer Schultz is a sophomore in Geological Engineering.

Time and Motion Studies: A Little Piece of Industrial Engineering

Diana Zeller

Say you are stuffing cards into envelopes for the holidays. You have several piles of letters, and several boxes of envelopes (you really have a lot of friends). Chances are good that after the first several envelopes you will develop a routine that cuts down on the amount of time it takes to do this task. You would have just conducted an informal time and motion study.


Source: Engineering Publications

Sensors measure the amount of force the man's arm is exerting.

The motions you go through are broken down into categories and subcategories. The main categories may be finishing a box of envelopes and finishing a pile of cards. A subcategory could be stuffing one envelope. Another subcategory could be the list of motions associated with stuffing each envelope, such as grabbing the envelope, grabbing the card, stuffing the card into the envelope, licking the envelope shut and setting the envelope aside. The engineer doing the time and motion study would write these categories out in the order you do them and find the time it takes to complete each motion.

A Little History...

These studies have been done since the early 1930's. Frank and Lillian Gilbreth were among the first to use time and motion studies. They have become famous for how efficient they could be, even while raising twelve children. Frank even went so far as to post French lessons on the bathroom wall so his kids would make better use of their time.

The Gilbreths performed time and motion studies with surgeons back in the days when doctors looked for their instruments on a tray before picking up the needed object. The time and motion study showed that the surgeons spent as much time looking at their trays as they did operating on their patients. This study led to the way operating rooms function today, with a surgeon looking only at the patient and an assistant handing over the instruments.

In World War II, technology was becoming more and more complex. Machines were built with all of the necessary controls, but the human element was often overlooked or overestimated. In other words, people could not handle the equipment because the controls were not well suited for them. This provided the incentive for the modern idea of trying to fit the workstation to the person, instead of trying to make the person conform to the workstation.

Now, time and motion studies have moved to the area of ergonomics, where discrete motions of the individual are studied in the hopes of alleviating any stress or discomfort associated with the job.

Different Tools Used

Generally, the engineer doing the time and motion study would like to know what posture the joints are in during the various phases of the job. We will stick to the hand and arm for discussion, but remember that these are not the only areas that can be measured.

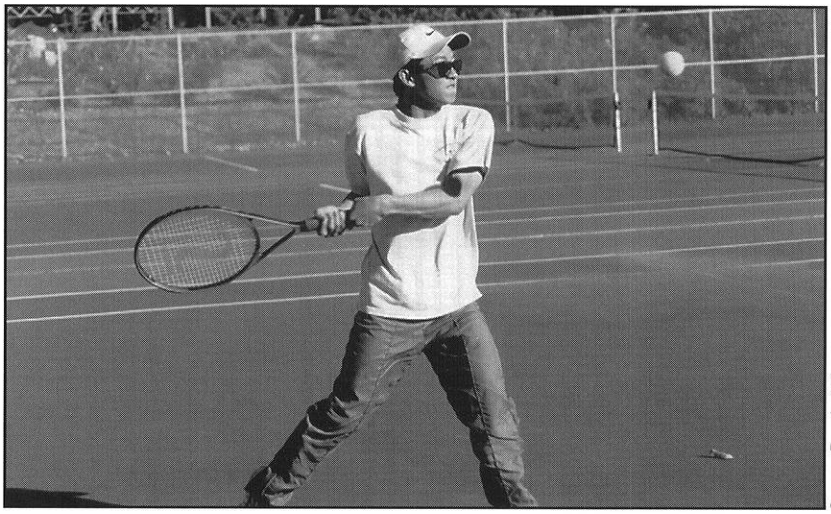
A tool that can measure the exact angles of the joints over time is an electrogoniometer. An electrogoniometer is an electronic spring, placed at the joint, which measures and constantly records the amount of bending or twisting. This is a great aid for showing what postures are achieved most often and which are held for long periods of time. While you are stuffing your envelopes, electrogoniometers can be attached at your elbow, shoulder and wrist.

continued on page 8

How Sweet It Is!!!

Matthew Vokoun

Good shots and bad shots: every tennis player knows exactly how they feel. Whether you are a finalist at the U.S. Open or a weekend warrior with your dusty racket and neon tennis balls, we all know the solid and clean feeling left by a good shot and the intense jolts, vibrations and pain left by a bad shot. A good-feeling shot happens when the ball hits one of the sweet spots of a tennis racket. A sweet spot is commonly defined as the place on the string bed that delivers sufficient power, consistent ball control and the least shock and vibration. In other words, the ball leaves the racket with the speed anticipated, it goes where it's expected to go, the racket doesn't jolt or vibrate your hand and arm and the shot feels smooth, effortless and true.



Source: Raechell Thuot

As this student prepares to fire, racquet characteristics influence his shot.

A tennis racket has three sweet spots, each of which measures a different physical characteristic of the racket. The first sweet spot is called the *center of percussion* (COP), and it is where the initial shock to your hand is at a minimum. The second sweet spot is the *node* of the racket's vibration (NODE), and it is where the uncomfortable vibration that your hand and arm feel is at a minimum. The third sweet spot is the maximum *coefficient of restitution* (COR), and it is where the ball rebounds from the strings with maximum speed or power. Figure 1 shows the three sweet spots in their typical positions on the face of a tennis racket.

Sweet Spot 1: The Center of Percussion. The first sweet spot is called the center of percussion (COP). When the ball strikes the COP, the initial shock or jolt to your hand is at a minimum. The impulse created when the ball hits the racket at the COP causes no reaction at the handle. In other words, the translational and rotational motion of the handle cancel each other when the COP is hit.

A tennis racket recoils to conserve momentum when it is hit by a ball. The racket translates or moves linearly to conserve linear momentum and rotates to conserve angular momentum. The translational motion is in the direction of the ball's movement before it hit the racket, and the rotational motion is in the direction of the ball's rebound. There is then one point on the handle where these two motions exactly cancel each other. The racket tends to pivot about this point and not move, so your arm would feel no shock or impulse if you were holding the handle at this point. Relative to your hand, the handle has no motion. The COP is defined as the point on the racket face where the ball hits when the two motions of this point on the handle cancel.

There is no shock or force on your hand when the ball hits the COP. If the ball doesn't hit the COP, there will be an initial net force on your hand. The racket will try to pull itself out of your hand if the ball hits the face farther away from your hand than from the COP. If the ball hits closer to your hand than to the COP, the racket will push into the palm of your hand.

Sweet Spot 2: Node of the Racket's Vibration. The second sweet spot is called the node of the racket's vibration (NODE). When the ball strikes the NODE, the uncomfortable vibration you feel in your arm and hand is at a minimum. The point at which the

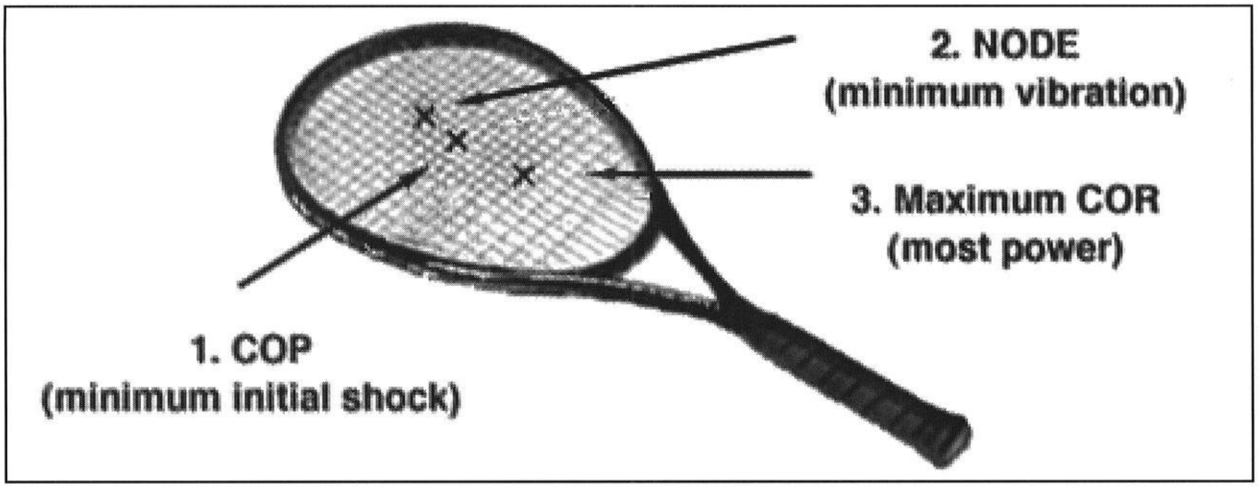


Figure 1. The three sweet spots of a tennis racket. The center of percussion (COP), node of the racket's vibration (NODE), and maximum coefficient of restitution (COR) are shown in their typical positions on the face of a tennis racket [Brody, 1987].

handle is being held does not vibrate or oscillate when the NODE is hit.

A tennis racket deforms from the impact of a ball and then begins to vibrate for a short period of time. The higher-frequency modes of this vibration feel uncomfortable and undesirable to most people. The vibration leads to loss of control, fatigue and an unsatisfactory feeling after the ball is hit. There is one impact point on the racket face, however, where this vibration is not produced in the handle. This point is defined as the node of the racket's vibration. The farther the ball hits from this spot, the greater the vibration.

When the ball hits the NODE, the resulting vibration is smooth and feels good to your hand. When the ball misses the NODE, the resulting vibration is harsh and jagged and feels unpleasant to your hand. Also, the forces transmitted to your hand by the racket's vibration are much larger when the ball doesn't hit the NODE [Brody, 1987].

Sweet Spot 3: Maximum Coefficient of Restitution. The third sweet spot is called the maximum coefficient of restitution (COR). When the ball strikes the maximum COR, the ball rebounds from the racket with maximum speed. You get the most power in your shot when you hit the ball at the maximum COR.

The COR is defined as the ratio of the rebound speed of the ball to the incident speed of the ball.

The greater the coefficient of restitution, the greater the speed of the ball as it leaves the racket strings. Thus,

$$\text{COR} = \frac{\text{rebound ball speed}}{\text{incident ball speed}}$$

the maximum COR means the maximum rebound speed. Therefore, the ball will leave the strings fastest when it hits the maximum COR. Most tennis rackets have a maximum COR value between 0.55 and 0.6 [Brody, 1987].

The three sweet spots of a tennis racket are usually found at separate locations on the face of the racket. It is impossible to hit all three at the same time. However, each sweet spot has an area around it, called a sweet zone, where you still get a large portion of the sweet spot's benefits. These areas are what most racket manufacturers advertise as the "sweet spot." It is then possible for the ball to hit a point on the racket that lies in all three sweet zones, giving you the benefits of each sweet spot: minimum initial shock to your hand (COP), minimum vibration in your hand and arm (NODE) and maximum ball rebound speed(COR). Good tennis players are very aware of the approximate location of these three sweet spots on their rackets, and they use the sweet spots to their advantage. So, next time you are playing tennis and you feel a wonderful or horrible shot, you will know exactly why the shot feels the way it does. But don't ponder this reasoning for too long, because that tennis ball is likely to come right back at you for yet another chance to study and master the use of the three sweet spots of your tennis racket.

