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wisconsin engineer

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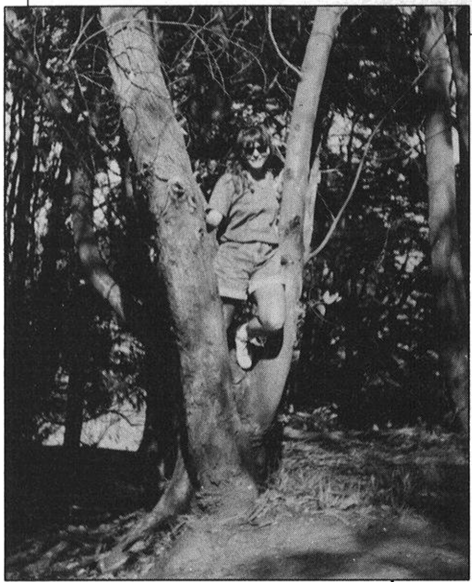
Editorial

Some Sage Advice



Amy Damrow
Wisconsin Engineer Co-editor

HI! WELCOME TO UW-MADI-son. For many of you, that should read, "Welcome back." I thought I would start your new and exciting school year off with a little friendly advice. Freshmen take note.

To make your four to six years at this fine institution worthwhile, I suggest getting involved in an extra-curricular activity or two. Working for the *Wisconsin Engineer* magazine is a great example of a rewarding release from your studies, especially for those of you concerned about maintaining the oh-so-rare-in-engineering ability to communicate in complete sentences. Professional societies like SWE and ASCE are great for brown-nosing with the big guys and padding your resume. Or, if you're looking for the inside scoop on COE happenings and free pizza every other Thursday night, check out Polygon, the engineering student council.

Regardless of which activities you pursue, there are many benefits to reap from the student organizations on campus. Obviously, these groups provide an excellent opportunity to meet others. Not only can you meet new friends, but you can bask in the infinite knowledge of upperclassmen. A not-so-obvious feature is the free food and BEvERages served at many organizational gatherings. Not to mention the perks like free travel. Most groups have regional or national conventions yearly, and the UW COE loves to be well-represented. So far I've cruised to New York, and jetted to southern California (twice last year), all expenses paid by the COE. I don't even really need to mention the hotel bathtubs filled with BEvERages on ice. I think you get the picture. The organization thing sounds like great fun, but if you overdo it, your four to six years here may quickly become ten.

Do not forget that first and foremost, you are here to learn. Be sure to get your money's worth from your professors and TAs. Don't be afraid to use their office hours or their home phone numbers. Get in a fair share of brown-nosing with each instructor, because it's a lot easier for them to give a good grade to a number that matches a name and a face.

Most importantly, study hard. Freshmen, this is not high school. (I hope you're all keeping track of the number of times you hear this. Someone just might give you a nickel for each). You cannot study effectively in your dorm or apartment. Go to a library. You have 30 or 40 to choose from, so choose a different one each day. If you run out of libraries, try vacant classrooms. (Usually open until 11pm and fair game as long as they're not occupied by a class.) Only three study spots on campus get my five-star rating: the 9th floor of Teacher Ed. Building (spectacular view), the Calvary Lutheran Church (located on the corner of Lake & State, open to the public), and the first floor of Wendt Library.

If you're sick of studying, relax and have a cold refreshing BEvERage. You deserve it. Becoming an engineer is not an easy feat. Nevertheless, stick with it—it will definitely be worth it in the long run$ I hope your experience at UW-Madisor will be as fulfilling as mine. I wish you all the best of luck, and may free-body diagrams be with you.

Finding your niche

Mary K. Rouse
Dean of Students

THE SIZE OF A UNIVERSITY is what you make of it.

There is nothing inherently wrong with a large campus, as some would have you believe. Instead, the size of our campus gives students the opportunity to choose what path they will take while at UW-Madison.

From the beginning of the UW-Madison experience to the end, our hope is that we can help students connect with one another and with the university.

The most crucial time to develop that connection is during the orientation process. That process takes place throughout the first year - from the moment you receive the Undergraduate Bulletin with the admissions application, as you read spring and fall issues of Home Address, as you as a newly admitted UW-Madison student participate in the Summer Orientation and Advising Registration, and as you begin to explore the university during Welcome Week. We devote many resources and a considerable amount of time to welcoming our incoming students. Our focus is always to connect new students with other students - both incoming and upperclass students - throughout the first year on campus.

Our goal is to help students find a niche, a place they can carve out on this campus and call home.

And in times of shrinking budgetary resources, one resource this campus will never lose is our human resources. With so many upperclass students to draw on, the UW-Madison culture is passed on from student to student, from class to class, from generation to generation.

We rely on the wealth of our students with our guidance and support rather than on direct tax dollars to form this connection and help make this university small. We depend on our students to transmit this culture and to teach.

In the classroom, this connection means teaching assistants who have gone through the undergraduate experience and know about the ups and downs of undergraduate life.

Outside the classroom, this connection means finding student organizations that enrich the college experience. Students pick from more than 600 student organizations in 14 different categories. Whether it's the Ultimate Frisbee Club, or the Society of Women Engineers, these groups provide the setting for students to contribute to their new community.

How do you find your niche here? During Welcome Week, more than 100 of these student groups participate in the Student Organization Fair making that first personal contact to let students know what they are all about.

Three years ago, we began a student mentor program, called Students Orienting Students to help students find that niche and define what the UW-Madison experience will mean for them. Through the program, new students living off campus are connected with upperclass students and form individual personal relationships. New students can draw upon the experience of upperclass students, who in turn, pass on their experience and knowledge of the UW-Madison culture. The SOS students receive training about university resources and programs as well as problem solving from senior student services staff prior to becoming mentors.

The response from the upperclass students has been extremely positive. Most are anxious to place themselves in the position of teachers, mentors and transmitters of knowledge.

By forming links between upperclass and new students, the connection is formed. And on an informal level, upperclass students can answer questions about classes, professors, apartment hunting or whatever concerns come up during the first year at UW-Madison.

I look forward to helping you make that connection.

Everything you ever wanted to know about **Airport Runways** (but were afraid to ask)

CAN YOU IMAGINE STARTING DETAILED planning on a project you will not be able to implement for ten years? Where will you do it? How will you do it? How long will it take? How much will it cost? These questions are the kind needed to begin planning the construction of a new runway at an existing airport. Contrary to what you may think, these procedures are necessary to add a single runway, not even close to building an entire airport. When designing and constructing a new runway, issues such as land acquisition, noise and safety must be considered.

Mitchell International Airport in Milwaukee, Wisconsin sees an average of 183 flights arrive and depart each day, making it the 47th busiest of the 309 airports with Federal Aviation Administration operated control towers. In 1989, the number of passengers was 2,132,000. Based on these figures and the current growth rate of air traffic at Mitchell Field, a new runway "is tentatively expected to be needed in about ten years," reports Jerry Sieling, Airport Development Engineer for the Wisconsin Department of Transportation. In addition to the new runway, the upgrade plan includes several options for expanding the terminal area.

The original master plan for upgrading Mitchell Field was developed in 1986. This plan, if accepted, will cost $87.4 million for land acquisition and $61.6 million for runway construction. The plan will require the purchase of 408 acres of land, affecting 2802 residential units. Various options for expanding the terminal range in cost from $120 million to $176 million, bringing the total estimated upgrade cost to over $300 million.

Of the several potential plans for the runway, the one that shows the most promise is a new runway that will span 7000 feet and run northeast to southwest, parallel to one of Mitchell Field's major existing runways. One advantage to having parallel runways is the capability for simultaneous operation of Instrument Flight Rules. Instrument Flight Rules are used when weather conditions are so bad that pilots must rely on their instruments to a greater degree than in good weather. There are various IFR categories corresponding to increasingly poor visibility. With simultaneous IFR operations, planes can be taking off on one runway and landing on another, thus increasing the capacity of the airfield.

Another benefit of parallel runways for northern airports concerns snowstorms. During a snowstorm, runways must be plowed frequently. With parallel runways, planes can use one runway while the other is being plowed. Then, planes can operate off the newly–plowed runway, and the plowing operations switch to the other runway. This trading off is done continuously so that planes always have a relatively clear runway for takeoffs and landings.

"The key objective [of building the new runway] is to provide capacity at the peak hour under instrument conditions," Sieling states.

The increase in air traffic at Mitchell Field is due largely to the greater use of hubbing over the last several years. Hubbing refers to the use of a particular airport by an airline as a sort of central meeting place for flights to and from all parts of the country, or even the world. Flights from several points of origin converge at one airport. The passengers then transfer from those planes to any of several other planes waiting to leave for various destinations. This procedure leads to peak periods and consequently, airport congestion. In addition to passenger traffic, the rapid increase in air cargo traffic also demands airport expan-

Airports at Sea

THE OTHER SIDE of the Pacific is seeing a boom in airport construction. In particular, Japan is constructing or enlarging many airports. The Japanese government plans to have airports capable of handling large jets at the capitals of every prefecture, the Japanese equivalent of a state.

While major construction is occurring at two Tokyo airports, Haneda and Narita International Airport, including new runways, terminals and transportation facilities, the construction of the Kansai Airport in Osaka makes these other projects seem insignificant. The most interesting aspect of the Kansai Airport is its location. The airport is not actually located in Osaka. Instead, it is three miles off shore in Osaka Bay on a 1,300 acre artificial island created in 60 feet of water. By comparison, the entire UW-Madison campus, including Picnic Point and Eagle Heights is 905 acres. In construction, 250 million cubic yards of fill were used for the island. Barges transported the fill from the mainland to the site and then dumped the material to build an island.

The project is definitely not without its flaws. In fact, there have been major problems with excessive soil settlement of the new island. To offset this loss of nearly ten feet, an additional 23 million cubic yards of fill were dumped at an extra cost of $4 billion.

This type of land creation does not come cheap. The bill for the Kansai Airport - one runway and terminal facilities - is $12 billion. An additional $12 billion is required for a highway and railway bridge to the mainland and for highways and expressways along the coast to serve the new airport. However, these costs are viewed as necessary since suitable land is quite scarce in Japan. When completed, the Kansai Airport will be a unique place. A flight from Kansai Airport will require a brief trip to sea first!

- By Joe Skidmore

sion. An expansion of approximately 200,000 square feet is projected for the cargo building area to accommodate this demand.

Before any of this expansion can begin, certain design considerations must be accounted for, with noise and safety being the most important. The noise level around an airport is measured as Day/Night Level. The DNL is arrived at by averaging noise levels over a one year period. "The uniqueness of that specific criterion is that it puts a nighttime penalty of ten decibels on any aircraft operations between ten at night and six or seven in the morning," explains Sieling. What this stipulation means is that at night, when a jet passing overhead would appear to sound louder due to a smaller amount of background noise, the permissible noise levels are lower. "The threshold level for residential areas is 65 DNL, and the 65 DNL contour at Mitchell is fairly large," comments Sieling.

