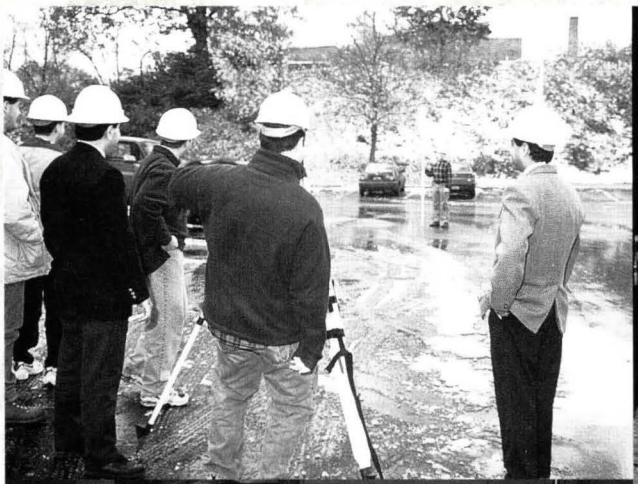
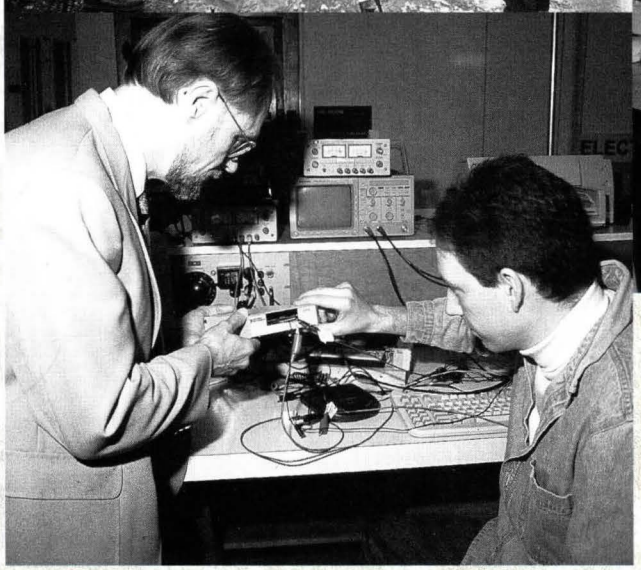
12-1998

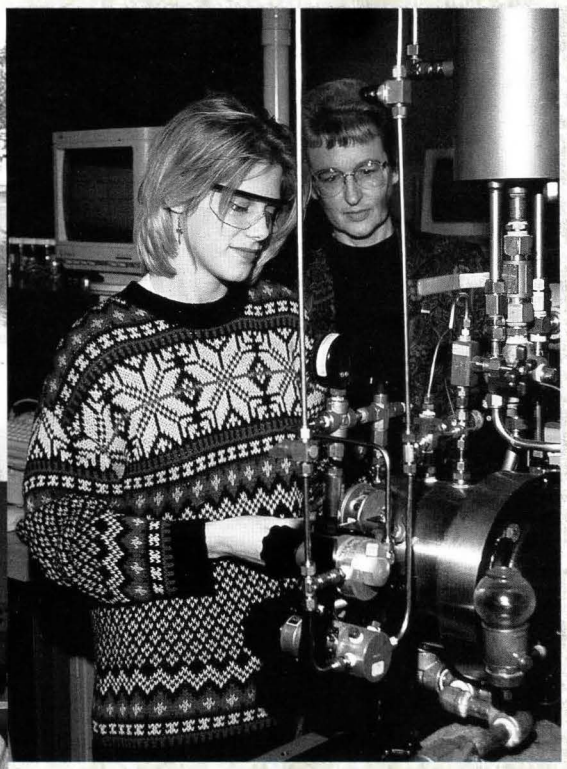
23rd Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

23rd Conference on Senior Engineering Design Projects







Tuesday, December 1, 1998

Bernhard Center

9:00 a.m. to 2:30 p.m.