A tennis racket has three sweet spots, each of which measures a different physical characteristic of the racket

References:

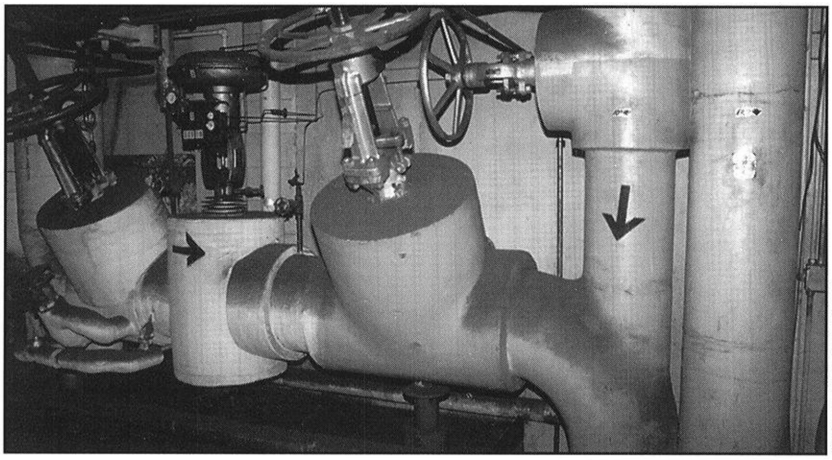
Brody, Howard, *Tennis Science for Tennis Players* (Philadelphia: University of Pennsylvania Press, 1987).

Author Bio: Matthew Vokoun is a senior in chemical engineering pursuing his Technical Communications Certificate. He has only two things to say: Jobu is the all-knowing, and watch out for Badgerball in 1996-97.

Asbestos: Natural (air) Borne Killers

Rob Nelson

For anyone passing through Engineering Hall today, the massive remodeling projects taking place are obvious. The causes of alarm for students range from having to avoid certain hallways, to the shuffling of classrooms to inconvenient locations, to concerns of falling objects and wires. Less obvious is the question of whether students should be concerned about the possibility of airborne asbestos strewn into the air from all this construction?


Source: Raechell Thuot

An example of pipes from Engineering Hall that contain asbestos. Just one of many on campus.

Asbestos is contained in more than 3,000 products today, including heat and acoustic insulation, fireproofing, roofing and flooring. Since the 1890's, asbestos has been utilized in many products for its intrinsic properties of fire resistance, heat resistance and strength. Not until much later was the public made aware of its health hazards. Many of the most harmful uses of asbestos were banned during the 1970's, starting with the ban on spraying in 1973. However, it wasn't until 1990 that the production of asbestos-containing materials for home construction was set to be banned in three stages during a seven year period.

Asbestos is contained in more than 3,000 products today, including heat and acoustic insulation, fireproofing, roofing and flooring

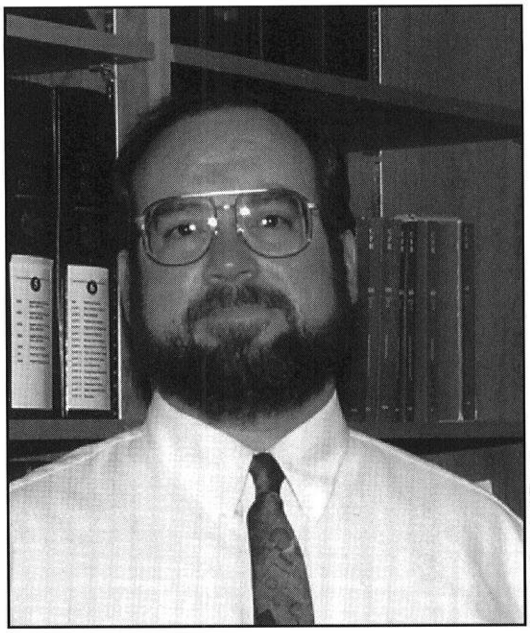
So what exactly is asbestos? Asbestos is a naturally occurring mineral with a unique crystal development that is extremely aerodynamic and poses its largest threat when airborne. Asbestos comes in two distinct forms, serpentine and amphibole. Amphibole has a chain-like structure and serpentine a sheet-like structure. The amphibole group includes five types of minerals, while the serpentine group contains only one, chrysotile. Chrysotile is the most important because it makes up approximately 90-95% of the asbestos contained in buildings in the US. These six types of minerals are found throughout the world and are still mined in a number of countries.

The negative health affects of asbestos exposure are well documented and linked to long-term occupational exposure and animal testing. While the Environmental Protection Agency (EPA) concludes that there is no safe level of exposure to asbestos fibers, the Occupational Safety and Health Administration (OSHA) allows an exposure of 0.1 fibers per cubic centimeter.

Three main diseases may occur from exposure to asbestos, including asbestosis, mesothelioma, and lung cancer. Asbestosis is a scarring of the lung tissue. In this disease, bundles of asbestos fibers become lodged in the lungs and break down into smaller and smaller fibers, with the scarring continuing even after exposure has stopped. It progresses slowly, making it harder for the victim to breathe and having a latency period of 15-30 years before the effects of this deadly disease become known. Mesothelioma, an otherwise rare form of cancer of the lining of the chest and abdomen can also occur. It has a longer latency period, 30-40 years, and is almost always fatal. The last main disease caused by asbestos is lung cancer. This disease results in a malignant tumor of the bronchi covering and has a latency period of 20-30 years. In addition, smoking in combination with asbestos exposure makes one extremely susceptible to lung cancer.

It is the responsibility of the department of General Safety of UW-Madison to inspect potentially hazardous sites. Douglas Smith, MS, the Advanced Environmental Health Specialist of General Safety has a masters degree in occupational safety from the University of Wisconsin - Whitewater. Smith worked in industry for three years before coming to UW-Madison where he has been a safety specialist for the past ten years. Smith says, "We've done a number of surveys, primarily prior to construction as a part of the remodeling [to Engineering Hall]." The surveys are done during the remodeling projects by two people from the safety department who do insulation removal. In addition, independent contractors are hired. Twelve to fifteen people are on contract every day to remove asbestos from around campus. The cost of this is around $20.00/linear foot of pipe insulation and $12.00/square foot of ceiling tile. Before starting remodeling, the asbestos containing materials must be removed. "They will institute a number of controls. [They use] negative air pressure via an enclosure so that nothing escapes the work area to another part of the building, and even at that, they do it wet to keep the dust down inside the containment, " Smith says.

A lot of asbestos is contained in Engineering Hall — in the floor tiles, ceiling, pipe insulation, etc.. So what is the University doing to prevent this from becoming a hazard? The policy of the University is to leave the asbestos intact unless remodeling or major structural changes are done near the area. This policy is widely recommended in industry because the removal of asbestos is often more dangerous than leaving it intact. Removing the asbestos should only be done as a last resort. However, in remodeling, the danger in exposing asbestos is greater than the danger caused by removing it. Therefore, it is then removed. Smith warns however, that students and faculty should always be aware that holes or tears can develop in the pipe insulation or ceiling tile. If holes or tears in insulation are noticed, the Central Answering Service for the Physical Plant (CARS) should be called so General Safety can go make a repair or conduct a removal. The call should be made immediately and the area evacuated, as only small amounts of asbestos, once airborne, can be harmful.



Source: Raechell Thuot

Douglas Smith, MS, Advanced Environmental Health Specialist of General Safety, discusses the safety of asbestos.

However, with proper maintenance, there is no cause for alarm. "Many years ago, we took a number of samples in various buildings where we knew there were asbestos products, and they came back at background levels, so we don't expect, under ordinary circumstances, to have any elevated levels," Smith says. With this in mind, we can all rest more easily. However, the diseases caused by asbestos are very serious, and the asbestos contained in our school is something we have to live with.

Author Bio: Rob Nelson is an ECE Senior who is looking toward this year with frustration. He doesn't graduate until Dec '97 and after seeking a summer internship at Career Connections, he turned away with much disgust at the competition to get a job with one of the "Big Names".

continued from pg. 3

A different tool is available for directly measuring forces that the muscles exert. Conductive polymer sensors are attached to muscles at various locations to electronically measure the amount of force exerted at any given time. The engineer could stick these onto your arm to measure the force you exert while stuffing the envelopes.

Both these tools can be used in combination with a computer system aided by a VCR. The sensors can be placed on the arm, and a VCR can videotape the activity at the same time. In this way, the data can be analyzed later instead of while it is happening.

Why would you want to do the work later? Picture someone trying to frantically write down the activities you are doing, and recording the exact time it takes to do them while you are stuffing the envelopes. It would be difficult or impossible. Taping the activity allows it to be viewed later, at a slower speed, and with the ability to pause to collect data. Also, it is much more accurate than real life because the times can be taken from the VCR counter.

Why do a Time and Motion Study?
People at work experience physical stress related to repetitive manual jobs, such as stuffing envelopes. The problems experienced are caused by the repetitive motions, uncomfortable postures that must be achieved and held for a long period of time and having to grasp something too forcefully. The time and motion study can find out how much physical stress workers are exerting so it can be controlled.

What are These Problems?
The physical stress workers experience has many symptoms. In general, the workers' productivity will decline, meaning they will be working more slowly, they will produce lower quality work and they will be more uncomfortable, more unhappy, and will experience more injuries.

To break these problems down even further, employers as well as workers themselves would benefit greatly from a time and motion study. The workers want to reduce the amount of physical stress they exert because it can cause temporary or permanent damage to their bodies. At first, they will feel their muscles beginning to get tired. Soon they will find that they can't feel their overworked muscle as easily as before. Then, they may lose the strength and dexterity of their joint, and finally, they may experience either temporary or permanent impairment of motor control.

Employers also have good reasons for wanting to reduce the amount of physical stress that their workers experience. First, they will have to pay higher medical bills and more worker's compensation. Secondly, they will find that the workers are moving more slowly which causes lower productivity, and finally there will be more time that the workers are not at their jobs, in addition to the fact that some employers do not like to see their workers suffering!

Where Do These Problems Come From?
Problems are caused by the fact that workstations are not designed specifically for the human being. There is a gap between what the station requires and what the human is physically capable of doing. More specifically, if a person can do the work, but develops physical problems, that station was not designed specifically for his or her needs. Usually, the station is designed more for the flow of parts through the station, and tries to incorporate humans as secondary characteristics.

How Can These Problems be Solved?
Workstations can be redesigned with more attention given to the human worker and his or her physical limitations. This can be done by physically redesigning the station (lowering a table, redesigning tools, relocating the various components of the workstation), or by changing such things as when and for how long workers are allowed to rest.

How does one know how to make good modifications? The changes have to occur in the right areas (perhaps lowering a table wouldn't help but scheduling rest breaks would) and in the right amounts (since it is impossible to just give workers the maximum amount of time conceivable for resting). You should know by now that a solution to this question is to conduct a time and motion study to evaluate the situation.

Author Bio: Diana Zeller is a senior in Industrial Engineering, and works in the Cumulative Trauma Disorders Lab.

Special Report

Spotlight on Technical Careers

PROJECT X

Source: Engineering Publications

The above high school guidance counselors play a key role in helping seniors decide which courses to take to prepare them for the path of life they choose to follow upon graduation.

Welcome!!

Source: Engineering Publications

Donald Woolston, Dean of Pre-Engineering

In the grand scheme of things, education is a modern invention. Thus, fascination with "What's your major?" is common today, but was nonexistent in Shakespeare's time. Only relatively recently on the cosmic calendar (10,000 years ago) did agriculture develop. Then some people could divert their efforts to being unproductive while they learned something else besides hunting and gathering, such as being a merchant, scribe or religious leader.

Therefore, I don't imagine the Hittites or ancient Egyptians, for example, really had much concern for career education. In fact, the same could be said for us all until perhaps a century after the Industrial Revolution, when technology led to more efficient agriculture, and then to large numbers of artisans, builders, craftsman, scholars, healers, engineers and even professors.