Safety is another major issue in airport construction. Runways have to be at least 3,600 feet apart for simultaneous IFR operations, and there are also limits on how close planes can be in the airspace surrounding an airport. However, both of these limits have been shrinking with the development of faster, more accurate tracking radars used by control towers.

The issue of safety encompasses more than the locations of planes relative to one another, however. In order for planes to descend at the optimal slope of three degrees, there must be no tall antennas, buildings or power lines too close to the airport. Once a plan is adopted, the FAA will protect the relevant airspace, prohibiting the building of any new structures which might interfere with the flight path. If the plan is not adopted quickly enough and development does take place, then the airport must purchase the land or make arrangements with the owner to remove the hazard from the flight path.

Selection of building materials is another important factor in the overall design. The materials used to construct the runway will be essentially the same as those used in highway construction, either portland cement or asphalt. The main difference lies in the thickness of the paved surface. Typical highway pavement is nine or ten inches thick, while a runway at Mitchell Field is typically 17 inches of reinforced concrete over six inches of econocrete. This heavy duty pavement structure is to compensate for the much greater weight of large planes compared to general highway traffic of cars and trucks.

One important advantage to using asphalt is that an active runway can be resurfaced in segments. The work can take place during off–traffic hours, for instance, late at night. Then, when it approaches the time the runway will be needed again, the new work can be blended smoothly with the existing runway. Planes use the runway for the day, and then the work picks up where it left off during off-traffic hours.

The main disadvantage of asphalt when compared to portland cement is the problem of rutting. Since asphalt is much softer than portland cement, it tends to develop ruts where the aircraft wheels run during takeoff and landing. Nonetheless, there have been improvements made recently in the durability of asphaltic pavements that should ensure a longer–lasting runway.

Construction of the new runway will begin when air traffic has increased enough to require the expansion and will span at least two construction seasons. Current projections place the start date around the turn of the century. Construction of the terminal and other building additions will take one to two seasons. Add to this number the six years that have been spent so far on the planning of these upgrades and the total time spent on this project will be over 15 years. If expanding a terminal and adding a single runway takes this long, imagine how long it must take to design and construct an entire airport from the ground up.

AUTHOR

Jeff Verdegan has graduated with a degree in Electrical Engineering. He plans to be married soon. Good Luck Jeff!

Form Follows Function

ALTHOUGH ONLY A CURIOSity on the other side of campus for most upper class engineers, almost everyone has been in or simply gazed upon the Humanities Building with quizzical awe. We have all had that humanities elective that required walking the trek down to Park street. Everybody remembers wondering who could have designed such a confusing and odd structure. It certainly was not designed by an *engineer*, was it?

"It was designed for crowd control in the 60s; if the protesters ever became too rowdy, people could escape over the slanted walls."

"The Humanities Building was really supposed to face the lake. Part way through construction, the architect realized the builders had the plans turned 90 degrees."

When asked, students seemed to think there was some explanation to the strange appearance of the Humanities Building, but few students could agree on the reason.

"Progress was behind schedule, so half way through the project, the architect (what was his name?) went crazy, burning the plans and killing himself. The construction company tried to piece together what they could..."

"Someone told me the building was built upside-down."

"If the students ever tried to forcibly occupy the building, say in a campus war, they could easily be sectioned off and isolated by the University Police or the National Guard."

"The problem they had with the Humanities Building was funding. Part way through the project, they ran out of money and had to start eliminating whole floors."

"It must have been designed by a University committee."

There are dozens of stories that have evolved concerning the appearance of the "South Lower Campus Project" as it was called during design and construction. As one might expect, none of them are really true. Still, it is more fun to think that the architect cut off his ear in a Van Gogh-like expression of anger, frustration or a combination of the common hallucinogens of the day, than to think somebody actually designed it that way.

What is the real story?

Shaun Burke

Humanities southeast corner.

Was it really designed that way?

Imagine, if you will, a campus, not unlike our own. The time frame was early 1960s. The University had a booming student population of around 25,000 which, after a brief slump, was expected to grow and level off at the devastating number of 32,000. The campus had seen little improvement or expansion for 20 years. Buildings such as Van Vleck, Van Hise and even the Engineering Research Building, were but ideas in the collective head of the University. The war years had taken their economic toll on any "big" ideas.

The "University Powers" decided to liven the sluggish mood by undertaking several improvement and expansion projects, including a new home for the art/art history, music and history departments. The 1963 State Building Commission proposal outlined four buildings to be constructed between Park and Murray Streets on the lake side of University Avenue. These buildings, four skinny, short, skyscraper-like buildings, attached to one low, squat building, were to house offices and classrooms for those departments.

When searching for a person to design this project, an interesting fellow stepped into the picture. His name was Harry Weese, and he was an architect based in Chicago. After considering the proposal, he offered, instead, to design a single building. His vision involved a large, low building to visually match the weight of its neighbor across State Street, the already present State Historical Society Building. This section of State street is what we now call Library Mall.

Weese was given the project. His design, although a single building, would give identity to each of the three departments concerned. In his design, he took into account desires from the building committees of each department: the history department wanted big lecture halls; the music department wanted performance auditoria and the art department wanted outdoor decks for art shows, as well as a place to display the University's permanent collection. Weese's design included all of these requests.

The shape of a room is governed by what goes on in it

There is a simple answer to the question, "Was it really designed that way?" Yes. The structure, now called the Humanities Building, looks as it did on Harry Weese's original plans. Answering the question, "Why?" is almost as simple. Although not as common in the United States as England, there was a movement in architecture taking place during this time. It was called—and I did not make this up—the New Brutalism movement. The specifics of what this name really means are unnecessary for my purposes here. Let me just say that points of this style included exposure of the internal structure of the building such as exposed columns and construction grade materials, in addition to an affinity for simple materials - like concrete.

Weese, however, does not refer to his design in this way. He simply refers to it as "Functionalism," not unlike Frank Lloyd Wright's ideas, who according to Weese, was an early functionalist. In Weese's own words, "Form follows function... The shape of a room is governed by what goes on in it."

Standing out was not Weese's goal. He felt fortunate to be involved with such a large project. Actually, he aimed to blend his building in with the rest of the University. Consider these points: the overall height of the Humanities Building is within a few feet of the height of the State Historical Society Building; the exposed concrete is made of limestone from the same quarry as the grey limestone covering the State Historical Society Building; the light brown stones covering much of the building, as well as the Elvehjem Museum, are similar in color to the stonework of Bascom Hall. These points did not happen by chance.

To help in the design, Weese called on the services of George Izenour. Weese, in a slow and quiet voice, described Izenour as a brilliant designer, specializing in acoustics. Izenour aided in the design of many parts of the building, notably the shapes of the music halls. Between these two men, an innovative idea in building design took shape. The building is massive, as was pointed out earlier; yet, it is possible to look through the building to the sky above. There are large, open, common areas within the building, both indoors and out. How many engineering buildings have this much room for freedom of thought?

Perhaps Weese did not design the building with his eyes closed after all.

Of course, there are some design flaws. The walking areas atop other rooms of the building have proven to be quite a maintenance problem. The footbridges over Park Street and University Avenue are part of a system that was never completed. It was planned that Vilas Hall, Humanities' protégé, would have a fourth theater, as well as the final section of the foot bridge system across Johnson street, delivering students safely to the foot of Sellery Hall. Neither the third footbridge nor the fourth theater presently exist. There are other problems as well, most of which are as insignificant as the ones described.

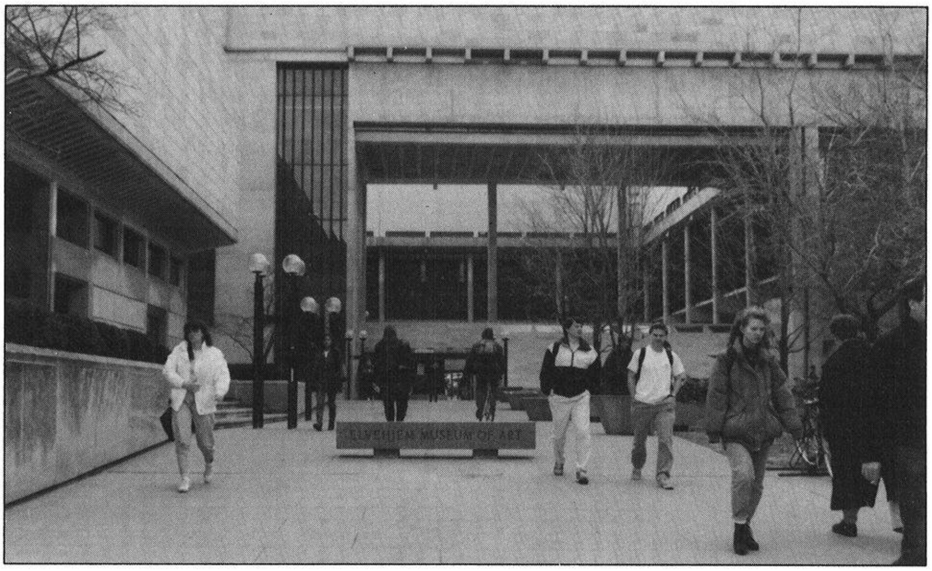
How many engineering buildings have this much room for freedom of thought?

If you are not convinced of the charm of the Humanities Building, I hope you can at least appreciate its unique and innovative design. For your information, you may want to consider other Weese designs: the Milwaukee Performing Arts Center, the Grand Rapids Convention and Entertainment Center and the Chicago Auditorium Theatre Restoration, to name a few.

Oh yes, and for those of you who have not figured it out yet, the architect is still alive, although retired now, and continues to own the Chicago firm, Harry Weese Associates.

AUTHOR

Paul A. Nylander, a senior in Physics, has a great fondness for riot-proof buildings designed by suicidal architects.



Shaun Burke

The inner mall of the Humanities Building.

UW–Madison's Living Room

THE IDEA OF A UNION WAS FIRST BROUGHT up in President Van Hise's inaugrual address in 1904. It was a radical idea, because only two other unions existed in the United States at the time. In 1925, the year construction began on the union, President Glenn Frank stated, "The Memorial Union building will give us a 'living room' that will convert the university from a 'house' of learning into a 'home' of learning." The Memorial Union has been just that since October 5, 1928 when it officially opened with ceremonies that lasted for three days. In 1938, construction on the theater began, and it formally opened on October 9, 1939 with the first showing of "The Taming of the Shrew" starring Alfred Lunt and Lynn Fontanne. In fact, The Architectural Record statedit as "probably the most complete community theater center to date." The Memorial Union underwent many other additions and facelifts, like the expansion of the dining wing in 1957 and the terrace in 1987. A second union, Union South, was built to help service the growing population of the university and opened in 1971. Both unions have been a social and diverse place for students. They have accomplished many achievements and a variety of firsts.

DID YOU KNOW THAT...