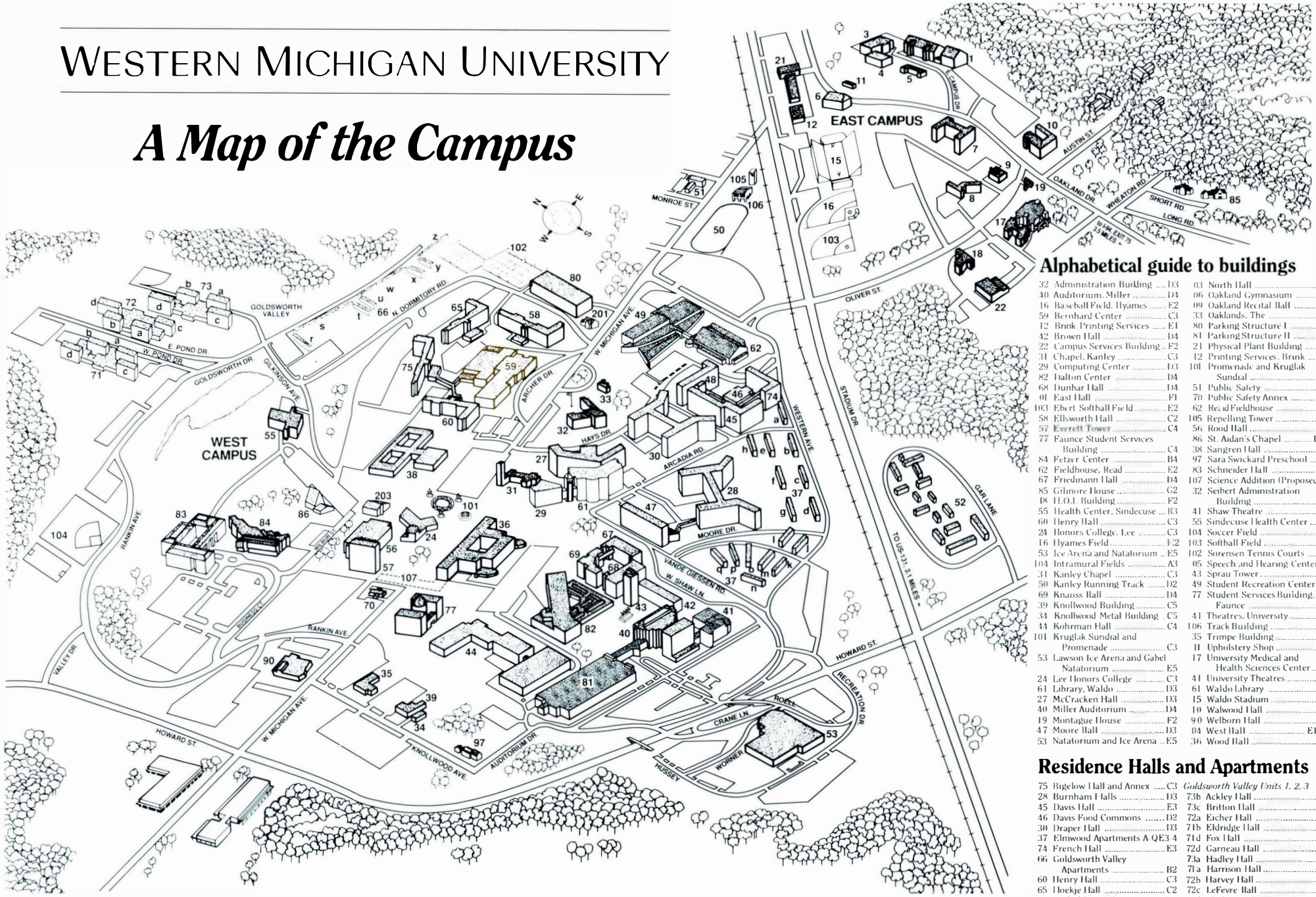
College of Engineering and Applied Sciences