Today, only 5% of Americans are needed to feed the rest of us, the 95% who have to think hard about how we can contribute to society and at the same time earn a living. Engineering is the education and career that this magazine is founded upon. It is that which bright high school students are told to pursue if they like math and science. Yet, engineering is just one of the cluster of careers relating to technology.

The point of this special issue on technical careers is to explore the whole realm of possibilities open now, and in the future, which we can count on to be increasingly technical. I hope the issue informs as it raises an inescapable paradox. As society becomes more influenced by technology (Think of it! The microchip just turned 25 years old!), technical education will become more complex, and the range of specialization will broaden each year. At the same time, as the rate of technical change itself accelerates, the gap between our formal education and our required on-the-job skills will widen. I recently heard a UW-Madison engineering grad give an eloquent talk about his career as a "major Internet service provider." Believe me, no one I knew growing up had that as a career plan. Did that engineering graduate feel he had made a mistake by majoring in mechanical engineering? Not at all, but only a long-range commitment to learning (and his facility for learning gained through his engineering education) made his mastery of the new communication technology a possibility.

Such is the future: formal education will last longer and be more intense, but everyone will have to commit to life-long learning (much of it devoted to keeping current on career opportunities!) just to be able to hold down a decent job. The era of high-pay, low-skill jobs seems to have ended, a little less than 25 years ago, not coincidentally.

This special issue is an outgrowth of a sinister-sounding Wisconsin-based educational effort called "Project X: Exchange of Information on Technical Careers." As head of that project since 1992, I am pleased to have helped guidance counselors and teachers across the state appreciate the importance of technology in their students future, and the subtleties in the range of opportunities from technical apprenticeships to graduate degrees in engineering and science. This issue captures many of the themes that Project X developed: the importance of career planning; respect for technicians and all skilled workers in the world of technology; and the changing world of work, where appreciation for diversity, team skills and communication are as important as computer skills.

My College of Engineering colleagues Bonnie Schmidt and Jay Samuel, along with our collaborators at Madison Area Technical College, join me in thanking the National Science Foundation for the generous funding for the project (Grant #9253248 for $382,000), and the Wisconsin Engineer magazine staff for applying their talent and enthusiasm to the cause.

-Donald Woolston, Dean of Pre-Engineering

Training for a Technical Career: How to Know Where to Go

Making career choices can be difficult. Before you can even think about choosing a specific career, however, you need to decide how you're going to finish the rest of your education. Should you go to a technical school or a college? What's the difference between the two? More importantly, which is going to serve your needs the best?

For some of us the choice is simple. Obviously if you want to be a doctor, you're going to have to go to a university or college for several years. However, for many people, the decision just isn't that easy. There are many technical fields in which one could be trained at either a technical school or at a university. And then again, some people do both, either by choice or because that's just the way things work out.

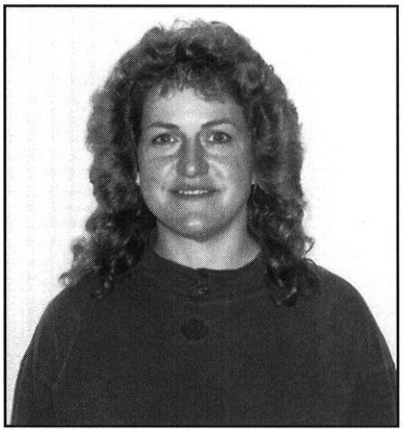
There are many differences between the programs offered by a technical school and those offered by a college

Carol Schmidt is senior who will be graduating this December 1996 from the College of Engineering (University of Wisconsin) with a degree in Metallurgical engineering. Carol is not your typical engineering student though. She didn't come to Madison right out of high school as the vast majority of us do. First, Carol obtained a degree from a two year technical school.

Like many people, when Carol was a senior in high school, she didn't know exactly what she wanted to do with her life. She spoke with her high school guidance counselor and took an aptitude interest test to see which types of fields she might be happy working in. Her scores indicated that she had strong math and science skills, and her guidance counselor suggested that she pursue a degree from a technical school. Carol recalls, "For whatever reason, he discouraged me from thinking about going to a college, but he did encourage me to go on to a trade school."

Carol went to visit the Hennepin Technical College in Brooklyn Park, MN, a suburb of Minneapolis. She liked what she saw there and decided to give it a try. Carol enrolled in a two year accelerated program, which means that she didn't get Holidays or summer breaks, and in 1985 she graduated with an Associates degree in Metallurgical Powder Metallurgy and started working for SSI Technologies, Inc. in Janesville, WI.

After working for a year and a half, Carol decided to go back to school part-time. She enrolled at the U.W. Center in Janesville, WI, where she took classes for a number of years while working full time at SSI. Carol went back to school because she felt she didn't know enough about what she was doing. She had many skills and was able to do her job well, but she wanted to know why she was doing the things she did and how the processes that she was using really worked. She felt she didn't know the internal mechanisms and reasoning behind the work she did. As Carol put it, "I went back to school on a quest for knowledge."



Source: Raechell Thuot

Carol Schmidt has much experience with both universities and technical schools.

After several years of both going to school and working in Janesville, Carol came to the point where, in order to finish her degree, she needed to take classes at the College of Engineering here at U.W.-Madison. She quit her job and became a full-time student. Carol's hard work has paid off. In December of 1996, she will graduate with a bachelor's degree in metalurgical engineering.

Carol has found that there are many differences between the programs offered by a technical school and those offered by a college. She stated that the program she was in at Hennepin Technical College was much more industry-oriented. She received a great deal of hands-on experience there. So much so, that Carol didn't need extensive job training once she started working in the powder metal field. On the other hand, her schooling at the University of Wisconsin has been more theoreti-

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The Best One or Two Years of Your Life

You're a senior in high school and need to make a decision about how your life will proceed after you graduate. "Total control, FINALLY! Wait a minute, now that it's all up to me, I don't know what I want. Before I thought the guidance counselors were a nuisance, always telling me what I needed to get done to graduate and move on to whatever may come next. Now I wish they were here to tell me exactly what it is I really want to do with the rest of my life! Augh!!" Most of us have had feelings similar to these when faced with the realization that the rest of our life depends upon the career decisions that we make today.

Melainie Kuzmanovic, a guidance counselor at Oak Creek High School, stated that "Eighty percent of jobs in the market today require more than a high school diploma and less than a 4-year degree (Dept. of Labor and Statistics)." What falls between a high school education and a traditional 4-year eucation? The answer is techni-

A degree from a technical college satisfies the requirements for a large percentage of the job market

cal colleges like Madison Area Technical College (MATC). These schools offer one and two year degrees. A degree from a technical college satisfies the requirements for a large percentage of the job market.

Graphic arts is one program available at techincal colleges. Though schools offer many programs, looking at this program will provide a typical picture of life at a technical school.

Gary Gade of MATC is the Program Director of Graphic Arts for the technical and industrial department. He stated there are no rigid requirements for admittance into this program. A high school diploma and an eagerness to learn is all you need to succeed.

The semesters are eighteen weeks with the first semester starting one week before labor day. Class sessions run from one to four hours with no more than twenty students. Because of the small class sizes, there is ample opportunity for the student to get individual time with the professor. The MATC professors are certified by the same agency that certifies the UW-Madison professors.

The price of attendance is well worth the quality of education the students will receive according to Gade. There is an application processing fee of $25 and a charge of $51.20 per credit. Besides the cost covering class time, there are other services available. "Getting the students to attend our institution is only a fraction of our job. The real test is to make sure they are happy here so they will stay," said Gade. In order to achieve this there is a career counseling service as well as a program called lifetime placement. Lifetime placement is a service that promises to help graduates find a job they will enjoy. A graduate can enter the work force and return to MATC five years later to be placed with a different employer. The fact that industry actively recruits from MATC contributes immensely in the success of this program. MATC is also very proud of their financial aide office. There is a very thorough booklet of information on scholarship and other financial aide opportunities.

For a career in graphic arts, there are two options available. The first option is a one year technical diploma, and the second is a two year associate degree. Some students, once they obtain the associate degree, continue their education and go into management. Other graduates go straight into the work force at a print shop, trade shop or in-plant print which could be part of an insurance agency or hospital.

While in the graphic arts program, students work with ten thousand square feet of lab equipment worth over three million dollars. Leading edge technology is used to ensure the graduates understand the equipment their employers will expect them to be able to operate proficiently. For example, the program is placing a special emphasis on familiarity with the electronic pre-press. MATC keeps in close contact with industry, who in turn donates supplies and equipment to help MATC stay current. The very strong hands-on emphasis is a large asset to the school as well as the students.

Once the degree is obtained the moment of truth comes - entrance into the work force. How do MATC graduates answer this challenge? They proudly boast a one hundred percent placement for the last ten years, but that may not mean all the graduates are employed in the field they earned their degree. Because print communications is currently the second largest industry there is usually between six and eight job offers per graduate.

Since this industry is very competitive, as well as technical, there is good opportunity to make money. The salary graduates earn depends on the type of student and the amount of effort they apply. Graduates have entered the work force earning from six dollars per hour to thirty thousand dollars per year.

So, is pursuing a degree at a technical college right for you? Maybe. At the very least it gives everyone one more option to consider in the future.

Author Bio: Sara Vail is hopefully going into Industrial Engineering at the end of this semester.

Technical college versus Four year universities

Technical College	Four Year University
*limited general studies	*plenty of liberal arts options
*students with specific career in mind	*more opportunities to explore interests
*possibly require strong high school math and science	*more strict entrance requirements for high school grades
*get degree in one or two years	*get degree in four or five years
*tuition is fairly low	*tuition is higher
*good salary	*good salary

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cal and much more research-oriented. Carol feels studying in a university setting "brings out the true value of engineering."

While studying at the University has been more enjoyable for Carol, she stresses that the choice is a very individual one. She believes that making the right decision really depends on an individual's aspirations. If one is interested in learning the skills and has a desire to get out into the job market quickly, then a technical college would probably be a good choice. If, instead, one really wants to learn in-depth information about what your doing and why, her advice would be a university setting.

Carol has no regrets about getting both a technical school and the University degree. Despite the fact that if she had it to do over again, she would just go straight to a University, she does feel that she gained valuable experience from her training at the technical school. Carol feels that going to a technical school first gave her "a good place to start" and that she definitely has a "better appreciation of college now." Carol's advice to students trying to decide the next step in their education is to "talk to a lot of people, students and faculty alike, at both technical schools and colleges. Ask that question, 'how did you know this was the right place for you?'"

After graduation, Carol plans to go into materials development. She thinks that in a few years she may go to graduate school to work on researching an industry project, but for now Carol is content to be counting the days until graduation and being done with school — again!

Author Bio: Michelle Truscott is a senior majoring in psychology and English. She loves her new position as editor on the magazine and sometimes gets so excited about it that she falls off her chair!