- The Memorial Union had the first university art gallery in 1928.
- The Memorial Union had the first college night club in 1932.
- The Memorial Union was the first union in the United States to serve beer in 1933.
- The Memorial Union helped the students during the Depression by providing meals for 24 cents.
- The Memorial Union has hosted well-known people and groups like Vladimir Horowitz, the New York Philharmonic, Eleanor Roosevelt, Bobby Kennedy, Martin Luther King, Jr., Betty Friedan, Louis Armstrong, John Kennedy and Jesse Jackson, just to name a few.
- The Memorial Union began intercollegiate games like billiards, bowling, and ping pong.
- The unions provide a day care center for students and faculty with children called "Bernie's Place."
- The Unions employ 1,800–2,200 students throughout the year.
- The Wisconsin Hoofers have the largest outing programs of any college with 2,800–3,000 members. Their sailing fleet is second only to the United States Navy in number of sailing vessels.
- Union South collected almost 4,300 pints of blood in 1988.
- The Unions handle over 23,000 room reservations a year.
- The Great Hall was once used as a dating parlor for men and women.
- The Rathskeller used to be a men's only meeting place until World War II when a female became president of the Union and helped open the Rathskeller to women.
- The Memorial Union was dedicated as a war memorial, and Union South was dedicated as a peace memorial.
- In 1984 Babcock chocolate chip ice cream was voted by *People Magazine* as the fifth in the country in flavor, and the recipe for the Union's famous fudge bottom pie was printed in *Madison Magazine*.
- During the 1986 football season, Union South's Badger Bash was the largest tailgate party on campus serving 1,400 pounds of brats, 700 gallons of beer and soda, and 60 gallons of ice cream to Badger fans.
- There are over 60,000 alumni, faculty and friends that are Union members.
- The Rathskeller was originally named the "Taproom" until the Union's interior designer, Leon Pesheret, saw the room and said, "Why this looks like a Rathskeller," (which means "the cellar of a German village hall, where the city fathers gathered after work for fellowship and refreshment.")
- The German greeting above the Rathskeller entrance says, "In cheerful spirit enter; leave your sorrows outside."

The Unions have a colorful history and continue to be a part of students' social and cultural lives. The unions, non-profit organizations, also offer a variety of other services such as photo developing and recyclable mugs among many others. The Memorial Union also houses the travel center and Interim Multicultural Center. The Information Center at Memorial Union has fascinating facts on the history of both unions.

In 1948 Time magazine summed up the Union's atmosphere stating, "It's almost impossible **not** to have a good time at Wisconsin." The statement still holds true today.

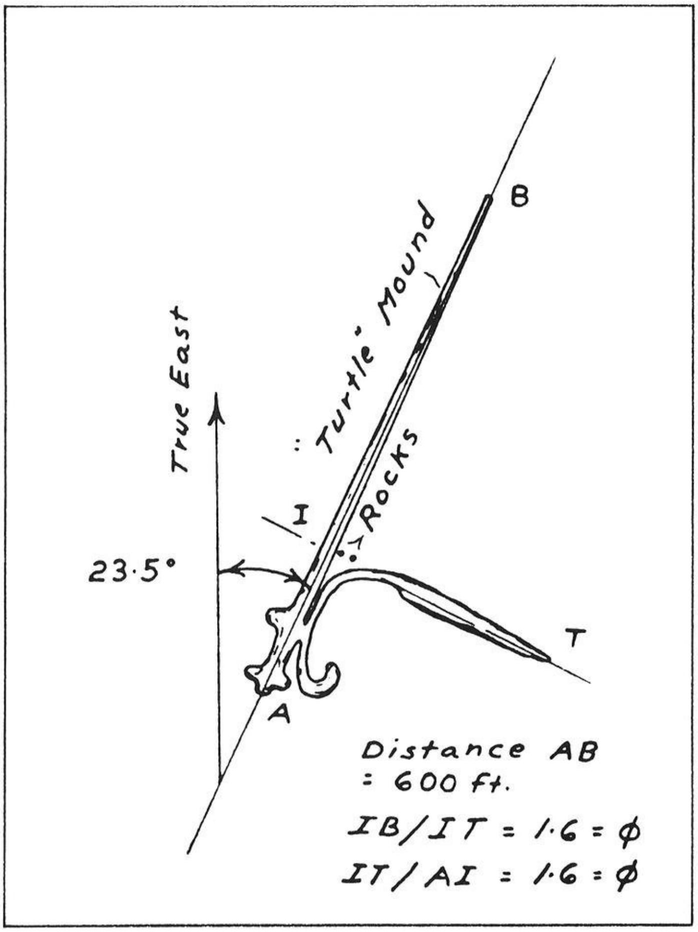
— Robyn Ryan

** All information courtesy of "The Wisconsin Union" brochure from the Memorial Union.*

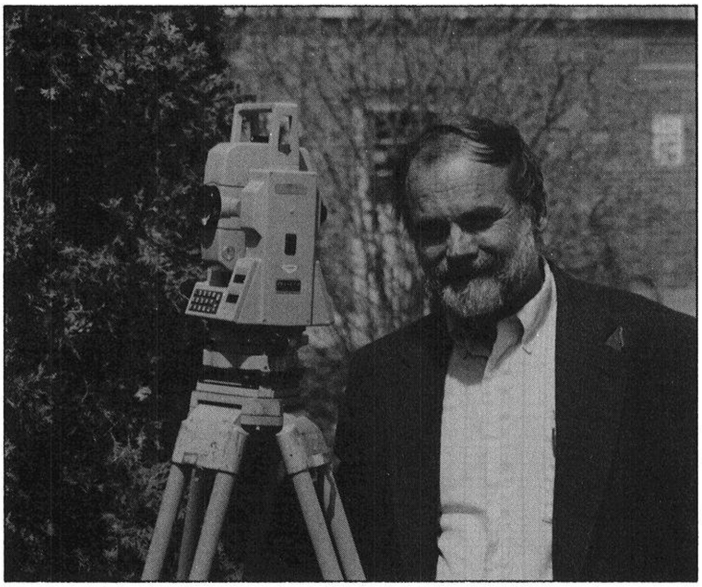
James Scherz

Engineering a Link with Ancient Indian Mounds or India Indians?

A QUICK GLANCE AROUND HIS OFFICE reveals a plethora of carefully organized maps stacked to the ceiling and many eye-catching relics from around the world, each adding character to the interesting Professor James P. Scherz. As a former engineering student of UW-Madison, Scherz earned his bachelor of science and master's degrees in civil engineering, specializing in surveying and geophysics. His research has involved extensive water quality tests in the lakes around Wisconsin, Michigan and Minnesota. He has also performed several geophysical surveys by airplane.



Long-tailed turtle mound and spiral at Aztalan.(Note Phi)
Courtesy of Professor James Scherz


Shaun Burke

Professor James Scherz is currently researching the civil engineering of ancient Indian mounds.

At UW-Madison, Scherz teaches basic surveying for non-engineers, photogrammetry, remote sensing and surveying. His students often practice surveying at the Arboretum, a nearby nature area of marshes, prairies and woods. In this setting, the students use their newly developed skills to map the environment. According to Scherz, the surveying students are also encouraged to utilize the College's computers "to the max." By using the Geographic Information System on the computers, all the surveyed information is tied together where it can be easily and accurately mapped.

Surveying on the ground is achieved with the help of lasers and reflectors. Electronic Distance Measurement uses time delay in a laser light to measure distances. If EDM equipment is not available, topography can be studied with the stadia method, using telescopes and rods. Aerial surveying is done with the use of photographs and is the most efficient way to survey; however, one must know the height and location of at least three points on the ground to use as a reference.

The surveyors collect the information for the maps and study the photos with a stereo-plotter. The stereo-plotter produces a three-dimensional image of the photo. The map-maker looks through the two eyepieces and sees a dot of light, which creates the illusion of being at different heights on the photo. The heights and distances are then plotted using GIS. The stereo-plotter is much like the old fashioned panoramic viewers which also created three-dimensional images.

For Scherz, the most exciting surveying involves the recent investigation of ancient Indian mounds. His current research focuses on this aspect of civil engineering. There are many sites being explored around Wisconsin. Most UW students have seen a few of the mounds on the Lakeshore Path, on Observatory Hill or at the Arboretum. Wisconsin has the largest collection of effigy mounds in the world, with Madison located in the center. Unfortunately, about 90 percent of the mounds were destroyed by developers in the years before legislation preserving the lands was enacted.

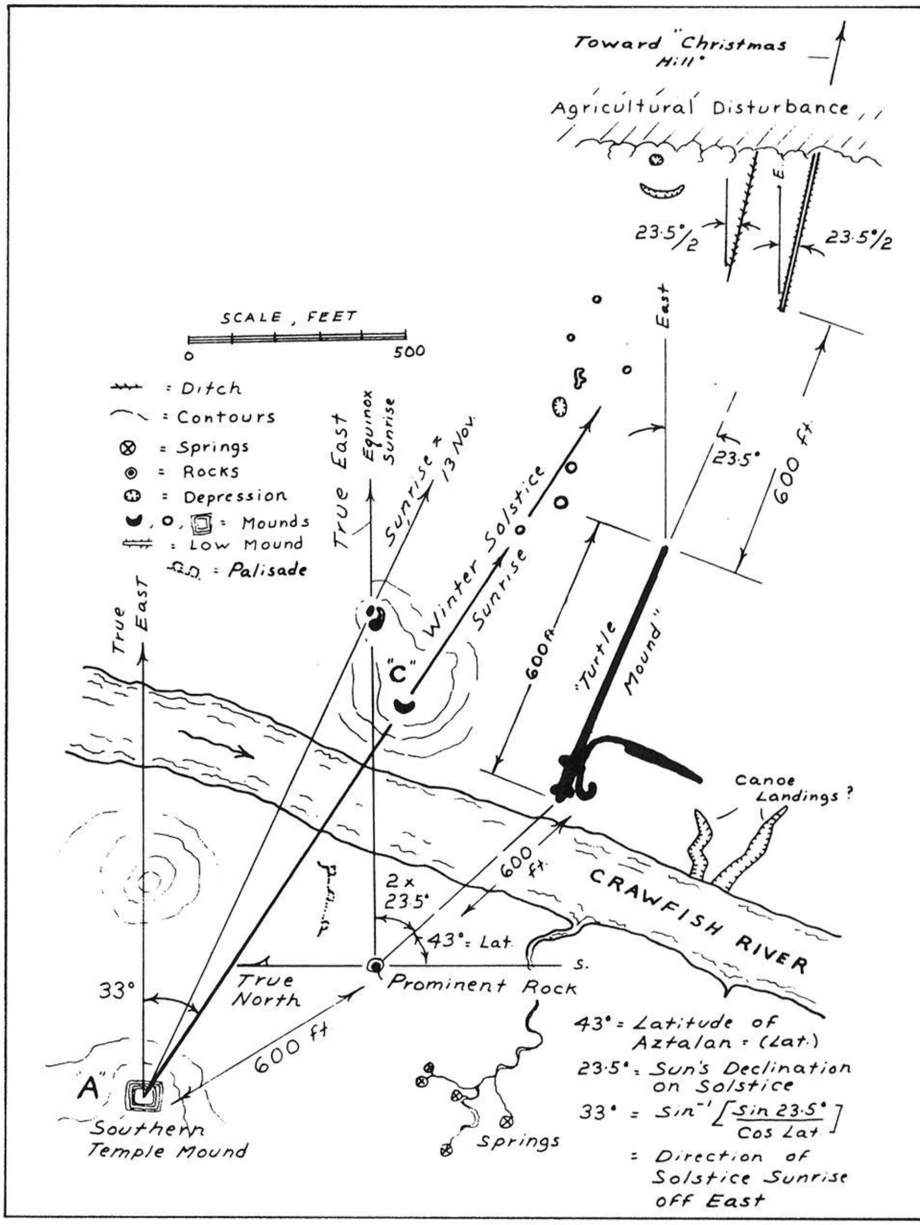
Surveyors study the placement of mounds by analyzing angles and distances, attempting to find evidence of prehistoric geometry. Study of the mounds has caused much public interest in the geometry and Indian legends. With the recent publicity and increased awareness, more and more mounds are reported and surveyed.