Western Michigan University

Making a Difference

WESTERN MICHIGAN UNIVERSITY

A Map of the Campus



Alphabetical guide to buildings

32	Administration Building	D3
40	Auditorium, Miller	D4
16	Baseball Field, Hyames	E2
59	Bernhard Center	C3
12	Brink Printing Services	E1
42	Brown Hall	D4
22	Campus Services Building	F2
31	Chapel, Kanley	C3
29	Computing Center	D3
82	Dalton Center	D4
68	Dunbar Hall	D4
01	East Hall	F1
103	Ebert Softball Field	E2
58	Ellsworth Hall	C2
57	Everett Tower	C4
77	Faunce Student Services Building	C4
84	Fetzer Center	B4
62	Fieldhouse, Read	E2
67	Friedmann Hall	D4
85	Gilmore House	G2
18	H.O.I. Building	F2
55	Health Center, Sindecuse	B3
60	Henry Hall	C3
24	Honors College, Lee	C3
16	Hyames Field	E2
53	Ice Arena and Natatorium	E5
104	Intramural Fields	A3
31	Kanley Chapel	C3
50	Kanley Running Track	D2
69	Knauss Hall	D4
39	Knollwood Building	C5
34	Knollwood Metal Building	C5
44	Kohrman Hall	C4
101	Kruglak Sundial and Promenade	C3
53	Lawson Ice Arena and Gabel Natatorium	E5
24	Lee Honors College	C3
61	Library, Waldo	D3
27	McCracken Hall	D3
40	Miller Auditorium	D4
19	Montague House	F2
47	Moore Hall	D3
53	Natatorium and Ice Arena	E5
03	North Hall	F1
06	Oakland Gymnasium	E1
09	Oakland Recital Hall	F1
33	Oaklands, The	D3
80	Parking Structure I	D2
81	Parking Structure II	D5
21	Physical Plant Building	E1
12	Printing Services, Brink	E1
101	Promenade and Kruglak Sundial	C3
51	Public Safety	D1
70	Public Safety Annex	B4
62	Read Fieldhouse	E2
105	Repelling Tower	D2
56	Rood Hall	B4
86	St. Aidan's Chapel	B3-4
38	Sangren Hall	C3
97	Sara Swickard Preschool	C5
83	Schneider Hall	A4
107	Science Addition (Proposed)	C4
32	Seibert Administration Buildmg	D3
41	Shaw Theatre	D4
55	Sindecuse Health Center	B3
104	Soccer Field	A3
103	Softball Field	E2
102	Sorensen Tennis Courts	C2
05	Speech and Hearing Center	F1
43	Sprau Tower	D4
49	Student Recreation Center	D2
77	Student Services Building, Faunce	C4
41	Theatres, University	D4
106	Track Building	D2
35	Trimpe Building	B4
11	Upholstery Shop	E1
17	University Medical and Health Sciences Center	F2
41	University Theatres	D4
61	Waldo Library	D3
15	Waldo Stadium	E1
10	Walwood Hall	F1
90	Welborn Hall	B4
04	West Hall	E1 D1
36	Wood Hall	C4

Residence Halls and Apartments

75	Bigelow Hall and Annex	C3
28	Burnham Halls	D3
45	Davis Hall	E3
46	Davis Food Commons	D2
30	Draper Hall	D3
37	Elmwood Apartments A,QE	3-4
74	French Hall	E3
66	Goldsworth Valley Apartments	B2
60	Henry Hall	C3
65	Hoekje Hall	C2
30	Siedschlag Hall	D3
8	Spindler Hall	F2
52	Stadium Drive Apartments	F3
7	Vandercook Hall	F1
48	Zimmerman Hall	D3

Goldsworth Valley Units 1, 2, 3

73b	Ackley Hall	A2
73c	Britton Hall	B2
72a	Eicher Hall	A2
71b	Eldridge Hall	A2
71d	Fox Hall	A2
72d	Garneau Hall	A2
73a	Hadley Hall	B2
71a	Harrison Hall	A2
72b	Harvey Hall	A2
72c	LeFevre Hall	A2
73d	Shilling Hall	A2
71c	Stinson Hall	A2

Private Property

201	Lutheran Student Center	D2-3
203	Wesley Foundation	B3-4

Conference on Senior Engineering Design Projects

You are invited to attend the twenty-third Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 2:30 p.m. **Tuesday, December 1**, at the Bernhard Center on the campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry.

The conference is **free** and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the circular drive in front of the Bernhard Center and then park in the lot in front of Hoekje Hall. (See map; take North Dormitory Road. Hoekje is #65 on the map.)

Teachers who cannot accompany their students to the conference may ask their students to sign in and out at the information table in the lobby on the second floor of the Bernhard Center. Sign-in sheets will be mailed to teachers the day after the conference.

Parking is available in the ramp near the Bernhard Center.

Presentations begin on the hour and half hour. Please do not enter a room after a presentation has begun.

Session locations, starting times, and page number for project descriptions:

Construction Engineering and Management	242	9:00	p. 4
Construction Science and Management	242	9:30	p. 5
Electrical and Computer Engineering	213	9:00 to 1:30	p. 6
Industrial and Manufacturing Engineering	204	9:00 to 1:00	p. 9
Mechanical and Aeronautical Engineering A-I	211	9:00 to 1:30	p. 12
Mechanical and Aeronautical Engineering B-I	212	9:00 to 2:00	p. 15
Paper Science and Engineering	205	9:00 to 9:30	p. 18

Refreshments will be available in room 215 from 8:30 a.m. to 10:30 a.m.