Technical Schools in Wisconsin

Blackhawk Technical College
Janesville
608-756-4121

Chippewa Valley Technical College
Eau Claire
715-833-6200

Fox Valley Technical College
Appleton
414-735-5600

Gateway Technical College
Kenosha
414-656-6900

Lakeshore Technical College
Cleveland
414-458-4183

Madison Area Technical College
Madison
608-246-6100

Medical College of Wisconsin
Milwaukee
414-257-8296

Mid-State Technical College
Wisconsin Rapids
715-423-5650

Milwaukee Area Technical College
Milwaukee
414-278-6600

Moraine Park Technical College
Fond du Lac
414-922-8611

Nicolet Area Technical College
Rhinelander
715-365-4410

Northcentral Technical College
Wausau
715-675-3331

Northeast Wisconsin Technical College
Green Bay
414-498-5400

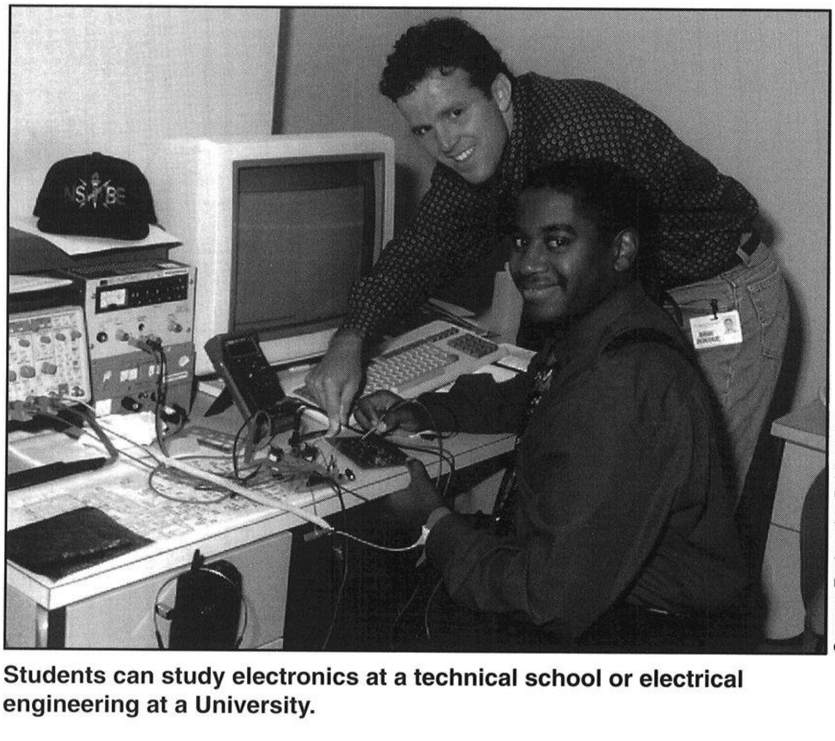
Southwest Wisconsin Technical College
Fennimore
608-822-3262

Waukesha County Technical College
Pewaukee
414-691-5566

Western Wisconsin Technical College
La Crosse
608-785-9200

Wisconsin Indianhead Technical College
Shell Lake
715-468-2815

Wisconsin School of Electronics
Madison
608-249-6611



Source: Engineering Publications

Students can study electronics at a technical school or electrical engineering at a University.

Internet Guide to Colleges, Universities, and Technical Schools

http://www.collegenet.com/

Engineering for the 21st Century

Society wants and demands technology. Technology has become so much a part of everyday life that we take for granted computers, cars and TV dinners. Engineers of all fields work to develop new technology or improve technology that already exists. So what is engineering?

According to Purdue University, "Engineering is the professional art of applying science to the conversion of natural resources for the benefit of mankind." As technology changes, this definition may also have to change. The American Society for Engineering Education (ASEE) addresses this issue in a report titled, "Engineering Education For a Changing World." (October 1994)

Math skills, knowledge of science, logic, problem-solving, and good communication skills are key to engineering

In the ASEE report, an action plan is presented. It states, "In today's world and in the future, engineering education programs must not only teach the fundamentals of engineering theory, experimentation and practice, but be relevant, attractive and connected." Ideally, education should be relevant to the student for preparation in a career and determination of continued learning to adapt with new technology. Engineering should be attractive to students of diverse backgrounds and talents. Lastly, engineering should be connected to a broader community to understand the needs of society.

Attributes of an Engineer

*** an ability to apply knowledge of math and science
*** an ability to design and conduct experiments, as well as to analyze and interpret data
*** an ability to design a system, component or process to meet desired needs
*** an ability to function on multi-disciplinary teams
*** an ability to identify, formulate and solve engineering problems
*** an understanding of professional and ethical responsibility
*** an ability to communicate effectively
*** the broad education necessary to understand the impact of engineering solutions in a global societal context
*** a recognition of the need for and an ability to engage in life-long learning
*** a knowledge for contemporary issues
*** an ability to use the techniques, skills and modern engineering tools necessary for engineering practice

*** These attributes provided by the Accreditation Board for Engineering and Technology (ABET) from the forthcoming "ABET Engineering Criteria 2000."

Don Woolston, Assistant Dean of the College of Engineering at UW-Madison, also feels education needs to change. With technology changing the work place, education must also adapt to prepare students to compete in this new world. Woolston stated, "Look at your education, not as a ticket, but as a way to find your path of life. We'd like to get people off to a good start with good skills to continue learning."

How should students prepare for engineering? Math skills, knowledge of science, logic, problem-solving and good communication skills are key to engineering. For the future, ASEE feels engineers need to have broader skills in areas such as: team skills; communications; leadership; ethics; and understanding the societal, economic and environmental impacts of engineering. A way to reach this goal is to promote cooperation and learning between the schools of engineering, business and letters and sciences.

Engineering is a challenging and rewarding career. The need for engineers continues to grow as society demands more technology. Education will change with the changing technology. Thus engineering for the 21st century will require a desire to never stop learning.

Author Bio: Besides proclaiming her love of ice cream, Jennifer Schultz has nothing else to say at this time.

MEDICAL CAREERS...
"What choices do you have?"

Graduation is right around the corner. You are wondering what in the world you want to do when you 'grow' up. You realize this could be one of the most important decisions you will ever make. There are so many choices, and you are unsure of where to begin. Well, start with your interests. If you want science and mathematics to play a major role in your academic career, you could look toward the medical field.

A medical career could provide you with a stable job, rewarding experiences and a knowledge of the human body. If you have already narrowed it down to medicine, all you need to do is look more closely at your likes and dislikes to find the career for you. There are several fields from which you can chose, ranging from anesthesiology to x-ray technology.

A nurse can work in many different areas, such as obstetrics, pediatrics,surgery, hospitals, and nursing homes

LPN (Licensed Practical Nurse)
Michelle Kamenick, a LPN in an urology clinic. Her duties include drawing blood, giving injections, assessing patients and taking their vital signs and doing laboratory analysis. She believes there is a large demand for LPNs in home care, hospitals and nursing homes.

A LPN's education is fast paced because it is only one year long. The first semester classes focus on written communication, human body physiology, basic nursing, infant care and the principles of nutrition. The second semester classes focus on verbal communication, nursing through the life span, personal relationships and governmental laws.

Kamenick had known she wanted a medical career for a long time. When she was 18, she did not go to school right away. When she finally went to school, she was married and had children, which made it difficult. Her advice is, "Go to school right away and do not wait. It is much more difficult with a family."

The most difficult situation that Kamenick faces in her job is knowing a patient's laboratory results and not being able to tell them. The patients want to know right away, but she must tell them to wait until the doctor can go over it in detail. Her most rewarding experiences were during clinical training. Although it was challenging, she loved spending time with the patients and feeling appreciated.

RN (Registered Nurse)
Margie Ross, a RN at Meriter Nursing Home, knew she wanted to be a nurse since the fourth grade. She said her most rewarding experience was having a terminal patient want only her care.

A RN's education is more specialized, focusing on chemistry, biology, anatomy, microbiology, English, psychology and clinical experience. A nurse can work in many different areas, such as obstetrics, pediatrics, surgery, hospitals and nursing homes. Ross states, "College was a wonderful experience, and I most definitely want my children to get an education."

Although Ross would do it all over again in a minute, there are difficult times that go with the job. Her most difficult time as a RN was when her first patient passed away. She recalls being with him during his final min-

Source: University of Akron

A nurse at the Akron School of Nursing examines a patient.

Career	Salary Range (per year)	Degree length	Education Cost	Education Update
LPN	$19,000- 30,000	1 Year	@$1500	CPR every year
RN	$31,000- 35,000	2 OR 4 Years	@$3000 OR $12,000	Seminars every two years
PT	$37,000- 42,000	4.5 Years	@$15,000	Seminars, journals
PA	$55,000	4.5 Years	@$19,000	Continuous Medical Education @ 200hours/2 years Recertified every 6 years

utes, holding his hand and helping him "let go". He called her "His Angel in White" right before he took his last breath. Although this was a difficult experience for her, she loved being able to be with him at the end, and she knew in her heart that he would be going to a special place.

PT (Physical Therapist)
John Van Susteran, the head of the PT Department at Lakeland Medical Center in Elkhorn, Wisconsin, became attracted to PT from a friend. A PT is a specialist of the neuromuscular skeletal system. A PT can become a orthopedic or hand specialist. One can also become proficient in burn accidents or spinal therapy. Basically, a PT specializes in patients who are unable to have movement; they also attend to burns, wounds, injuries, disease, stroke victims, spinal cord injuries, joint replacement or bad backs. In the majority of the cases, the patients are treated with movement therapy.

Van Susteran believes that the hardest thing to do is to explain to a person that he or she may not have the same abilities that they once had. The most difficult case is a spinal cord injury, especially when the patient is young. A PT must stay positive and encourage the patient, without giving false hope.

On the other hand, his most positive experience is helping a person who has been through many health practitioners. Often he is the one who is finally able to help them accomplish their goals, such as participating in sporting activities or gardening.

Physician Assistant is a growing career; for every one PA, there are eight jobs availiable

Volunteer work experience is critical to a PT. The more relevant the experience that is gained, the more beneficial the education will be. Van Susteran also says a PT needs to maintain his or her education. This is done by reading journals, attending seminars and establishing relationships with one's peer, so difficult problems can be solved through teamwork.

Van Susteran says to be a Physical Therapist, you need to have interests in sports, training or geriatrics. But most importantly, you must enjoy working with people!

PA (Physician's Assistant)
Bob Volk, a PA at the Federal Correctional Institution, was inspired to become a PA by a military captain. Volk states that "PA Kreis took me under his wing and taught me everything I needed to know." The aspect of being a PA that interested him the most was being able to do what he loved and still go home at night and have a family.

A PA's education is quite structured. A student interested in the PA program must apply and be accepted. Prior to acceptance, one should take classes in zoology, anatomy, physiology, bimolecular chemistry, chemistry, bacteriology, humanities and ethnic studies.

The last year of a PA's education is similar to an internship. Volk's last year consisted of practice vascular surgery, family practice, orthopedic surgery, mental hospital and emergency medicine. His degree is a Bachelor of Science with a Certification from the Department of Family Practice - PA Program.

Volk's most rewarding educational experience was in orthopedic surgery. He says that it is extraordinary to see an elderly person hobble in, prior to a

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Never Fear, Captain Craft Is Here!

With technology appearing everywhere, people are trying to prepare as best they can. On the minds of many is job acquisition. Several people experience a basic human emotion when asked about their job security, fear.

Do not fear, CAPTAIN CRAFT is here! There is a myth feared by all and spoken of by few. It is that "machines are taking over the future and unless you are maintaining them, you have no job security." Not so! This remains a myth. People fail to realize that there are many career choices that will be left virtually unscathed by those cold robotic hands. As Captain Craft will show us, careers abound for skilled craftsmen in the fields of construction, industrial and service industrial trades.

Job security for skilled craftsmen has been rated excellent by some, and with good reason. A skilled craftsman is a person with enough knowledge in his or her field to solve problems that he or she may be faced with. One question that comes up is how can one tell whether one is suited for this career. There are actually some fundamental areas of interest that most people in these fields share. Some people find it rewarding to be involved in the actual development and production of things.

A skilled craftsman is a person with enough knowledge in his or her field to solve problems that he or she may be faced with

Once the work is done on a particular object, craftsmen can enjoy an immediate sense of gratification. An outsider may not be able to see a difference, but progress would have been made.