Most UW students have seen a few of the mounds on the Lakeshore Path, on Observatory Hill or at the Arboretum. Wisconsin has the largest collection of effigy mounds in the world, with Madison located in the center

In the late 1800s and early 1900s, surveyors mapped and sketched some of the mounds using compasses and chaining methods, which may produce errors in angle measurements of five degrees, values not sufficient for geometric analysis. However, by using modern methods, such as EDM, measurements can be accurate to 0.02 degrees.

A possible explanation for the large number of mounds in this area is that Wisconsin has many waterways connecting Lake Superior to the Mississippi River. These waterways were important for trading and transporting copper from the Lake Superior mines to Southern regions during the years 2000-1000 BC and 1000-1200 AD.

Analysis of the mounds' geometry shows that there were versions of mapping and surveying performed many years ago.



Crawfish River from Aztalan State Park in Southeastern Wisconsin.

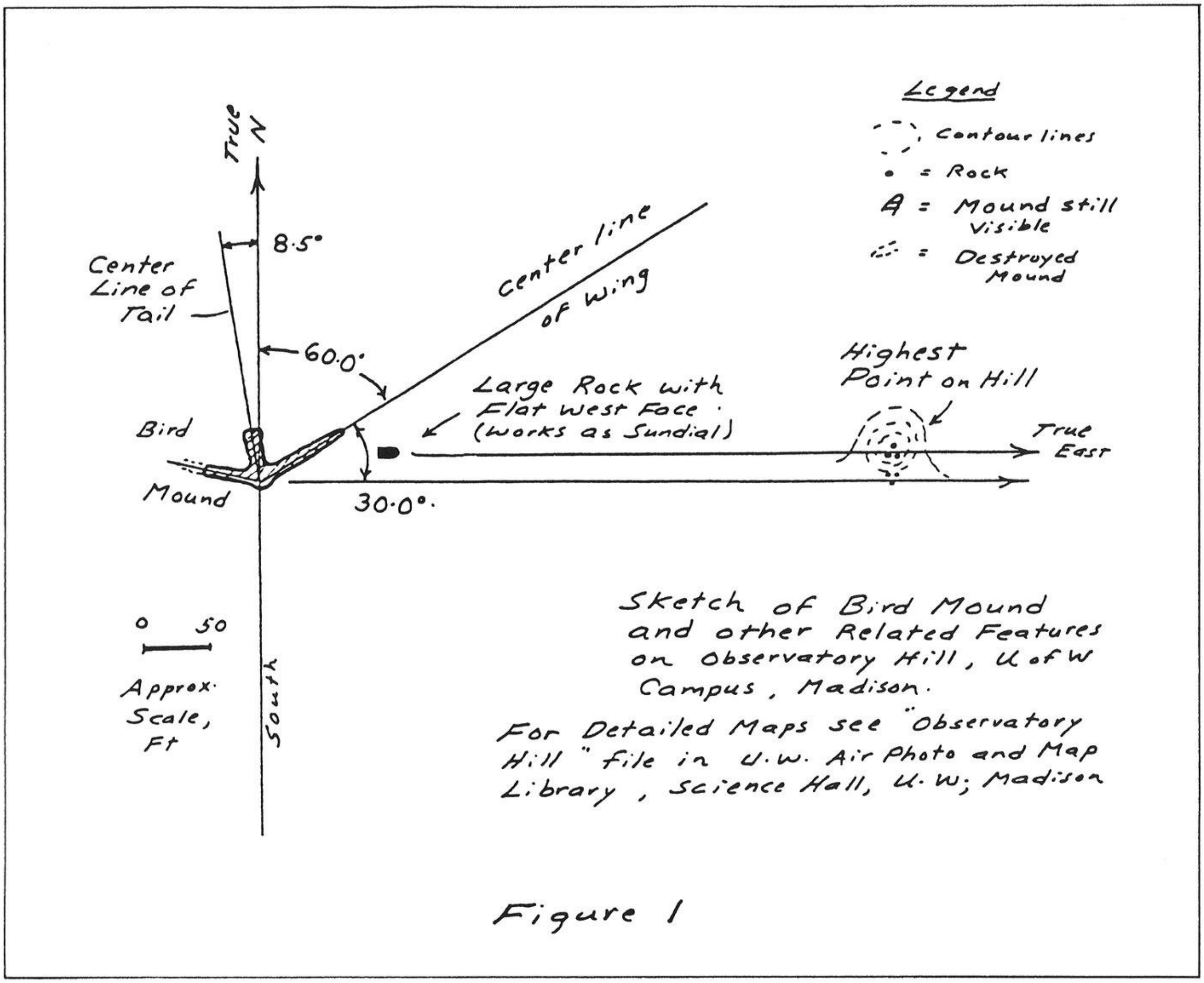
Courtesy of Professor James Scherz

After thorough investigation of the mounds, it is evident that many angles are commonly used in their construction. Sacred geometry, the highest geometry of the old world, prevails. The common angles are 30, 60, 90, 23.5, 51.5 and its complement, 38.5 degrees. The earth is tilted at an angle of 23.5 degrees to its orbital plane around the sun; therefore, 23.5 degrees is the maximum declination of the sun north or south of the equator on the solstices.

The angle, 51.5 degrees, is related to the golden section or divine proportion known as Phi. This ratio is found in human finger joints, three-by-five and five-by-eight library cards and music. The angles of 30, 60 and 90 degrees are related to the latitude of the mound site and the cardinal directions. Some well-known examples of this divine ratio are found in the Egyptian pyramids whose sides are aligned at angles of 51.5 degrees from the horizontal, at Stonehenge which has a latitude of 51.5 degrees or at the prehistoric Center of Cahokia on the Mississippi River near St. Louis, Missouri which also has the latitude of 51.5 degrees.

According to Scherz, "This complex geometry has no business in this part of the country."

Some of the mounds point to the sun's position on the shortest or longest



Geometry of bird mound on Observatory Hill. Graphic courtesy of Professor James Scherz

days of the year, while other mounds point toward the rising and setting moon. Therefore, the mounds can be used to set the solar calendar, having cycles of 365 days or the lunar calendar, having cycles of 18.6 years.

The base unit for the mounds is clearly 600 feet, an ancient Egyptian land measuring unit called the stade. A stade is one-tenth of a nautical mile. If the stade is divided into six units, each unit is equal to one second on the earth's surface. The mounds were constructed using multiples of 600 feet.

The most exciting Indian mound discovery involved ancient coins. This finding is the best evidence thus far in developing a link to India. People who study historical art discovered that the symbols engraved on coins found in Illinois and Wisconsin are very similar to the symbols on coins made in India during the same century, 88 AD to 194 AD. The coin evolution in India was easily matched with the coins of the same age found here in the Midwest. Scherz explains that with this discovery, many new questions arise. The primary question of the past, of course, is: did the people of India actually have contact with people on the other side of the world?

People who study historical art discovered that the symbols engraved on coins found in Illinois and Wisconsin are very similar to the symbols on coins made in India during the same century, 88 AD to 194 AD

Many journals and papers have been published by the Ancient Earthworks Society, an organization dedicated to mapping, studying and preserving Indian mounds and other related features. The complexity of the Indian mounds fascinates many people, whether their interests lie in geometry, legends, surveying or history.

AUTHOR

Amy Erickson is a third year ECE student. She is home in Stillwater, Minnesota this summer, tutoring kids in math and working.

AAAAAAArrrrrgggghhhh

STRESS

A Students' Guide to Stress Relief

THERE IS A VERY GOOD chance that at some point in your life the above phrase has at least crossed your mind, if not your lips. As a student, the primary cause of this outburst is stress in one form or another. However, as my own graduation nears, and the thought of entering the "real world" looms heavier and heavier in my mind, I find that stress is something that is not going to go away. I realize that if I do not find a good way to relieve this stress, I might end up in a nice padded room somewhere.

I have found in my experiences that stress comes in many different forms and intensities. Stress is that wonderful feeling I get when all my professors get together and decide that all my homework, tests and labs will be due, given, and written up in the same week. This time is usually the same week my roommates decide that it is "Practical Joke Week" and "Let the Cockroaches Clean the Dishes Week. "

To alleviate this stress, I would propose a healthful regime of eating right and getting proper sleep. You might also opt for recreation. If these oversimplified measures have no effect, more drastic measures may be the solution. To give you some examples of "drastic," I offer the following list:

- ✔ Jam tiny marshmallows up your nose and try to sneeze them out.
- ✔ Use your Mastercard to pay your Visa bill.
- ✔ Pop some popcorn without putting the lid on.
- ✔ When people say, "Have a nice day." tell them you have other plans.
- ✔ During your next class, sneeze and then loudly suck the phlegm back down your throat.
- ✔ Find out what a frog in a blender really looks like.
- ✔ Make a list of things you have already done.
- ✔ Dance naked in front of your pets.
- ✔ Put your toddler's clothes on backwards and send him off to preschool as if nothing was wrong.
- ✔ Thumb through National Geographic and draw underwear on the natives.
- ✔ Go shopping. Buy as many clothes as you can carry home. Sweat in them. Return them the next day.
- ✔ Drive to work in reverse.
- ✔ Read the dictionary backwards and look for subliminal messages.
- ✔ Start a nasty rumor and see if you recognize it when it gets back to you.
- ✔ Bill your doctor for the time you spent in his waiting room.

Well, that's all folks, everything that I did, or considered doing during my college career to help me cope with life's little surprises. I hope this definitive guide will help you find something to reduce the stress in your own life.

AUTHOR

This article was submitted by Roy Liang, a graduating ECE. Roy is a guest writer from the ECE 350 class.

BRIEFS ENGINEERING BRIEFS ENGINEERING BRIEFS ENGINEERING BRIEFS

Hey Engineers, Join POLYGON!