A **lunch** break is scheduled from noon to 1 p.m.

For more information about the conference, call Yvonne Steffler at (616) 387-4017.

CEM = Construction Engineering and Management
CSM = Construction Science and Management
ECE = Electrical and Computer Engineering
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering
PSE = Paper Science and Engineering

Time	Room	Dept.	Topic
9:00	242	CEM	Estimating and Scheduling of a Medical Building
	213	ECE	Three Channel Sound Location Device
	204	IME	Optimizing the Production of Automotive Condensers
	211	MAE A-I	Welding of an Aluminum Propshaft
	212	MAE B-I	Finite-Element Analysis of a Guitar Neck
	205	PSE	Determination of Groundwood Fiber Content Using UV Light Absorption
9:30	242	CSM	Non-Traditional Building Materials for Commercial Construction
	213	ECE	Smart Self-Illuminating Delineator
	204	IME	Improving Material Flow Using Lean Manufacturing Techniques
	211	MAE A-I	Analysis of Heat Exchanger
	212	MAE B-I	Tool Design for a Cold Formed Part
	205	PSE	Study of Kenaf Fiber for Optimization of Stretch in Paper
10:00	213	ECE	The Home Appliance Dialer (H.A.D.)
	204	IME	Analyzing Material Flow at a Manufacturing Facility
	211	MAE A-I	Automatic Gear Lubrication Device
	212	MAE B-I	Comparison of Wind Tunnel Tests Using WMU's 1997 Solar Car
10:30	213	ECE	An Analog Neurocomputer
	204	IME	Wear Aspects of Copper Alloy Components for Injection Molds
	211	MAE A-I	Analysis of Compliance Force Finishing Heads
	212	MAE B-I	Design and Construction of a Class F High Power Rocket
11:00	213	ECE	Automated Test Station for a Motor Control Board
	204	IME	Optimization of Type 304 Stainless Steel Through Tube Annealing Cycle
	211	MAE A-I	Automated Production Test Stand
	212	MAE B-I	Laminar Airflow Grid
11:30	213	ECE	Smart Electric Safety Socket (SESS™)
	204	IME	Design of a Thermal Distortion Tester
	211	MAE A-I	Piezoelectric-Actuated Pneumatic Valve
	212	MAE B-I	Flow Separation Around External Rearview Mirrors of a Vehicle

1:00	213	ECE	Cane Position Sensing Device (CPSD)
	204	IME	Locking Hinge for Collapsible Table
	211	MAE A-I	Sagittal Attachment for a Surgical Drill
	212	MAE B-I	Design and Development of a Golf Swing Training Device
1:30	213	ECE	Real-Time Defect Input Devices
	211	MAE A-I	Redesign of Rotation Knob Detent Mechanism for Laproscopic Scissors
	212	MAE B-I	Ratcheting Clutch Redesign
2:00	212	MAE B-I	Automatic Autoclave Loading of Surgical Tools

CONSTRUCTION ENGINEERING AND MANAGEMENT

Session Chair - Osama Abudayyeh
Room 242

ESTIMATING AND SCHEDULING OF A MEDICAL BUILDING

by Martin Malek
Sponsor: Dan Lamor - Wolverine Construction Management Incorporated
Faculty Advisor: Anil Sawhney
9:00 a.m. to 9:25 a.m., Room 242

This project focused on the estimating and scheduling of an 11,500 square foot medical building. To perform these functions, information from construction core courses, standard handbooks, guidelines, and software was used. A control system for the project was also designed. The project provided a complete picture of the estimating, scheduling, and control functions performed by construction engineering and management professionals.