Source: Wisconsin Engineer

After this apprentice steamfitter has mastered welding, he will continue his studies in order to become a journeyman.

In an apprenticeship program, you get the chance to obtain on-the-job experience while simultaneously learning in the classroom. While gaining experience, you are under direct supervision. The duration of the apprenticeship varies depending on the individual skills you choose to master. Apprenticeships can last from two years to six years. Semester costs vary at different institutions, as well. Some trades may cost an average of one hundred fifty dollars per semester. If a person compares different institutions, another difference may be found. In some places, a student gets reimbursed for tuition money if a high enough average is obtained. Money will come from the student's physical labor as well.

The total time needed for a student to become a skilled worker is referred to as a "journey." During this time period, apprentices get paid and enjoy benefits such as insurance or pension. Depending on the percentage of the journey level completed, increments may be added to the salary. For example, a student may start out earning seven or eight dollars an hour. By the end of the journey, an apprentice may be earning from seventeen to twenty-two dollars an hour. After completing an apprenticeship, a person may go on to positions in various fields, one of which may be as a supervisor. Mary Knight, coordinator of Tools for Tomorrow: Women in the

This welder has completed his training as an apprentice and now works for his own company.

Trades, stated it best when she said apprenticeships are a "good potential for career ladders."

As in all ladders, there are certain 'steps'one must climb in order to become an apprentice. In Wisconsin, these steps are governed by the Bureau of Apprenticeship Standards. A person must first have graduated from high school or earned their G.E.D. This can be viewed as "setting up" your ladder. In order to stabilize this ladder, students should have a good background in math and science. In some instances, aptitude tests may be given. Once the ladder is set up, the next step is to contact the local committee in your area for information on that particular craft. The fields to choose from are very diverse. They include, but are not limited to, construction, industrial and service industrial trades. Construction trades may include trades such as bricklaying, construction electrician, plumbing, or steamfitting. Apprenticeships in industrial trades include machinists, millwrights or tool and die makers. Service industry trades vary from cosmetology to barbering. The areas mentioned are only a few of the many areas available for study. After having a general idea of what one wants, the next step is to submit an application along with a transcript. The applicant is then interviewed and, hopefully, approved.

A call to the Bureau of Apprenticeship Standards at (608)266-3133 will help to get more information about local committees in particular areas. I leave you with these words from Captain Craft.

"A challenging career can offer you a world of success. Pursue it."

Author Bio: Veronica Narvaez is a new addition to the *Wisoconsin Engineer* staff. Welcome aboard!

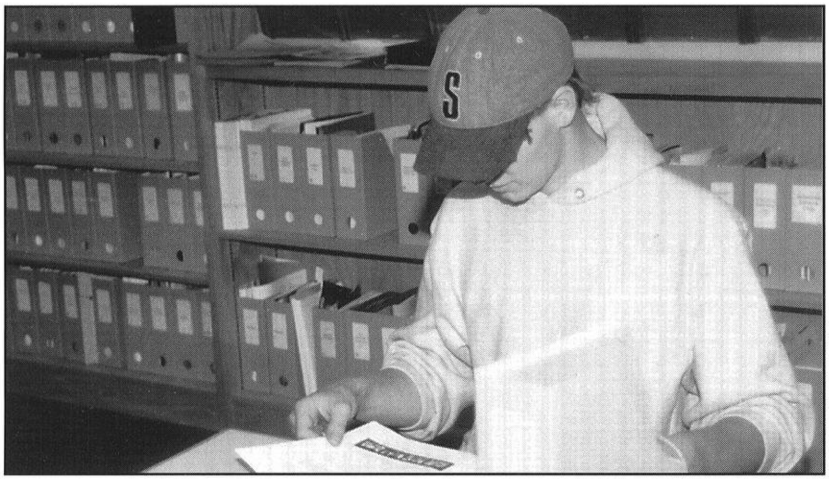
Project X Info

For more information on Project X, contact Donald Woolston at (608)-262-0684 or Bonnie Schmidt at (608)-262-4822

Project X
Rm. 2640 Engineering Hall
1415 Johnson Drive
Madison, WI 53706
http://www.cae.wisc.edu/~projex

The Wonderful World of Engineering

Maybe you're a high school student thinking about what to do after graduation. Maybe you're a college student deciding on a major. Or, maybe you're someone interested in going back to school in order to change careers.



An engineering student checks job postings outside Engineering Career Services for a possible summer intership or co-op.

Ask yourself: Am I curious about how things work? Do I do well in mathematics and science courses? Do I enjoy learning and mastering new concepts? Do I want a challenging career which allows me to contribute to society?

If you answered "yes" to the above questions, then studying engineering might be the right choice for you.

Studying Engineering at a University
Engineering concepts can be studied at technical colleges or universities. Traditionally, degrees granted by technical colleges certify people as "technicians," while degrees granted by universities certify people as "engineers."

So what is the difference between a technical college and university? A technical degree is usually completed within 2 years, and its coursework is primarily hands-on. Assistant Dean Don Woolston of the Pre-Engineering office at UW-Madison suggests, "For concrete learners who enjoy hands-on work, a technical college or apprenticeship might be the best choice."

In contrast to a technical degree, a university degree takes 4-5 years to complete, and the coursework is both theoretical and practical. In addition to core engineering classes in their major, students choose different engineering and liberal arts electives. According to Dean Woolston, students that are likely to be successful in an engineering setting generally possess certain characteristics, including the ability to process lots of information and the ability to be resilient, especially under a lot of work and stress.

Although engineering students concentrate their studies in one area, their courses and work experiences can be applied to many fields and career paths

Choosing a University
Suppose that you decide to enroll in a university to study engineering. How would you go about deciding which universities to apply to? Universities differ widely based on cost, location, educational facilities, instructors and types of engineering degrees offered. These factors should be considered when making your decision.

Wisconsin's public university system includes three campuses which offer degrees in engineering. First, UW-Stout offers an engineering degree in manufacturing as well as engineering technology degrees in construction, telecommunication, packaging and industrial technology. Second, UW-Platteville offers degrees in civil, electrical, industrial, engineering physics and mechanical engineering. And third, UW-Madison, which is a research-oriented university, offers ten different undergraduate degrees. Master's and doctoral degrees are also offered in several of the engineering fields at the above universities.

Two of Wisconsin's private universities, Milwaukee School of

Engineering (MSOE) and Marquette University, also grant degrees in several engineering disciplines. MSOE offers architectural, electrical, computer, industrial, mechanical and biomedical engineering degrees, and Marquette offers civil and environmental, electrical and computer, industrial, mechanical and biomechanical engineering degrees.

The job market for engineers has looked much better recently than it did during the early 90's

Choosing a Major
Many first-year engineering students have not decided on a particular major for various reasons. They may not have a preference for a particular field, and they might not know exactly what an engineer in each field does.

The College of Engineering at UW-Madison offers some introductory engineering courses for those students interested in engineering but unsure of a major. EPD 160, an introductory engineering design course, offers students the chance to work in teams on an engineering project. One of the projects was to design a wheelchair ramp for one of the buildings at Old World Wisconsin. EPD 100 and 101 also offer students information on engineering majors and how engineering works with society and technology.

Students are also encouraged to work in internships or co-op programs in order to find out what roles engineers play in industry. Dean Woolston summarized the opportunities for students to explore career and academic interests at UW-Madison, "Students can join the many student organizations, which often have speakers from industry, and students can also study independently for credit." Finally, career fairs such as Career Connections and student competitions such as Engineering Expo are excellent ways to learn more about industry, make contacts and see current technology.

Life after Graduation
Suppose you have enrolled in a university, chosen an engineering major and survived all of the courses required. After graduation, you have more choices. You can work in industry or you can go on for more education after your bachelor's degree.

The job market for engineers has looked much better recently than it did during the early 90's. Starting salaries for engineers range from $20,000-50,000 depending on major, company, qualifications of the candidate and other factors. In industry, engineers can choose from many fields, including food processing, petroleum refining, electronics, aerospace, pulp and paper, environmental applications, automotive systems and others.

An engineering degree can also provide an excellent basis for graduate work. Graduates with a bachelor's degree can pursue work in specialized topics in engineering or continue education in medicine, law or business.

What Makes an Engineering Education Useful?
An engineering education will help you develop your problem-solving ability which can be applied in many areas of life. You will learn how things work. You will learn to search for different, more economical, safer and faster ways of accomplishing goals. Engineers cooperate with people in areas such as business, law and medicine to manage societal issues to benefit peoples' lives.

Although engineering students concentrate their studies in one area, their courses and work experiences can be applied to many fields and career paths. According to Stephen Carr, associate dean of the school of engineering at Northwestern University, "Engineering...is the best general background in a high-tech society and in the international marketplace."

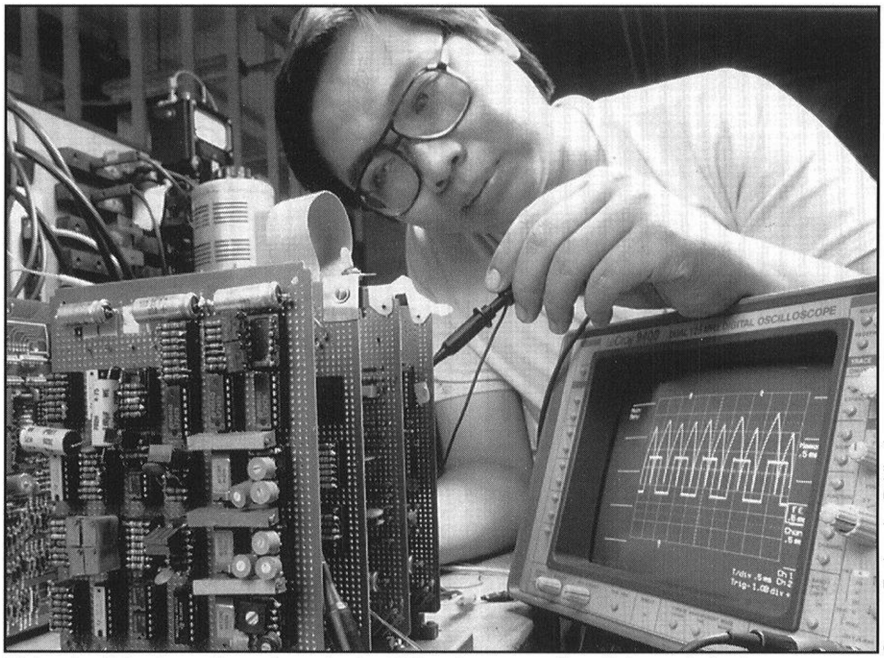
Author Bio: Sarah Storm, a senior in chemical engineering, is graduating in December 1996 and would like to be rich and famous when she grows up.

Source:Engineering Publications

There are many research opportunities to take advantage of at a university. These students are trying to improve gas milages on cars.

Engineering from A-Z

Let's say you're an engineering student in your first or second year at college, and you're trembling at the thought of choosing your major. Never fear. Your situation is very common because many people are unsure of what the different types of engineers do. Below is a short A-Z guide to introduce you to the variety of engineering majors.



Source: Engineering Publications

This electrical engineering student fine tunes a circuit board during one of the many labs required for his degree.

Aeronautical/Astronautical engineers study jet engine and aircraft design. They might also work on space mission applications.

Agricultural engineers design farm machinery, animal shelters, crop irrigation systems and farm product processing systems.

Chemical engineers develop processes and products made from chemicals. A chemical engineer might work in the food, petroleum, or pharmaceutical industries.

Civil engineers design roads, buildings, transportation systems, and other large-scale construction projects. Specialties within civil engineering include structural, environmental, geological, hydraulic, transportation and construction engineering.