POLYGON?!...What's that?!... Well, POLYGON Engineering Council is the student council for the College of Engineering. POLYGON's central purpose is to serve as a liaison between the engineering student body and the College of Engineering administrators in order to address issues of concern to students. POLYGON also provides many services to students such as a sponsoring a career fair each fall, funding various activities for engineering student groups and awarding scholarships for outstanding leadership and academics. POLYGON is looking for enthusiastic individuals to fill five executive officer positions, Pre-Engineering Committee positions and departmental representative positions. If you are looking to develop leadership skills to prepare you for a successful career as an engineer and make friends with other highly-motivated individuals, join POLYGON today. There is NO MEMBERSHIP FEE, and the lessons you will learn will be as important as anything taught in the classroom. For more information, interested students are encouraged to call the POLYGON office at 265-2212.

Engineering Briefs

by Mike Waters

EXPO '93 *Challenging the Senses*

Engineering Exposition (EXPO) '93 has begun planning for the next biennial open house to the world of engineering and technology at the UW-Madison College of Engineering. The theme for EXPO '93 will be "Challenging the Senses," referring to how engineering can help replace, enhance or fool the five basic senses. The EXPO committee wishes to encourage all interested students and student groups interested in exhibiting to begin planning immediately to ensure completion as well as quality projects to compete for thousands of dollars in prize money. Individuals and groups needing financial assistance for their projects will have the opportunity to apply for monetary grants through the EXPO committee. The money for these grants will be provided by POLYGON Engineering Council and the College of Engineering. Students wishing to volunteer for EXPO '93 should keep their eyes open for posters publicizing informational meetings. The dates for EXPO '93 will be April 16-18. Questions can be directed to EXPO '93 Co-Chairs Tom Wiesen and Dave Aber at 262-5137 or via electronic mail to EXPO@caelab1.cae.wisc.edu.

ENGINEERING BRIEFS ENGINEERING BRIEFS ENGINEERING BRIEFS

UW Schooled in Total Quality Management

The University of Wisconsin-Madison was one of only eight universities nationwide chosen to participate in the Total Quality Management University Challenge. The project, supported by Motorola, Xerox, Milliken, IBM and Procter and Gamble, is an attempt to teach engineering and business faculty about quality management concepts to help them incorporate these principles into their curricula. Total Quality Management is an approach developed by an American, W. Edwards Deming, for use by Japanese corporations. In light of the success of the Japanese using this approach, many American businesses have become very interested in TQM. About 100 faculty and administrators from the UW-Madison College of Engineering and School of Business attended a workshop at Procter and Gamble headquarters in Cincinnati May 26-29.

College of Engineering Nears Top Ten

According to the latest *U.S. News and World Report* ranking of the top 25 graduate engineering programs in the U.S., the UW College of Engineering ranks 12th, up from its 1991 ranking of 14th. Gregory Moses, COE Associate Dean for Research, cited the College's outstanding young faculty and strong partnerships with industry as possible reasons for the increase in ranking. COE departments ranking in the top five in the nation included chemical engineering (fourth) and nuclear engineering and engineering physics (fifth). The rankings are based on factors including scholarly production, curriculum quality and faculty reputation. The rankings were made by department heads and directors of graduate studies at engineering schools granting five or more doctoral degrees between 1986 and 1990.

Engineers CAN WRITE!

Approximately 25 engineering students submitted papers in the first annual Steuber Prize for Excellence in Writing contest. The contest is exclusively for juniors and seniors in the UW College of Engineering and the top three entries took home $10,000 in prize money, awarded at the POLYGON Spring Banquet, April 12th. Those individuals were John Verberkmoes -1st place, $5000, Mark Payne - 2nd place, $3000, and Mark Plesac - 3rd place, $2000. The essays could be on any engineering-related subject. The only requirements were that the essays be approximately 2,500 words, typed, double-spaced, be the original work of the writer with no outside help, and one entry per person. Entries were judged on writing content and style, composition, organization and grammar. Want to get in on the winnings? Well, get started on your essay for next spring's contest!

ENGINEERING BRIEFS ENGINEERING BRIEFS ENGINEERING BRIEFS

Channel Tunnel Links England and France

The Eurotunnel will allow the transportation of goods and passengers that is not possible by sea.

FOR CENTURIES THE English Channel has been central to the identity of Great Britain. This body of water only 35 kilometers wide at its narrowest point has on many occasions served as a vital defense against Britain's enemies. However, the Channel is also a major barrier to trade and travel. London and Paris, with 11 million and 9.5 million residents respectively located only 350 km apart, have no fixed transportation link. Crossing the Channel, which has some of the roughest seas in the world due to strong conflicting currents, has always been a necessary 'evil' to reach the Continent.

With so many people separated by the narrow English Channel, some sort of fixed-link tunnel or bridge seems like a natural choice. The idea of a tunnel under the Channel is not a new one. In fact, the first plans for a fixed link between England and France were proposed by Albert Mathieu to Napolean Bonaparte in 1802. Sadly, his vision faded as relations between England and France were strained by Napolean Bonaparte's invasion of Malta.

Thirty-one years later another French Engineer, Thomé de Gammond, started his lifelong quest for a Channel tunnel. De Gammond has been called the "Father of the Channel Tunnel" because he was the first person to actually submit plans for a tunnel. In 1833, he began with a systematic study of the geology of the Channel and its coasts. The results convinced him that a tunnel was plausible. In 1834, de Gammond submitted the first of many proposals. It consisted of steel tubes laid along the bottom of the Channel. This proposal was quickly followed in 1836 by a plan for an iron bridge across the Channel, which was considered economically impossible. A year later, he considered an idea to build long piers out into the Channel, and then operate huge ferries across the narrowed Channel. This plan also failed.

De Gammond then turned his efforts towards a tunnel under the sea bed. In the spring of 1856, he was received personally by Napolean III, and he proposed a stone tunnel 34 km long and large enough for two tracks. The tunnel would have sloping entrances on each side to meet with the rail systems of both countries. Napolean promised his support and sent the plans on for further review. Finally, the tunnel seemed to be on its way toward reality. But again, Franco-British relations soured and the tunnel idea was tabled

De Gammond returned in 1867, this time with the help of William Low and James Bunlees, two British engineers. They proposed a system of two bored tunnels under the Channel connected by transverse passages. Each tunnel would carry one track, and the successive passage of trains would naturally ventilate the tunnel. In principle, this plan was remarkably similar to the current tunnel under construction.

De Gammond died in 1876, but Low continued the drive for a tunnel. In 1881, Low, with the financial assistance of Sir Edward Watkin, a wealthy railway owner, began construction of preliminary tunnels under the Channel from Dover. The French had begun tunnelling from their coast the year before. The Submarine Continental Railway Company was then formed. Stock options were sold, construction continued, and the tunnel grew longer. As the tunnel grew so did the opposition. There was considerable fear of the military implications of a fixed link to France. A British military commander, Sir Garnet Wolseley, spoke of the danger of a "road for the invader into England, along which no army we could, under any circumstances pass over to the Continent." Finally, on July 1, 1882, work was stopped on the tunnels after an order from the British government.

The push for a tunnel was resurrected early in the twentieth century. Now, elaborate defense measures were considered. These measures included a means of easily flooding the tunnel, strategically located entrances which could be easily defended and most interesting, the construction of short viaducts which took the railway over each coast of the Channel, before returning inland and plunging underground. These viaducts could easily be destroyed by the Royal Navy.

World War I, and to a greater extent, World War II, greatly changed Britain's view of its defense. The age of the airplane meant that Britain had lost it immunity from surprise attack. In 1949 yet another tunnel was proposed, a tunnel carrying two tracks on a lower level and a highway on the upper level. The automobile age was having an impact on the tunnel designs. This design, while creative and exciting, was declared unsound, with the greatest concern placed on the inability to effectively ventilate the tunnel.

The 60s and the 70s produced still further proposals for a fixed link. Bridges, highway tunnels, rail tunnel and all possible combinations were considered. In November 1984 Britain's Prime Minister Margaret Thatcher and France's President François Mitterand met at Rambouillet, France to reaffirm both countries commitment to a privately financed fixed Channel link. A request for proposals was issued and in 1986 Eurotunnel was granted a 55 year concession to build and operate a tunnel. In 1987, Eurotunnel received £6 billion package of equity and loan finance, and construction began. The Eurotunnel concept, which many people considered to be the most boring of those suggested in 1986 is actually becoming one of the most advanced transportation systems in the world.

A detailed study of the Channel geology revealed that contiguous bands of chalk stretch from coast to coast. Directly beneath the sea bed, there is a layer of very permeable white chalk which allows water to seep through. This same layer continues up to the famous white cliffs of Dover. Under this layer is a band of impermeable grey chalk marl, which is a deposit of clay and calcium. This layer is an excellent material to tunnel through since it allows little water seepage, yet is easily drilled. this layer is where the current tunnel is being constructed.

> **For the first time since the last Ice Age 10,000 years ago, Britain was no longer an "island"**

The Eurotunnel consists of three parallel tubes. Two large tubes will carry one railway track each, called running tunnels. The third, smaller tube, will be used as a service tunnel. This service tunnel was the first to be constructed. To build this tube, as well as the larger tubes, large Tunnel Boring Machines were employed. These machines, resembling large drills, cut through the chalk and deposit the spoil onto a train for removal. They then immediately install a lining to ensure that the tunnels are structurally sound.

TBMs operated from two shafts. One shaft was located in Britain at Shakespeare Cliff, and the other was in France at Sangatte. At the bottom of each shaft, the TBMs progressed in two directions, landward to the tunnel entrances and undersea towards a meeting point under the Channel. At 11:12 am on December 1, 1990 the two tunnels met. The event was greeted with much celebration. For the first time since the last Ice Age 10,000 years ago, Britain was no longer an "island." Television cameras carried the event live in both countries.

With the service tunnel complete, work continued on the two running tunnels. Both of these were completed by May of 1991. In addition to the three basic tunnels, numerous other excavations were required. Every 375 meters Cross Passages connect all three tunnels, and every 250 m piston relief ducts connect the running tunnels. These relief ducts are needed to relieve the excessive pressure in front of an approaching train and to fill the partial vacuum of a train which has just passed. The most interesting excavations are the two crossover caverns constructed along the tunnel. They are large caverns where the two running tunnels come together, in order to allow a crossover between the two tracks. This link will allow different sections of track to be closed for maintenance when needed, while still keeping the tunnel open.

While actually digging the holes was by far the largest single task, the job of turning them into an efficient transportation system is also quite complex. One major concern is ventilation. Even though the train will be electric powered and produce no air pollution, the high humidity of the tunnel air requires that the air in the tunnel be renewed often. This ventilation will be accomplished using large fans at the top of the two shafts. Air will be pumped down into the service tunnel. From there it will leak into the running tunnels. The direction and volume of air flow can be changed in emergency situations.