CONSTRUCTION SCIENCE AND MANAGEMENT

Session Chair - Osama Abudayyeh
Room 242

NON-TRADITIONAL BUILDING MATERIALS FOR COMMERCIAL CONSTRUCTION

by Jason Howard, Loren Kelly, and Jason Sandusky
Sponsor: Greg Johnson - Michigan Department of Transportation
Faculty Advisor: Osama Abudayyeh
9:30 a.m. to 9:55 a.m., Room 242

Non-traditional building materials have been used in residential construction for many years with positive results in cost, aesthetics, and ease of use. However, commercial contractors have hesitated to use most of these materials because of a lack of specifications, engineering data, and availability. This project studied the available traditional and non-traditional materials and compared their application in current construction environments. The results were evaluated to determine when these materials can be used effectively, and a technical report was prepared. The report will be presented to a segment of the commercial construction industry.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair - John Gesink
Room 213

THREE CHANNEL SOUND LOCATION DEVICE

by Mark Jonaitis
Sponsor: Paul Ponchillia - WMU Department of Blind Rehabilitation
Faculty Advisor: Damon Miller
9:00 a.m. to 9:25 a.m., Room 213

Visually impaired individuals need to know their positions relative to objects in their surroundings. A device was designed to enable the identification of important landmarks in a person's immediate environment through the use of audible beacons. A lightweight, portable control module contains one switch for each beacon. When a switch is activated, the associated beacon emits a sound and the control module replays a voice recording of the user's description of the beacon location.

SMART SELF-ILLUMINATING DELINEATOR

by Patrick Hooi Voon Chong, Terrence John Kouju, and Victor Chung Sain Voo
Sponsor: Ronald J. Fredricks, P.E.
Faculty Advisor: Johnson Asumadu
9:30 a.m. to 9:55 a.m., Room 213

Poor visibility conditions caused by rain, snow, or fog can cause accidents on roads and highways. Highway delineators equipped with reflectors and flashing lights are placed along roads to guide traffic safely through. A regular highway delineator was modified to include a variety of sensors to detect oncoming traffic and poor visibility. When a vehicle approaches the delineator and the sensors detect low visibility conditions, the delineator will turn on. The delineator will shut off automatically when the vehicle is no longer detected. This saves battery power and prolongs the life of the bulb.

THE HOME APPLIANCE DIALER (H.A.D.)

by Siva P. Subramaniam, How Hun Lee, and Tien Dung Nguyen
Faculty Advisor: Lambert Vander Kooi
10:00 a.m. to 10:25 a.m., Room 213

The Home Appliance Dialer (H.A.D.) is a device that is used to control any electrically operated home appliance over the telephone. The device is connected to a telephone line and can be used to switch up to three appliances on or off by making a call from any touch tone telephone. The H.A.D. can also check whether a home appliance is on or off. A user-defined access code is needed for operation. Feedback from the H.A.D. to the caller is in the form of audio signals, while communication from the H.A.D. to appliances is in the form of radio frequency signals.

AN ANALOG NEUROCOMPUTER

by Akeel Marikar, Chad Lange, and James Whitney
Faculty Advisor: Damon Miller
10:30 a.m. to 10:55 a.m., Room 213

Artificial neural networks (ANNs) are computing architectures capable of learning from their environment. ANNs typically consist of simple processing elements referred to as neurons. A neurocomputer consisting of four artificial neurons was designed and built using discrete electronic components. The design was based on simple models of biological neurons. The neurocomputer is primarily intended to be used as an instructional tool and is housed in an ergonomic enclosure. The user can adjust individual neuron parameters in order to illustrate the basic functionality of such networks. The operation of the neurocomputer was verified through simulation and testing.

AUTOMATED TEST STATION FOR A MOTOR CONTROL BOARD

by Kurt Etherington, Kristie Kowalski, and Brendt Pung
Sponsor: Greg Rabick - Stryker Instruments
Faculty Advisor: Sanjeev Baskiyar
11:00 a.m. to 11:25 a.m., Room 213

An automated test station to check a motor control circuit board was developed. The circuit board controls the rate of fluid flow through an irrigation unit. The station tests memory on the circuit board and samples input and output voltages under various loads for other tests. Software was developed on LabView to test the circuit board. The results of the test are stored in a database for future reference.

SMART ELECTRIC SAFETY SOCKET (SESS™)

by Edward S. Udoetok, Jr., Kam Boon Lee, and Wan Mohd Kamal Wan Omar
Sponsor: Syed Abdul Kadir Syed Ibrahim - Petroliam Nasional Bhd., Malaysia (PETRONAS)
Faculty Advisor: Joseph Kelemen
11:30 a.m. to 11:55 a.m., Room 213

An electric socket was designed to prevent electric shock-induced injuries by switching the power off when a source of heat, e.g. human or animal, has been detected in the close vicinity of the socket. Once the heat source is no longer present, the socket will be re-energized. The electric socket uses a pyroelectric sensor for the detection of heat. A microcontroller was used to control signals within the electric socket, to reduce the number of components, and to provide greater flexibility in making future custom design changes. Three switches allow the user to manually control the operation of the electric socket.