Electrical and computer engineers design, construct, and maintain electronic systems, which may include working with computer chips, circuits and electronic communication.

Geological engineers help find the best ways to solve Earth related technical problems while at the same time protecting the environment.

Industrial engineers plan and design engineering and business facilities for the best product quality and employee working conditions.

Materials engineers study metals, ceramics, plastics, and composites to design materials for applications that may involve transportation, communications or power production.

Mechanical engineers create machines for use by humankind. They might work on transportation systems, power production or performance analysis.

Nuclear engineers harness the energy of the atom by working with reactors, fusion or radiation applications.

Note: Universities may not offer degrees in all of the majors listed above. Also, some universities offer technology or manufacturing degrees, which may differ from engineering degrees.

Lifelong Learning

As we have learned, technical skills and a background in mathematics and the sciences are important for success in a number of careers. Though this lesson was the main goal of the recently completed Project X, it was not the only message to be learned. In the words of Project X co-director Bonnie Schmidt, this project also attempted to inform teachers and counselors from around the state that, "students need to establish a framework for lifelong learning—they need to realize that they can't stop learning if they are going to make it." In other words, to succeed in this world one must be ready to constantly evolve and change with the changing times.

Think about it. We live at an exciting time—a time filled with discovery and breakthroughs. But with these discoveries comes new knowledge. To be successful in any career, and in life, a person has to be prepared to be a student for the rest of their lives. Though the classroom itself may change, the learning will always continue.

To many people, this may seem obvious. 'If new software is developed I'll have to learn it,' they may say. True enough, but this is not the full extent that one must learn. Subjects that are seemingly as simple as teamwork and communication skills can constantly be developed. The world truly is an open book and from its pages we can constantly learn and hopefully better ourselves.

This may scare a fair number of people. After all, who wants to be continually pressured to learn new things. Fortunately, this is not something that is forced upon us and there isn't an exam waiting to be taken. Learning will become a necessary part of your everyday life. It will be what makes life challenging and interesting. Without it life would be stagnate and boring. Learning shouldn't be a chore. No one is expected to learn everything because no one can learn anything. But as life proceeds new challenges will continually present themselves and we won't be ready for them all. Luckily, we can learn to handle them.

School can't teach you everything. As a matter of fact, it may only teach you a small amount. But that which it does teach is invaluable. School and an education, any type, will help you develop a framework for learning. They will help give you the skills necessary to deal with the problems life presents. School won't give you all the answers, nothing will, but it can definitely point you in the right direction and give you a solid background from which to build.

Remember, you learn something new everyday.

-Jon Furniss

continued from pg.17

hip replacement, and to follow up knowing he has been able to decrease the pain. His most vivid memory of college is his close relationships with his classmates. He states, "The friendships start in anatomy and continue for a lifetime."

PA is a growing career; for every one PA, there are 8 available jobs. Volk says, "A PA can do 85% of a diagnosis a physician makes; however, they are paid a lower salary so they are more desirable." Two years ago, there were only 48 schools that had PA programw. Now there are 60. Volk believes that "PA is the wave of the future!"

These are only a few of the career choices available in the medical field. My recommendation to you is to evaluate your interests and find the career that is just right for you. This is an important decision, but do not stress yourself out about it. If the career interests match your interests, then enjoy... you may have found the perfect match!

Author Bio: Trisha Scott, who is finally going to graduate with her Master of Science in Industrial Engineering. She definitely could have used some help in finding her niche when she began college back in 1991!

Wisconsin Universities

Below is a listing of a majority of the universities and colleges in Wisconsin. The phone number of the applications office is listed along with a web site adress, if available. Not all the Wisconsin schools are listed below.

Alverno College
Milwaukee
414-382-6100

Beloit College
Beloit
608-363-2500

Cardinal Stritch College
Milwaukee
414-351-7504

Carroll College
Waukesha
414-524-7220

Carthage College
Kenosha
414-551-6000

Concordia University
Mequon
414-243-4300

Edgewood College
Madison
1-800-444-4861

Lakeland College
Sheboygan
414-565-1217

Lawrence University
Appleton
414-832-6500

Marian College of Fond du Lac
Fond du Lac
414-923-7650

Marquette University
Milwaukee
414-288-7302

Milwaukee School of Engineering
Milwaukee
414-277-7200

Mount Mary College
Milwaukee
414-259-9220

Mount Senario College
Ladysmith
1-800-281-6514

Northland College
Ashland
715-682-1224

Ripon College
Ripon
1-800-94-RIPON

St. Norbert College
DePere
1-800-236-4878

University of Wisconsin - Eau Claire
Eau Claire
715-836-5415
http://www.uwec.edu/

University of Wisconsin - Green Bay
Green Bay
414-465-2111
http://www.uwgb.edu/

University of Wisconsin - La Crosse
La Crosse
608-785-8067
http://www.uwlax.edu/

University of Wisconsin - Madison
Madison
608-262-3961
http://www.wisc.edu/

University of Wisconsin - Milwaukee
Milwaukee
414-229-3800
http://www.uwm.edu/

University of Wisconsin - Oshkosh
Oshkosh
414-424-0202
http://www.uwosh.edu/

University of Wisconsin - Parkside
Kenosha
414-595-2355
http://www.uwp.edu/

University of Wisconsin - Platteville
Platteville
608-342-1125
http://www.uwplatt.edu/

University of Wisconsin - River Falls
River Falls
715-425-3500
http://www.uwrf.edu/

University of Wisconsin - Stevens Point
Stevens Point
715-346-2441
http://www.uwsp.edu/

University of Wisconsin - Stout
Menomonie
1-800-44-STOUT

University of Wisconsin - Superior
Superior
715-394-8230
http://www.uwsuper.edu/

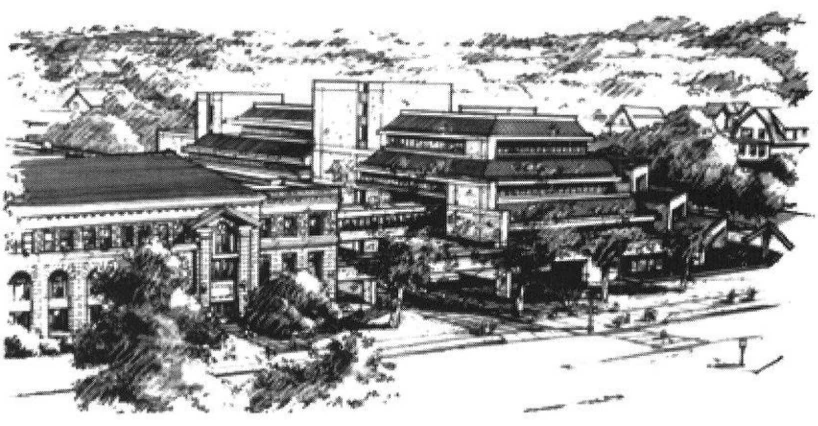
University of Wisconsin - Whitewater
Whitewater
414-472-1440
http://www.uww.edu/

Viterbo College
La Crosse
608-791-0420

Wisconsin Lutheran College
Milwaukee
414-774-8620

The New Engineering Center Building

Jim Feldman



Source: Jim Anderson

The artist's conception of the proposed Engineering Centers Building, shown from the University Avenue side.

The space problems of the School of Engineering, which amount to a shortfall of about 160,000 square feet, will be solved by the erection of the Engineering Center Building. The four story building will be built at the corner of Breese Terrace and University Avenue. Completion is projected for May 2000, according to Dean of Engineering John Bollinger. This will be 101 years after the construction of the University's first dedicated Engineering building, now known as the Education building, located on Bascom Hill.

The cost of the new building will be about $44 million, half of which will come from private donations and half from WISTAR funding. WISTAR is a program initiated by ex-chancellor Donna Shalala, in which the state will match existing funds. Dean Bollinger hopes to announce final funding arrangements later this year.

Contents of the New Building

The building will have a basement and four above-ground stories comprising approximately 160,000 gross square feet. The basement will be used for laboratories for research that requires very low vibration conditions, such as high resolution microscopy. Floors one and two will be dedicated to student organizations. Many student organizations are now housed in temporary or leased space around campus. They have little or no contact with each other. Placing these groups in the new building will give them improved facilities; opportunities to interact with each other, the faculty and staff; and share resources. For example, the new automotive research laboratory will have four bays for work on different projects. There will be space for new student organizations, such as a Leadership Center to encourage the learning and practice of engineering leadership and management techniques and a student auditorium for use by student groups and for seminars. The student Communications Center will contain the Technical Communications courses, now housed in the General Engineering Building. An Innovation Center will provide laboratory space for independent student projects.

Dean Bollinger says it is hoped that engineering students will spend all their non-class time in the Center Building. The upper floors will contain offices and laboratories for such fields as Manufacturing and Production Research and the new field of nanotechnology. All floors will emphasize maximum flexibility with moveable partition walls.

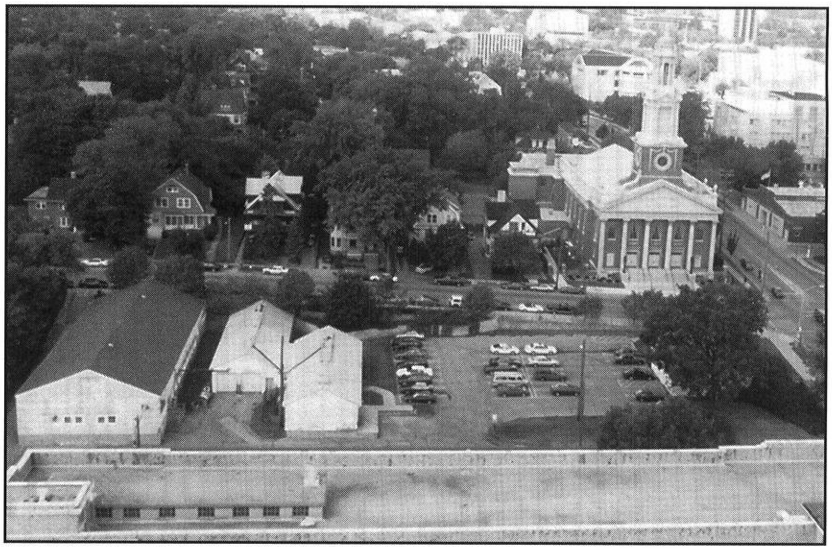
Location and Design of the New Building

The building will be located at the corner of Breese Terrace and University Avenue. It will cover the area now occupied by Temporary buildings T21, T22, T23, the General

We hope that engineering students spend all their non-class time in the new building

Engineering Building and lot 14. This area is controlled by the College of Engineering, except for T22 which belongs to the Memorial Union. According to union director Ted Crabb, arrangements have not yet been completed for the transfer of T22. The temporary buildings were erected in 1947 after they were moved from Camp McCoy, where they were used as army barracks and offices. Although the temporary buildings are laden with asbestos siding and insulation, the Dean foresees no problem with their removal.

The design of the new building will be shaped like a ziggurat, with each level stepped back ten feet from the lower one. The main reason for this design, according to Dean Bollinger, is to reduce perceived mass of the building and avoid a huge looming presence that would dwarf and shade the church and residential neighborhood across Breese Terrace. A plain high-rise structure could provide the needed space at a lower cost, but at a significant loss to the aesthetics of the area. Neighborhood associations have been included in the design process and are supportive of this design.



Source: Jim Feldman

The corner of Breese Terrace and University Avenue, 1996. T-23 is at the extreme left, and T-21 at the right. General Engineering is hidden behind the Mechanical Engineering Building.