Another major undertaking is providing all the power needed for the tunnel. Electricity is needed for many things including: ventilation, lighting, pumps, cooling and most importantly, traction to power the trains. Power is supplied from the national grids of both countries at 400 kilovolts. This duo-source setup will ensure that in the event that power is completely lost on one national grid, there is still a supply of electricity to the tunnel.

With an average power input of 50 Megawatts within the confines of the tunnel it quickly becomes clear that large amounts of heat will be generated. Without some sort of cooling system, the tunnel would heat up to above 25 degrees Celsius within a few months of opening. To solve this problem, the tunnels will be cooled by running pipes filled with partially frozen water through them. Large refrigeration plants at the top of each shaft will cool the water to a slushy ice and then pump it through the tunnel. Since the melting of the ice will absorb more latent heat, more cooling can be achieved for a given volume of water. The tunnels are also equipped with drainage pumps to remove any water that may leak into the tunnel. These pumps will send water back to each coast for treatment and release.

Outside of the tunnels themselves, massive terminal facilities are being constructed. These facilities, located at Cheriton, England, and Coquelles, France will serve as loading and unloading points for an automobile and truck shuttle service which will run through the tunnel. They will also include maintenance and administrative facilities.

Three basic types of trains will travel through the tunnel. First, freight trains will carry goods to and from various British and European terminals. Also, passenger trains will use the tunnel. High speed service to London is already being planned and trains are being built. The trains will travel through the tunnel at 160 kilometers per hour. These trains, as well as the freight trains, will travel directly into the tunnel from the British Rail Network and the French National Railways. All trains will be required to have twice the power needed to get out of the tunnel. This is a precaution in the event one engine fails, the remaining one could take the train to safety.

The most interesting trains to use the tunnel will be the vehicle shuttles. These shuttles will travel only between the two terminals. There will be separate shuttles for trucks, automobiles and buses, and the entire system is designed to be quick and convenient. A vehicle will simply drive up to the terminal, pay the toll, clear customs which may soon be obsolete with the European Community Unification in progress, and drive onto a shuttle for the 35 minute trip under the Channel. There are numerous loading tracks and platforms, so shuttles will be continuously loading. Sensors are also being placed on the Motorways leading to the tunnel so that increases in traffic can be determined as much as an hour early and extra shuttles can be prepared.

Almost 500 trains per day are expected to use the tunnel from the start

All three types of rail traffic - freight, passenger and shuttle - must be integrated together to flow through the tunnel as smoothly as possible. Almost 500 trains per day are expected to use the tunnel from the start. The ultimate design capacity is over twice that value, and allows 30 trains per hour to pass through the tunnel - *in each direction.* That's a train, traveling over 120 km/h, passing through each tunnel every two minutes. All trains in the tunnel will have automatic control of speed and braking, and communication links in the tunnel ensure total contact between the trains and the control center.

With trains carrying hundreds of automobiles, all of which have tanks of gasoline, the risk of fire must be seriously considered. The shuttle trains are constructed of fireproof material, and also have built-in halon fire extinguishers. The halon extinguishers in conjunction with fire doors throughout the train should contain a vehicle fire until the train reaches the portal, where it would be directed onto an emergency fire siding to meet fire fighting equipment. Should a fire spread to the tunnel itself, it would be fought with water from any one of three fire mains running through the tunnel. The ventilation and door system would also be set to isolate and expel the smoke. If an evacuation were somehow required, people would be directed to the service tunnel, which would be free of smoke and danger. With all these precautions, Eurotunnel hopes to prevent any possible fire, but will also be ready should one occur.

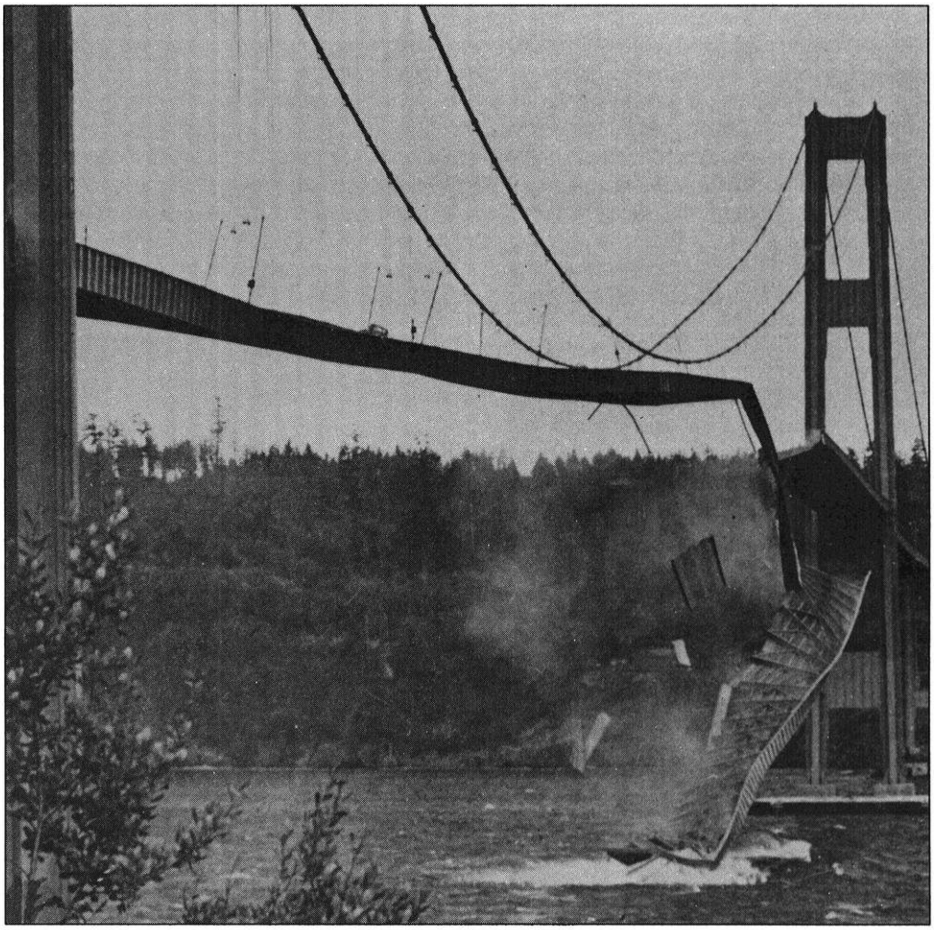
Currently, the tunnels are being fitted with all their internal systems and the terminals are being finished for an opening in late summer of 1994. In less than one year the extraordinary - a journey *under* the English Channel - will become commonplace. Eventually, as many as 20,000 people will be in the tunnel at the same time. The rail and highway networks of Britain and the Continent will be effectively linked, and the dream of a Channel Tunnel will be complete.

AUTHOR

Joe Skidmore is a senior in Civil and Environmental Engineering. Joe spent the summer in Madison working for the DNR. He specialized in Water Resource Management.

Bridging the Gap

The Tacoma Narrows bridge in its final moments



Farquharson, Neg. no. 12, Special Collections Div., Univ. of Wash. Libraries

THE TACOMA NARROWS bridge celebrated its grand opening on July 1, 1940. This mile long span of concrete and steel bridged Washington with its Olympic Peninsula over Puget Sound. Immediately upon its opening, this very light and thin suspension bridge became notorious for its extreme flexibility and response to the forces of the winds that breezed through the Narrows daily. Soon dubbed "Galloping Gertie," the bridge became a popular attraction for thrillseekers who came to ride the waves which rose as the bridge oscillated vertically from even the slightest breeze. A routine ride home from work became an adventure for many. It was said that even in winds of only a few miles per hour, the center span would rise and fall as much as three to four feet. On November 7, 1940, the wind picked up. A large storm system sent gale force winds of up to 40 miles per hour howling through the Narrows. After only a few minutes in the relentless wind, the bridge's familiar up-and-down oscillation turned into a fierce twisting motion. Aerodynamicist Theodore von Karman described the bridge's action in the wind as a "writhing corkscrew motion," with the deck tilting "from side to side as much as 45 degrees from the horizontal." Forty-five minutes after the twisting motion began, a 600-foot section of the center span of the four-month old bridge broke free and crashed to its death in Puget Sound below.

The failure of the Tacoma Narrows bridge shocked the nation and caused unnecessary, yet inevitable fear and distrust of suspension bridges worldwide. The failure also caused a rift between scientists with different philosophies about why Galloping Gertie collapsed. This half century-old disagreement not only encompasses bickering among mathematicians, physicists and engineers, but it also entails arguments over discrepancies in undergraduate textbook explanations of the failure. The Tacoma Narrows bridge failure has been the focus of controversy for the last half-century, and an agreement on the how and why of the collapse still has not been reached. In order to improve suspension bridge design, restore public confidence in engineering structures and educate America's students correctly about the effect of wind on structures, these scientists, mathematicians and engineers must work together to come up with a viable and uniform explanation.

Presently, the major difference of opinion in "the great bridge controversy" exists between mathematicians and civil engineers. The current state of techno-warfare was waged by mathematician Joseph McKenna of the University of Connecticut at Storrs and colleagues W. Walter of Germany and A.C. Lazer of the University of Miami in Florida. McKenna claims that civil engineering graduates do not have sufficient backgrounds to fully understand the complicated mathematics behind the action of suspension bridges. He and his colleagues published their theory about the vibration of suspension bridges after studying equations and computer models of simple oscillating systems, never actually studying the physical system of a bridge. They claim that suspension bridges do not always behave in the manner in which they are designed to behave and that with the correct forces acting upon them, these bridges can instantaneously collapse or self destruct.

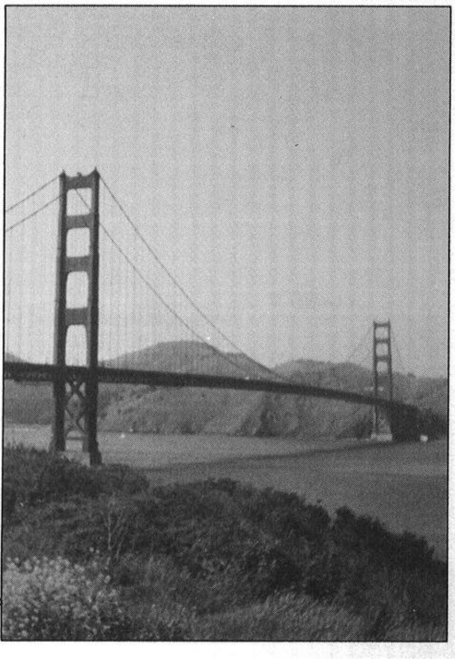
According to Robert H. Scanlan, professor of civil engineering at Johns Hopkins University and world-renowned wind engineering expert, the great bridge controversy is a big hoax. He claims that engineers have known about the behavior of suspension bridges for years and that the only great controversy is "imagined in McKenna's mind," or perhaps in the minds of authors who have sensationalized this battle of intellect. Scanlan's opinion is that "mathematicians can do math," but he objects to the transfer of that math to bridges without a transfer through dynamics and mechanics.