CANE POSITION SENSING DEVICE (CPSD)

by Meng Seng Ng, Wee Ling Tan, Fock Hing Yap
Sponsor: William Wiener - WMU Department of Blind Rehabilitation
Faculty Advisor: Raghvendra Gejji
1:00 p.m. to 1:25 p.m., Room 213

Correct use of a long cane by blind individuals requires that they synchronize the movement of their cane with their footsteps. A teaching aid was developed to inform a visually impaired instructor if the stepping of a student learning to use the cane was properly synchronized with his/her cane movement. The device uses ultrasonic sensors to determine the cane's position. If a student's steps are out of synchrony, the device notifies the instructor by speaking an electronically recorded message.

REAL-TIME DEFECT INPUT DEVICES

by Paul Aaron Bornstein and Alan Michael Glenn
Sponsor: William Jordan - InAmation, Incorporated
Faculty Advisor: Janos L. Grantner
1:30 p.m. to 1:55 p.m., Room 213

In manufacturing there is a need to collect accurate real-time information about product defects. This information is generally collected by hand and compiled for quality reporting. With this method, it can take several hours to several days to react to defect-producing situations. This project designed, developed, and prototyped a hand-held defect input device ("DiD") to reduce this reaction time. The "DiD" collects defect type, product model, machine name, area, and other data and transfers it to factory floor computers. A software interface was created for "Defect Analysis Software," produced by Softech Engineering, Inc. This software assists in troubleshooting a process by reporting defects in Pareto diagram format.

INDUSTRIAL AND MANUFACTURING ENGINEERING

Session Chair - Sam Ramrattan
Room 204

OPTIMIZING THE PRODUCTION OF AUTOMOTIVE CONDENSERS

by Jeremy Schumann, Becky Tran, and Dan Watson
Sponsor: Tom Rohlwing - Denso Manufacturing, Incorporated
Faculty Advisor: Steven Butt
9:00 a.m. to 9:25 a.m., Room 204

A manufacturing company is planning full production of a new type of automobile condenser core. This new core will be integrated into an existing condenser line. Data regarding the new line was collected utilizing time studies. Analysis of the time studies resulted in a relationship between the number of workers required and the parts produced per hour. Further investigation using techniques such as line balancing and work sampling led to recommendations in the areas of equipment, manpower, and plant layout.

IMPROVING MATERIAL FLOW USING LEAN MANUFACTURING TECHNIQUES

by Jacob J. Achatz, Mi'chele Y. Crump, and Kyle C. Pierce
Sponsors: David Geib and Karen Laetz - Bosch Braking Systems
Faculty Advisor: Liwana Bringelson
9:30 a.m. to 9:55 a.m., Room 204

An automotive company that produces hydro-boosts for ABS braking systems had problems maintaining a balanced material flow. Due to the age and reliability of machinery, they experienced difficulty in producing an effective production schedule while minimizing inventory levels. Since multiple product lines flow through the same department, tracking in-process inventory was a major concern. Lean manufacturing techniques such as kanban and visual controls were used to eliminate waste within the system. This project identified inefficiencies in the current system and made recommendations to improve the manufacturing process.

ANALYZING MATERIAL FLOW AT A MANUFACTURING FACILITY

by Pat Carpenter, Emeka Iwegbue, and Brent Williams
Sponsors: Virginia Coulter and Dave Feuerstein - I. I. Stanley Co., Incorporated
Faculty Advisor: Tycho Fredericks
10:00 a.m. to 10:25 a.m., Room 204

A manufacturer of printed circuit boards had encountered inefficiencies in the layout of an automated solder production department. The two main inefficiencies were long travel distances and less than optimal storage locations for materials. The layout of the department was evaluated and recommendations were formulated based on the use of basic plant layout techniques, principles of lean manufacturing, and kanban techniques. By optimizing department layout, production levels should increase.

WEAR ASPECTS OF COPPER ALLOY COMPONENTS FOR INJECTION MOLDS

by Alicia Haberkorn and Allen Woodruff
Sponsor: Dale Peters - Copper Development Association Incorporated
Faculty Advisor: Paul Engelmann
10:30 a.m. to 10:55 a.m., Room 204

Today, due to superior thermal conductivity, copper alloys are being explored as an alternative to steel tooling in the injection molding industry. In order to be accepted, further information is needed on the wear of these materials. This project focused on the wear of copper alloy mold components. A specially constructed mold at WMU provided wear data. The repeatability of the gage that measured this wear was improved. This information will be used to develop a guideline that will predict the wear of copper alloy mold components. This project produced numerous parts which required enhancements to the resin recycling system.