State approvals for the project, including the appointments of an architect and contractors, will be forthcoming after financing is finalized later this year. Dean Bollinger estimates that construction will begin in the spring of 1998, with the first part of the project being a four level parking ramp in lot 17 to replace the spaces lost in lot 14. Anticipated completion for the project is the spring of 2000.

Author Bio: Jim Feldman is a new addition to the *Wisconsin Engineer.*

Expo '97 Updates April 18-20

Expo '97 Welcomes Wisconsin K-12 Students

On April 18, 1997, thousands of K-12 students from all over Wisconsin will come to the UW-Madison College of Engineering campus. They will come to take part in Engineering Expo '97, a massive technology fair exhibiting the cutting-edge technology that is currently being developed at UW-Madison and in industry.

Friday, April 18 is Students' Day, a day devoted to educating K-12 students about the field of engineering. On Students' Day, participating students will have the chance to visit the UW-Madison campus, discover today's major technological developments through UW-Madison student and industrial exhibits and test their own engineering prowess by competing in contests designed specifically for them.

Students who attend Expo '97 will visit and learn about one of the largest universities in the nation. They will explore the facilities that are available to UW-Madison students and will learn about the degrees and courses offered there. This information can help high school students decide whether or not UW-Madison is the right college for them.

Students who attend Expo '97 will see student and industrial exhibits which showcase modern technological advances. While touring the exhibit routes, these students will discover the fun side of engineering – concrete canoes that float on water, knee-high robots that compete in a miniaturized soccer game and Lego models of the engineering campus. The students can also investigate the current state of the engineering profession and its prospects for the future. Representatives from technological leaders like GM and Ford will be on hand to explain what practicing engineers do and to address students' questions about the future of the profession.

Students who attend Expo '97 will have the chance to flex their own engineering muscles in a number of competitions that test their knowledge of engineering principles.

Source: Engineering Publications

At the previous EXPO, students stand clear of "The Slapshot," a machine designed by students to shoot hockey pucks.

Expo '97 will provide K-12 students with the information that they need to decide whether or not engineering is right for them. It will also give them the chance to test their own engineering prowess by competing in four engineering-related contests. In short, Expo '97 will show K-12 students what engineering is all about!

Robot Triathlon

Following EXPO '95s successful Robot Triathlon, EXPO '97 has set out to surpass that event with the new Robot Triathlon. Unlike previous years when the robots were more like remote controlled cars than anything else, this EXPOs competition has been expanded to allow for more flexibility in design. With this increased flexibility also comes an increase in difficulty of the tests which the robot must pass, ranging from a maze of confusion to an obstacle course to RoboBall, a robotic soccer game.

With an expanded contest, the EXPO committee felt that there should be an expanded location. Therefore, this year's Robot Triathlon will be held in the UW Field House. Not only is this facility more suited for spectator attendance, it also allows for the increased participation that is anticipated.

This increase in participation is not exclusively due to the increased interest in the Robot Triathlon. For the first time, EXPO has made this a national competition, inviting groups from other schools to compete. With this increased competition also comes increased prizes. Currently, prizes total in excess of $15,000.

The following is a brief break down of the Robot Triathlon rules. For a more complete listing, check out EXPOs website at http://www.engr.wisc.edu/~expo.

I. Robot Specifications
It is required that the same chassis compete in each of the Triathlon events and the Aesthetic competition. Chassis has been defined as the unit hosting the receiver and drive train. Modifications to this chassis are permitted as long as the robot meets the following specifications at the start and finish of each Triathlon event and Aesthetic competition. Teams should keep in mind that the turnaround between events may be as short as 1 hour, thus modifications should be well-planned and relatively simple.

II. Events
Each of the events in the Triathlon is designed to test the robot teams in design, maneuverability, performance, teamwork, and competitive sportsmanship. The events are structured to accommodate matches. Robots will be paired for each event and points will be awarded for (1) completing the event and (2) for winning the match. The three events are the Maze of Confusion, Obstacle Course, and RoboBall.

III. Aesthetic Competition
A panel of judges will select the best robots. Points will be appropriately awarded to the finalist based on the some of the following: overall appearance, design, teamwork, sportsmanship, technical knowledge, presentation, etc.
-Jon Furniss

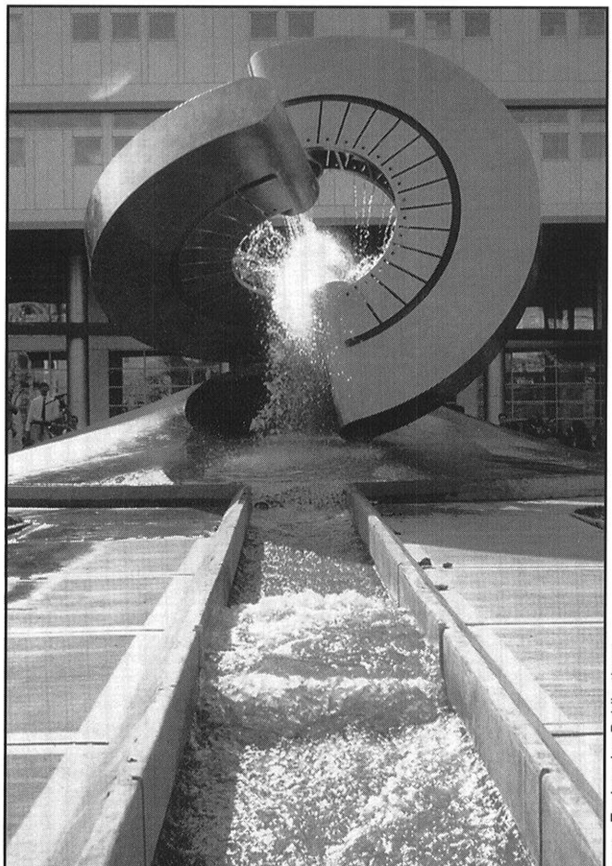
The Fountain and Engineering EXPO 1997

One of the most prominent and recent additions to the UW-College of Engineering Campus is the upgrade to the mall area in front of Engineering Hall. Once a large, ugly parking lot, this area now features an original sculpture by Bill Severson - now voiced on campus as "the fountain." The Society of Hispanic Engineers was awarded the opportunity to spotlight the Fountain for Engineering EXPO '95 and thus named the new fountain Maquina—which is Spanish for Machine.

But it is far more than a machine. The Fountain has many capabilities which include an extensive programmable computer and audio system that enables air, water and steam to be synchronized with music. Photo sensors are also embedded in the five posts that line the sidewalk directly in front of the Fountain. A person is able to vary the spray of the water jets on the fountain by placing their hand directly in front of one of these sensors located on each post. At EXPO '95 a different song played when each bollard sensor was activated.

A 1200 watt speaker system was included with the Fountain project. Many sound options are possible through an extensive library of sound cards. Examples include sounds of breaking glass to a 747 jet airliner. Shortly after completion of construction of the fountain, Allen Bradley donated a $15,000 PLC programmable controller which made possible the feature of synchronized music with the water jets of the fountain and north tower fountain. A PLC program has been written to coordinate the Westminster Abbey Chimes to toll on the hour, every hour. The 1997 Engineering EXPO Committee hopes to incorporate synchronization of the water spray from the Fountain to the music being featured for their fountain presentation. UW Dean of Engineering John Bollinger has mentioned that he would like to see art and engineering technology join together utilizing the natural features of the fountain for EXPO '97. The UW Art Institute is currently exploring the possibility of working with engineering students in planning the EXPO '97 Fountain presentation.

UW - Electrical and Computer Engi-



Source: Engineering Publications

The most recognized symbol of the Engineering campus, the fountain will be the focus of next year's EXPO.

neering (ECE) Professor Dick Marleau has some students investigating possible fountain project upgrades. ECE students are considering creating a web site interface which would include a real time visual projection of the fountain. Web users would possibly be able to manipulate the water jets of the fountain through the internet from any where in the world. Another project being considered is surrounding the periphery of the North Tower pool with proximity sensors and additional water jets. These sensors would create a wall of water as they are approached. An emitting control keyboard may also be possible which may control the water jets of the fountain from a remote location on campus.

Upgrades are planned for the North Tower Pool end of the mall area. A design project for additional water jets being added to the periphery of the North pool is currently underway. However, designers are skeptical that these changes will be incorporated in time for EXPO '97 as the oncoming winter season limits the construction changes that can be made to the fountain.

Individuals interested in working on the fountain should contact Engineering EXPO via email at "expo@caelab1.cae.wisc.edu" with *fountain* in the subject line or call 608/262-5137 for more information.

-Mary Poupore

Exhibiting at the Engineering Exposition

What is EXPO '97?

EXPO is a biennial student organized technology exhibition whose purpose is to acquaint the public with recent technological advances developed in the College of Engineering and throughout industry, and to motivate future engineers from area high schools to attend UW-Madison. The 1995 EXPO featured over 70 industrial and student organized exhibits and was attended by over 14,000 visitors, and EXPO '97 promises to be the biggest in recent history.

EXPO History

The roots of the UW Engineering EXPO can be traced to the early 1930's and an annual feud between UW Law and UW Engineering students. While newspaper headlines of the day were filled with rumors of an impending war abroad, a different type of conflict was stirring at the University of Wisconsin.

Every March, UW Engineering and Law students prepared to rekindle their dispute over the true vocation of St. Patrick; the engineers asserting that Patrick had been a fellow "slide-rule pusher", the lawyers laying claim to Patrick as one of their own. Every March, each group held a parade in their patron saint's honor. From the mid 1920's, these parades had clashed in a good-natured manner, but year after year the bickering became more spirited until it burst into a riot on St. Patrick's Day, 1938.

As a result, the Engineering faculty desperately sought a means of diverting the students' efforts into a more constructive enterprise. The result was the Engineering EXPO - a new keynote to the St. Patrick's Day celebrations and successor to the traditional, yet unpredictable parade. The first EXPO was held in 1941 and has been biennially since 1965.

Student Exhibits

Student exhibits will compete for cash awards in each of four separate judging categories: Individual(one undergrad), Small Group (two or more undergrads), Graduate Student, Student Organizations.

Awards, which are even bigger than the awards given out in EXPO '95, will be given to the top three exhibits in each category. People's Choice and Honorable Mention Awards will also be given out.

Exhibits and exhibitors will be judged on a variety of criteria which may include any of the following: presentation (oral and visual), comprehensibility to non-engineers, originality, creativity, application of engineering principles, engineering pertinence, response to judges'questions, vision of the future.

To receive a high mark, exhibitors must give a clear, concise presentation of their project's engineering principles. The areas of comprehensibility and presentation will be emphasized on the score sheet, since many of the people viewing EXPO are not engineers. Exhibitors should focus on making sure the average person can comprehend the basics of the exhibit. Each exhibit will receive a numerical score based on the decision of the judging panel.

Robots

Because of nation-wide interest and increased participation, the robot competition has grown into a separate committee this year. For additional information on the robot competition please contact Doug Herman at expo@caelab1.cae.wisc.edu or at (608) 262-5137.

Summary

The 1997 Engineering EXPO promises to carry on the strong tradition that has been established at the University of Wisconsin - Madison. EXPO allows students to get first hand experience in design and manufacturing, and better prepares them for today's ever-changing future. It also allows high school students to gain knowledge in science and shows them a wide variety of what is in store for them if they decide to attend UW - Madison.

For further information, please contact the EXPO office at: expo@ caelab1.cae.wisc.edu or at (608) 262-5137.