The Tacoma Narrow bridge failure has been the focus of controversy for the last half-century, and an agreement on the how and why of the collapse still has not been reached

McKenna's purely mathematical explanation of the Tacoma Narrows disaster is based on the occurrence of a single large upward thrust of the bridge by a gust of wind, which in slackening the bridges cables sent it into a state of nonlinear oscillation that intensified and eventually destroyed the bridge. However, for this theory to uphold, the cables supporting the tons of roadway would have had to slacken almost instantaneously upon impact of this great force. According to Scanlan, this phenomenon "doesn't happen." He grants that intense studies have shown a bridge cable or two to lose a little tension but never more than 20 percent of its original tension. In order for a cable to go slack, it would have to lose 100 percent of its initial tension. He elaborates: "If you were to fasten the top end of a cable to a brick ceiling and push up on the cable until it lost all of its tension - then it would be slack." However in the case of a suspension bridge, there is no brick ceiling. The main or "hanger" cable moves with any change in load. This point has been known for ages and is evident in the differential equations of suspension bridges.

McKenna's twisted theory would have been harmless had he not taken it to the public before conferring with other experts in the field or discussing his ideas in professional journals. In the summer of 1990, McKenna caused pandemonium

The Golden Gate Bridge Gets a Facelift


Amy Damrow

The 54-year-old Golden Gate Bridge recently underwent its first physical. Examiners Mark A. Ketchum and Al Heldermon, Senior Bridge Engineer and Project Engineer, respectively, with TY Lin International in San Francisco completed an intense and very detailed study of the bridge in the summer of 1991.

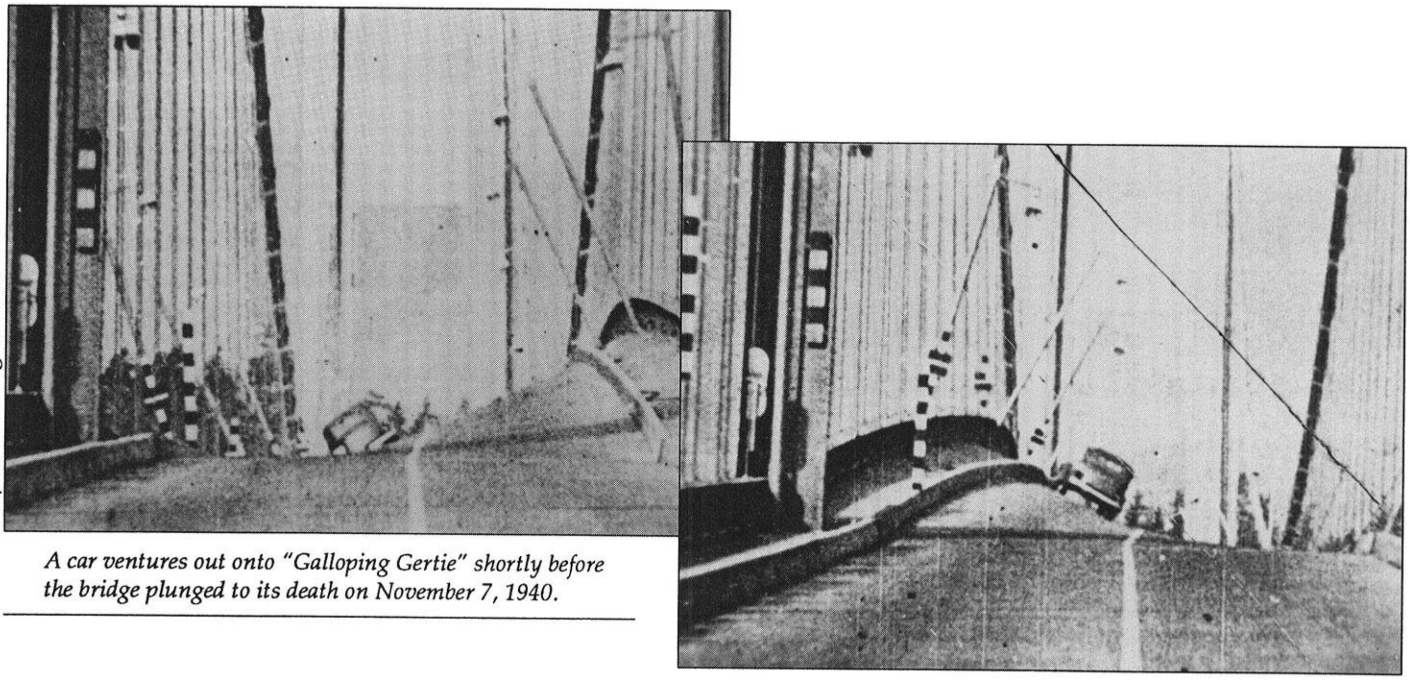
The main goal of the investigation ordered by the Golden Gate Bridge, Highway and Transportation District, was to establish the feasibility of adding a lower-level rapid transit deck to carry two Bay Area Rapid Transit trains over the Bay. The two trains would fit snugly inside the 25 feet deep stiffening trusses which already exist below the bridge's deck.

According to Ketchum, who discussed his detailed analysis in *Civil Engineering* magazine last summer, the studies included static and dynamic response evaluations using computer and scale models under dead load, highway and pedestrian load, transit load, temperature change, wind and seismic loads.

Ketchum claims that he was especially intrigued by a "worst case" example: "Two fully loaded BART trains pass each other at 50 miles per hour on the three-quarter point on the main span. The span rises 17 inches, then descends 63 inches." He states that "while the train and deck can handle such deflections, motorists might be alarmed by a five foot traveling wave moving along the bridge over a 30 second interval."

After complete analysis of the bridge under many conditions, the researchers found that with numerous structural modifications to the bridge, the BART plan is feasible. Plans to correct the Golden Gate's wind and seismic shortcomings are underway.

— *Amy R. Damrow*



Farquharson, Neg. no. 14D and 14E

A car ventures out onto "Galloping Gertie" shortly before the bridge plunged to its death on November 7, 1940.

in the city of San Francisco, home of two famous suspension bridges. A front page article in the *San Francisco Examiner* on June 7th informed Bay-area residents that either the Bay Bridge or the Golden Gate Bridge could perhaps crash into the Bay on their way home from work that very day. Scanlan and his colleagues, who had published their own theory about Tacoma's failure earlier that year, condemned McKenna's lack of professionalism in going straight to the public. Scanlan says that McKenna is "off his trolley."

At the present time, Scanlan's theory is the scientifically accepted explanation of this disaster. The Tacoma Narrows bridge did not collapse due to simple resonance, according to Scanlan and civil engineering professor K. Yusuf Billah of Princeton University in their February 1991 article in the *American Journal of Physics*. In studying equations and scale models and in running wind tunnel experiments, they found many factors which contributed to the Tacoma failure, and termed the cause of the failure "single-degree-of-freedom torsional flutter." Scanlan explains that "Mostly, bridges will vibrate in one or two vibration modes." He states that in watching the bridge's motion, one can tell that it was moving in one mode, and twisting in a torsional mode. "When it goes into that one mode, that is its single degree of freedom," claims Scanlan.

That explanation takes care of the "single-degree-of-freedom" and "torsional" parts of the definition, but what about the "flutter" element? Scanlan explains that it comes from the "flutter derivative," which is simply a way of packaging the mathematical form that explains the basic aerodynamic mechanisms involved, such as the negative damping that occurred in the vibration of the bridge. These mathematical forms help to fully understand the overall mechanisms of suspension bridges. The same methods are used on modern bridges.

Scanlan and Billah also voiced their disappointment at the explanation undergraduates are given about the Tacoma Narrows failure. In a recent study they found that nearly all undergraduate physics and mathematics texts blamed the failure on a case of simple resonance. This oversimplification is very misleading and very detrimental to education on the subject. They state in their paper to the *American Journal of Physics* that "because it lodges itself so easily in the memory, it is doubly important for educators to draw the correct lessons from this classic and sensational event." They suggest that given the more sophisticated understanding of today's students, it is time to "offer the next generation of students subtler, more complex and *correct* explanations."

It is time to bridge the gap between the various areas of technical expertise and science education. Making all the pieces of the puzzle fit to form the big picture — that is what it is all about. It is about working together, coordinating education in a timely manner, coordinating research efforts and most importantly, keeping an open channel of communication. No one person will ever know all there is to know about our world, but working together makes it much easier to put all the pieces of this great puzzle into place.

AUTHOR

Amy Damrow is a civil engineering student working for the Wisconsin Department of Transportation. She has been an editor of the *Wisconsin Engineer* for several years.

Society Spotlight:

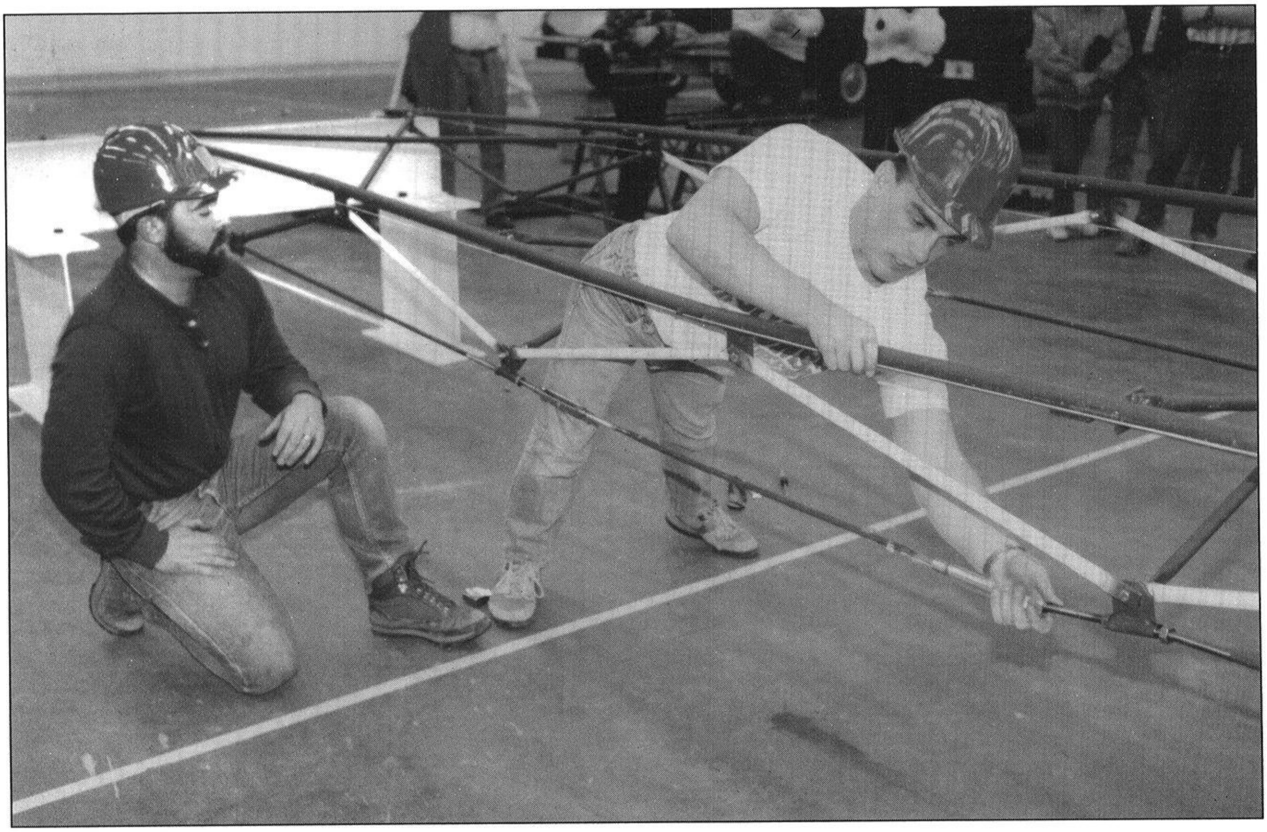
American Society of Civil Engineers

THERE ARE CROOKED lawyers and dishonest politicians, but there will always be civil engineers. But where might you find these civil engineers? They might be at the steel bridge contest held at the Dane County Forum sporting a T-shirt with this slogan on it. With incredible dexterity and speed, teams of civil engineering students from five different schools competed for the regional title of this year's bridge building contest. The Madison chapter of the American Society of Civil Engineers organized this competition as part of the 1992 ASCE Great Lakes Conference. The conference included the two major aspects that ASCE represents: a quality social life as well as outside classroom experience.

Offering a mentor program and periodical meetings with lectures on civil engineering, ASCE provides an excellent opportunity to learn outside of the engineering curriculum. Realizing that the first year of college can be confusing, ASCE offers a mentor program to provide guidance for freshmen. In the mentor program, freshman are paired with seniors who share experiences about classes and professors. ASCE members can listen to the advice given by guest speakers throughout the year. Guest lecturers are brought in from the university as well as from industry. As an example, ASCE recently featured a debate on the lakeshore parks referendum.

A variety of social events supplement many of ASCE's learning events. For those interested, an occasional happy hour supplements the lectures. Additional social events are held throughout the year including cookouts and end-of-semester parties. The jump from 30 to 80 members is proof of a succesful balance of social and academic activities.

The conference is a prime example of the experiences offered by ASCE. There was a plant trip to Zalk Josephs



Jay Salvo

A common scene at the ASCE Bridge contest.

Fabrications, the supplier of the steel used in the competition. There were technical sessions ranging from "Facility planning for the Milwaukee In-Line Sewer Project" to "Integrated Hydraulic Network Analysis using AutoCAD." The experiences gained from the conference were varied, yet all participants had the opportunity to learn as well as to socialize. Jim Tinjum, ASCE president, made sure there were social events throughout the weekend. "We like to stress the social part of ASCE," says Tinjum. With a hardy laugh, Neil Glaser, one of Wisconsin's bridge designers, agreed.

The conference began with a social hour at the Inn on the Park turning into a dance with live music. A dinner banquet was held on Friday. The conference kept people interested and offered something for everyone.

In addition to the steel bridge contest and annual conference, ASCE features an annual concrete canoe race. This event involves making and racing a canoe out of concrete. This year, Madison's ASCE chapter designed its own concrete for the canoe which is lighter than last year's model. The regional competition was held at Tri-State University this spring.

ASCE is an organization dedicated to helping civil engineering students throughout their college career. If you are a civil engineering major, you are qualified to join ASCE. For those interested, contact Jim Tinjum or stop by the ASCE office at B239 Engineering building.

AUTHOR

Jim Webb will be a sophomore Mechanical Engineer this Fall. He spent his summer in Madison working and attending summer school.

Bridge Contest

The steel bridge contest was the main event of the 1992 Great Lakes Conference, "Bridging the Gap to the Environment." The categories of the competition included:

1. Fastest bridge construction
2. Lightest bridge
3. Highest capacity
4. Best capacity-to-weight ratio
5. Lowest cost bridge
6. Aesthetics

Wisconsin won the best overall aesthetics. Out of the nine schools that came to the conference, five participated in the competition: University of Wisconsin-Madison, Marquette, University of Minnesota, Purdue and University of Illinois-Champaign.

Can Highbrow Engineers Somehow Understand More Mental Exercise? Relentless Laboratory Activity Becomes Sorely Tedious. Is New Knowledge Superfluous?

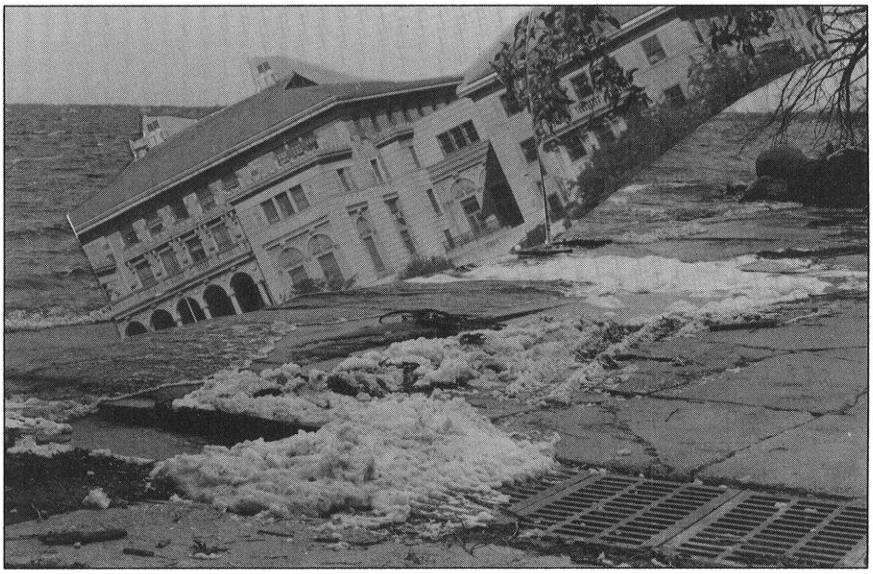
Freak Earthquake Sucks Memorial Union Into Lake Mendota

(Madison, WI) - In a freak of nature, Memorial Union was sucked into Lake Mendota late Sunday night injuring 3.14 people, killing 666 fish, and denting Chancellor Shalala's Suzucki Sammyrai. Experts believe the unforseen cataclysm was caused by an earthquake registering 13 on the Richter Scale. The causes of the earthquake are yet unknown.

Justin Fordagrade, a UW student, was in Memorial Union when it was being swallowed into the earth. "I didn't know what the [heck] was going on. It was like slimy stuff was drippin' down the walls and people were screamin' an' stuff. It was like *Ghostbusters 2*, only better."

According to the University Police, all of the people trapped inside escaped through the WSA office window.

Several university Geology, Geological Engineering, and Civil Engineering professors believe the earthquake was caused by shifting of plates along the Langdon Street Faultline. According to Civil Engineering professor Fyshin Ford Tenure, the plates shifted approximately 2.718281828° from their normal axis, and will continue shifting for the next 6.02 x 10E23 years.



The Wisconsin Engineer's most recent photo of Memorial Union.

However, not all believe it was caused by the faultline. Dontee Kracmup, a Political Science Professor, stated, "There is no doubt in my mind that the earthquake is the earth's reaction to the recent advent of Ross Perot into the presidential race."

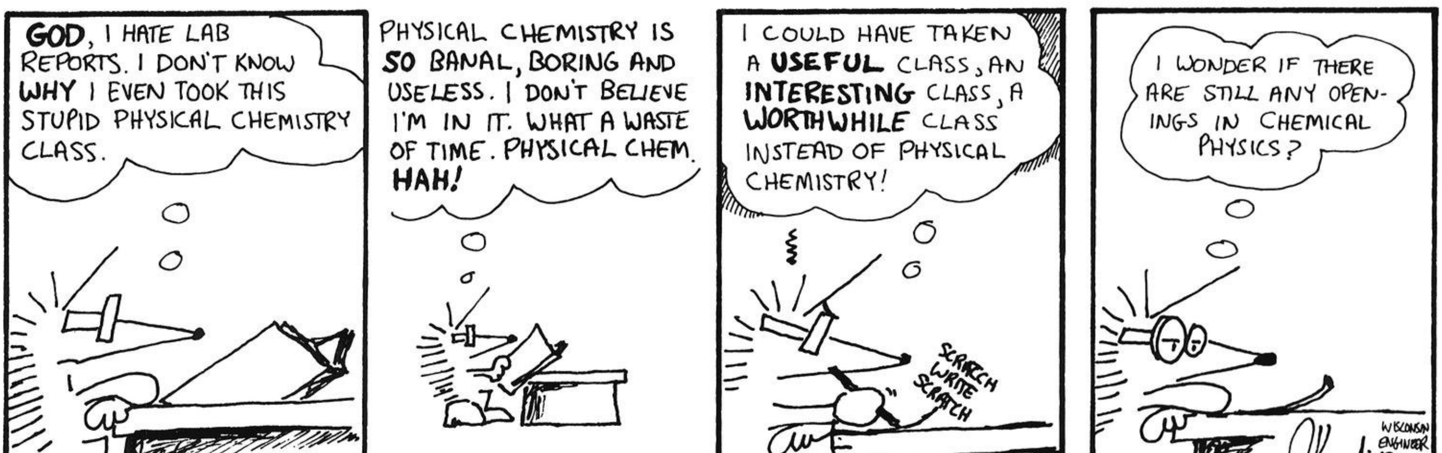
General reaction to the event has been of shock. Several engineering students were heard mumbling, "Wow, I didn't even know there was another union."

At a recent press conference, Chancellor Shalala commented on the cataclysm, "I didn't know an earthquake could do that to a car."

Traffic along Langdon and Park will be slow for the next couple of days, and there is still the potential for aftershocks. As a precaution, people are advised to stay away from the Memorial Union area.

AUTHOR

Sharon Chen is a fifth year senior in Chemical Engineering. This summer she is taking the infamous chemical engineering summer lab.


GOD, I HATE LAB REPORTS. I DON'T KNOW WHY I EVEN TOOK THIS STUPID PHYSICAL CHEMISTRY CLASS.
PHYSICAL CHEMISTRY IS SO BANAL, BORING AND USELESS. I DON'T BELIEVE I'M IN IT. WHAT A WASTE OF TIME. PHYSICAL CHEM. HAH!
I COULD HAVE TAKEN A USEFUL CLASS, AN INTERESTING CLASS, A WORTHWHILE CLASS INSTEAD OF PHYSICAL CHEMISTRY!
SCRATCH WRITE SCRATCH
I WONDER IF THERE ARE STILL ANY OPENINGS IN CHEMICAL PHYSICS?

WET PAINT