OPTIMIZATION OF TYPE 304 STAINLESS STEEL THROUGH TUBE ANNEALING CYCLE

by Fahad Al-Khater, Rebecca Morgan, and Theresa Shane
Sponsor: Scott Eisen - Benteler Automotive Corporation
Faculty Advisor: Larry Mallak
11:00 a.m. to 11:25 a.m., Room 204

Bending, annealing, and hydroforming processes are used to form different types of exhaust tubes such as downpipes and manifolds for the automotive industry. Type 304 stainless steel is the primary material used in manufacturing downpipes. Research into annealing temperatures for various pipes made of type 304 was conducted to standardize the annealing procedure. Simulation and related methods were used to find an optimal schedule for the annealing cycle of type 304. Implementing the recommended schedule will result in decreased production costs.

DESIGN OF A THERMAL DISTORTION TESTER

by Ryan Blystone, Scott Byrne, and Jolyon Ross
Faculty Advisors: Mitchel Keil, Sam Ramrattan, and Jorge Rodriguez
11:30 a.m. to 11:55 a.m., Room 204

A device was needed to test thermal distortion characteristics of various sand molds used in casting operations. This project designed and constructed a testing device to provide this information. The Thermal Distortion Tester (TDT) measures the displacement that takes place for all sand/binder systems at elevated temperatures. With this newly found information, the accuracy in the casting of parts can be greatly increased. It allows foundry engineers to cast objects closer to actual size, thus eliminating many unnecessary operations. The newly constructed TDT will service the entire foundry industry.

LOCKING HINGE FOR COLLAPSIBLE TABLE

by Maria E. Carrasquero, Milton M. Choto, and Brian O. Metcalfe

Sponsors: James Weber and D. Charles Fair - Weber Specialties Company / Redco
Faculty Advisor: Jorge Rodriguez
1:00 p.m. to 1:25 p.m., Room 204

This project analyzed and redesigned a locking hinge to make it more reliable. The locking hinge consists of a platform, three aluminum sections, two rods, two bushing sets, and one spring. A testing machine was constructed to evaluate the fatigue life of the hinge mechanism. The structural integrity of the hinge was tested using a dedicated deflection tester. The hinge's greatest weaknesses were identified and targeted systematically. Design solutions were implemented in an effort to achieve a more competitive and profitable product.

MECHANICAL AND AERONAUTICAL ENGINEERING A-I

Session Chair - Jerry Hamelink
Room 211

WELDING OF AN ALUMINUM PROPSHAFT

by Brad Ketchel and Marcus Montie
Sponsor: Joe Flanagan - American Axle and Manufacturing
Faculty Advisor: Jerry Hamelink
9:00 a.m. to 9:25 a.m., Room 211

A local manufacturer wanted to improve the manufacturing process used to produce propeller shafts for F-cars (Camaro and TransAm). The focus of the project was on attaching weld yokes to the torque tube. Friction welding was selected to help increase process stability, and to reduce cost and assembly time. Finite element analysis (FEA) was used to select weld locations. FEA results were compared to the actual test results to ensure validity of the model. FEA was then utilized to explore design changes. The yoke design was changed slightly to meet friction welding requirements. With the new process, the cost for producing the parts decreased.

ANALYSIS OF HEAT EXCHANGER

by Daniel Kushner and Robert Wahls
Faculty Advisor: Jerry Hamelink
9:30 a.m. to 9:55 a.m., Room 211

A local company had a novel heat exchanger that needed to be analyzed to determine its heat transfer capabilities. A test loop was designed and built to analyze the heat exchanger. Tests were run to determine the heat transfer coefficients. Once the tests were complete, the data was analyzed and computer programs were written to calculate the heat transfer coefficients within the heat exchanger and to predict its performance under different conditions. The programs were written using Engineering Equation Solver software.