-Jon Furniss

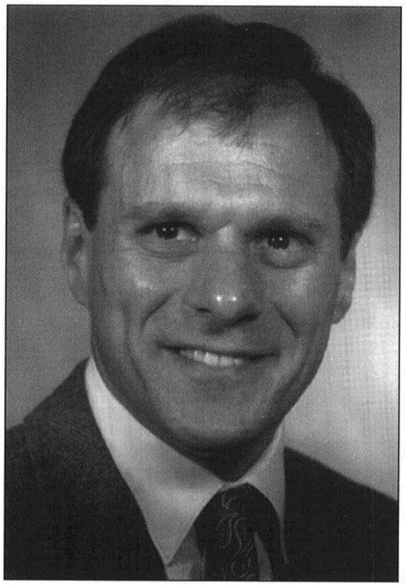
Faculty Profile: Sanford A. Klein

Jon Furniss

Many engineering students at the University of Wisconsin - Madison have benefited from the work of Professor Sanford A. Klein. Though a relatively small number of these students may recognize this man, many of them have, at one time or another, used the Engineering Equation Solver (EES) or one of the other programs written by Klein.

A faculty member since 1977, Klein migrated here from Chicago, Illinois, where he was born and where he earned his undergraduate degree in chemical engineering from the University of Illinois - Chicago. From there, Klein learned of Madison through his brother-in-law, who received his Ph.D. from the UW in Molecular Biology. Knowing that Madison was a reputable university and wanting to spread his wings, Klein ventured forth to Madison because, "it was close enough to be close to home but far enough to be far enough away." Klein proceeded to do his graduate and Ph.D. work at the UW finishing up in 1976. With the exception of a year long sabbatical, Klein has been teaching here ever since.

Through the years, Klein has had many accomplishments at the university, most of them dealing with solar energy, his specialty. Working with his colleagues, Professors Duffie and Beckman, Klein has studied and developed many methods for designing energy systems. Many of these methods have become commonplace in industry and have become the international standards used by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE). Also, Klein has written a simulation program dealing with solar energy called TRNSYS (which stands for Transient Systems). According to Klein, "this program simulates systems by creating thermodynamic models for each component of that



Source: Engineering Publications

Professor Klein, who spends many hours in the Solar Engery Lab, has been with the university for over 20 years.

system. Then these components can be hooked together and linked as a whole." Klein goes on to say that this program acts as a library of components of interest to heating, ventilating and air-conditioning engineers. Still in use today, Klein estimates the users of this program to be about a thousand. In many ways, Klein feels this program was the predecessor to EES.

Currently, Klein spends a vast part of his time in the Solar Energy Lab where he is working on a project for ASHRAE to identify weather patterns in certain geographical locations to help aid in the testing of new equipment. Klein believes that the UW Solar Energy Lab is the oldest lab of its type in the world dating back 50 years. Klein is also working with the National Institute of Standards and Technology to help create a program called REFPROP which deals with refrigeration cycles and their properties. This is a project Klein started in 1995, while on sabbatical for a year in Colorado. Though he enjoyed his time away, Klein was happy to be back in Madison following his leave.

Perhaps Klein's greatest accomplishment, at least to students here, is the success he has had with his EES program. While teaching thermodynamics in 1989, Klein had difficulty assigning homework because many of the problems were too involved, containing too much useless math or "busy work." In an effort to ease the burden on the students and himself, Klein wrote the first version of EES later that year. Simply stated, EES is a program that can solve any number of equations, given the proper parameters, tabulate them and graph them. Ideally, it is used by chemical and mechanical engineers as it includes thermodynamic and transport property functions. Klein takes much pride in this project since it is not University funded and it has been completely developed on his own time.

Begun as an aid for students, EES has developed into a small side business for Klein. In 1993, Klein copyrighted the software and he currently sells it across the nation. For other university departments, in Wisconsin and out, the cost for a license is $800 for unlimited use. For individuals in a company the cost is $400. Luckily, for students EES is free through the Computer Aided Engineering (CAE) center.

Klein has taken some criticism for the EES program from opponents who say that it takes away much of the work students must do and makes things too easy for them. In reality though, this couldn't be further from the truth. Klein very much enjoys the teaching part of his work, so much so that he actually missed it while on sabbatical, and his purpose in writing the EES program was to aid in making students' time here more valuable and worthwhile. Klein approaches teaching with much enthusiasm and has won numerous awards from the department and the University for his efforts, including the prestigious Chancellor's award for teaching in 1990. He teaches mostly mechanical engineering courses and has 12 graduate students whom he shares with two other professors in the Solar Energy Lab. According to Klein, the most important thing to do at the University is to, "find something you like to do. That way you can do it over a long period of time and you can spend lots of time doing it." If it's possible, a "merger of hobbies and schooling" can often lead to an enjoyable future.

For more information about Professor Klein and the Solar Energy Lab, check out their website at http://www.engr.wisc.edu/centers/sel/sel.html

Author Bio: Jon Furniss will be graduating in December of this year and would like to thank everyone who has made his time at the University the wonderful (though long) journey it was. Hopefully, they know who they are.

Correction

The *Wisconsin Engineer* would like to apologize to Kate Jehring for her omission as Circulation Manager for the past two issues. She has done a fantastic job and we regret this mistake.

Just One More

People who work in the fields of science and technology are not like other people. This can be frustrating to the nontechnical people who have to deal with them. The secret to coping with technology-oriented people is to understand their motivations. This chapter will teach you everything you need to know. I learned their customs and mannerisms by observing them, much the way Jane Goodall learned about the great apes, but without the hassle of grooming. Engineering is so trendy these days that everybody wants to be one. The word "engineer" is greatly overused. If there's somebody in your life who you think is trying to pass as an engineer, give him this test to discern the truth.

ENGINEER IDENTIFICATION TEST

You walk into a room and notice that a picture is hanging crooked.
You...
A. Straighten it.
B. Ignore it.
C. Buy a CAD system and spend the next six months designing a solar-powered, self-adjusting picture frame while often stating aloud your belief that the inventor of the nail was a total moron.

The correct answer is "C" but partial credit can be given to anybody who writes, "It depends" in the margin of the test or simply blames the whole stupid thing on "Marketing."

FASCINATION WITH GADGETS

To the engineer, all matter in the universe can be placed into one of two categories: (1) things that need to be fixed, and (2) things that will need to be fixed after you've had a few minutes to play with them. Engineers like to solve problems. If there are no problems handily available, they will create their own problems. Normal people don't understand this concept; they believe that if it ain't broke, don't fix it. Engineers believe that if it ain't broke, it doesn't have enough features yet.

No engineer looks at a television remote control without wondering what it would take to turn it into a stun gun. No engineer can take a shower without wondering if some sort of Teflon coating would make showering unnecessary. To the engineer, the world is a toy box full of sub-optimized and feature-poor toys.

FASHION AND APPEARANCE

Clothes are the lowest priority for an engineer, assuming the basic thresholds for temperature and decency have been satisfied. If no appendages are freezing or sticking together, and if no [apply imagination here] are in plain view, then the objective of clothing has been met. Anything else is a waste.

LOVE OF "STAR TREK"

Engineers love all of the "Star Trek" television shows and movies. It's a small wonder, since the engineers on the starship Enterprise are portrayed as heroes, occasionally even [apply imagination here] with aliens. This is much more glamorous than the real life of an engineer, which consists of hiding from the universe and [apply imagination] without the participation of other life forms.

DATING AND SOCIAL LIFE

Dating is never easy for engineers. A normal person will employ various indirect and duplicitous methods to create a false impression of attractiveness. Engineers are incapable of placing appearance above function.

Fortunately, engineers have an ace in the hole. They are

JustOneMore

widely recognized as superior marriage material: intelligent, dependable, employed, honest and handy around the house. While it's true that many normal people would prefer not to date an engineer, most normal people harbor an intense desire to mate with them, thus producing engineer-like children who will have high-paying jobs.

Male engineers reach their peak of sexual attractiveness later than normal men, becoming irresistible erotic dynamos in their mid thirties to late forties. Just look at these examples of sexually irresistible men in technical professions: Bill Gates, MacGyver, Etc...

Female engineers become irresistible at the age of consent and remain that way until about thirty minutes after their clinical death. Longer if it's a warm day.

HONESTY
Engineers sometimes bend the truth to avoid work. They say things that sound like lies but technically are not because nobody could be expected to believe them. The complete list of engineer lies is listed below.

"I won't change anything without asking you first."
"I'll return your "hard-to-find" cable tomorrow."
"I have to have new equipment to do my job."
"I'm not jealous of your new computer."

FRUGALITY
Engineers are notoriously frugal. This is not because of cheapness or mean spirit; it is simply because every spending situation is simply a problem in optimization, that is, "How can I escape this situation while retaining the greatest amount of cash?"

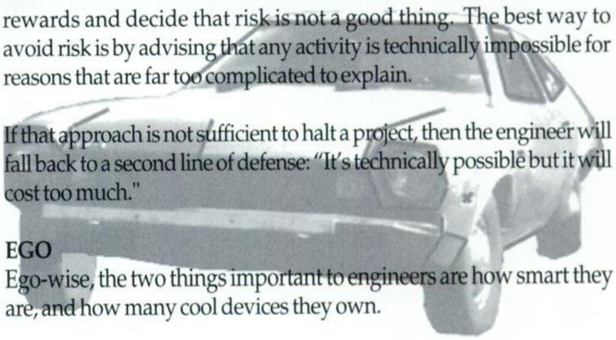
POWERS OF CONCENTRATION
If there is one trait that best defines an engineer it is the ability to concentrate on one subject to the complete exclusion of everything else in the environment. This sometimes causes engineers to be pronounced dead prematurely. Some funeral homes in high-tech areas have started checking resumes before processing the bodies. Anybody with a degree in electrical engineering or experience in computer programming is propped up in the lounge for a few days just to see if he or she snaps out of it.

RISK
Engineers hate risk. They try to eliminate it whenever they can. This is understandable, given that when an engineer makes one little mistake, the media will treat it like it's a big deal or something.

EXAMPLES OF BAD PRESS FOR ENGINEERS
Hindenberg, Space Shuttle Challenger, SPANet(tm), Hubble space telescope, Apollo 13, Titanic, Ford Pinto, and Corvair.

The risk/reward calculation for engineers looks something like this:
RISK: Public humiliation and the death of thousands of innocent people.
REWARD: A certificate of appreciation in a handsome plastic frame.

Being practical people, engineers evaluate this balance of risks and rewards and decide that risk is not a good thing. The best way to avoid risk is by advising that any activity is technically impossible for reasons that are far too complicated to explain.



If that approach is not sufficient to halt a project, then the engineer will fall back to a second line of defense: "It's technically possible but it will cost too much."

EGO
Ego-wise, the two things important to engineers are how smart they are, and how many cool devices they own.

The fastest way to get an engineer to solve a problem is to declare that the problem is unsolvable. No engineer can walk away from an unsolvable problem until it's solved. No illness or distraction is sufficient to get the engineer off the case. These types of challenges quickly become personal—a battle between the engineer and the laws of nature.

Engineers will go without food and hygiene for days to solve a problem. (Other times just because they forgot.) And when they succeed in solving the problem they will experience an ego rush that is better than sex.

Nothing is more threatening to the engineer than the suggestion that somebody has more technical skill. Normal people sometimes use that knowledge as a lever to extract more work from the engineer. When an engineer says that something can't be done (a code phrase that means it's not fun to do), some clever normal people have learned to glance at the engineer with a look of compassion and pity and say something along these lines: "I'll ask Bob to figure it out. He knows how to solve difficult technical problems."

At that point it is a good idea for the normal person to not stand between the engineer and the problem. The engineer will set upon the problem like a starved Chihuahua on a pork chop.

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PROJECT X