AUTOMATIC GEAR LUBRICATION DEVICE

by Russell E. Kluting and Michael H. Warber
Sponsors: Kurt Lentner and Karen Smit - Stryker Instruments
Faculty Advisor: Jerry Hamelink
10:00 a.m. to 10:25 a.m., Room 211

A device was designed to automatically oil three gears of a medical instrument during its assembly. Two of the gears are on fixed points, but the third gear has an infinite number of positions. The final device delivers an accurate amount of lubrication to the required locations in a safe and efficient way.

ANALYSIS OF COMPLIANCE FORCE FINISHING HEADS

by Andrew D. Boldyreff and Gregory M. Hodgins
Sponsors: Richard Hewitt and Charlie Young - Hammond Machinery
Faculty Advisor: Jerry Hamelink
10:30 a.m. to 10:55 a.m., Room 211

A surface finishing company needed an analysis of two methods of compliance force machining: As parts are machined, reaction forces occur at the point of contact. Compliance is the opposing force the machine must provide to counteract the contact forces. One method is a newer yet more expensive option. Customers would like verification that this cost is actually worth the results. A test was designed and conducted on a machine that performs both methods of finishing. The data was analyzed, and a final report of the two methods was written.

AUTOMATED PRODUCTION TEST STAND

by Thomas A. Snell and Keith H. R. Weidel
Sponsor: Mike Perrine - FEMA Corporation
Faculty Advisor: Jerry Hamelink
11:00 a.m. to 11:25 a.m., Room 211

This project redesigned a hydraulic test stand to automate a testing sequence and eliminate operator influence. The stand is used to test solenoid valves before they are shipped. A programmable logic controller (PLC) was selected and an electrical circuit was designed for the stand. The fixture was redesigned to use one air cylinder for clamping two styles of valves. A system was designed to measure the valve flow and leakage flow of the solenoid valve. In addition, a relief valve was designed to control the supply pressure from the PLC.

PIEZOELECTRIC-ACTUATED PNEUMATIC VALVE

by Amy Barnes and James Knight
Sponsor: Len Jabcon - Humphrey Products Company
Faculty Advisor: Koorosh Naghshineh
11:30 a.m. to 11:55 a.m., Room 211

The current industrial standard for pneumatic valve actuation is solenoid coils. These coils are inexpensive and easily manufactured but dissipate a large amount of heat, are affected by magnetic and vibrational fields, and do not offer an accurate form of linear actuation. Piezoelectric actuators do not generate heat or sparks, are unaffected by magnetic and vibrational fields, and have high linear resolution. A piezoelectric-actuated, pneumatic valve was designed. This valve, due to inherent characteristics of piezoelectric ceramics, can be used in many standard applications as well as those requiring exacting precision or those in hazardous operating environments.

SAGITTAL ATTACHMENT FOR A SURGICAL DRILL

by Ashley Brinn and Brian Sharp
Sponsor: David Nic - Stryker Instruments
Faculty Advisor: James Kamman
1:00 p.m. to 1:25 p.m., Room 211

During heart surgery, a sagittal attachment is needed to convert a surgical drill into a saw. A new attachment was designed so a surgeon can cut through the sternum bone without damaging the heart during surgery. Models of components were created and combined into assemblies using Pro-Engineer software. Analyses were performed to ensure that the new design would withstand stresses encountered during use. Detailed drawings of each component and assembly were completed. The final design was reviewed and critiqued by senior engineers to ensure compatibility with existing drills.

REDESIGN OF ROTATION KNOB DETENT MECHANISM FOR LAPROSCOPIC SCISSORS

by Gregory Sloan and Kevin Cienki
Sponsor: Steve Peters - Imagyn Surgical
Faculty Advisor: James Kamman
1:30 p.m. to 1:55 p.m., Room 211

The current design of laproscopic surgical scissors involves the use of a difficult to assemble and operationally cumbersome detent mechanism. This detent mechanism controls the rotational position of the shaft of the instrument during surgery. This project redesigned the detent system. The new design improved the assembly time, reduced the amount of improperly assembled devices, and improved the ergonomics for rotation.

MECHANICAL AND AERONAUTICAL ENGINEERING B-I

Session Chair - Iskender Sahin
Room 212

FINITE-ELEMENT ANALYSIS OF A GUITAR NECK

by Brandon M. Nickolas and Daniel E. Shangraw
Sponsors: Rendal Wall and Bill Paige - Heritage Guitar Incorporated
Faculty Advisor: Dennis Vanden Brink
9:00 a.m. to 9:25 a.m., Room 212

Adjustable truss rods are placed into guitar necks to add stiffness and counteract the forces produced by the strings. Adjustment of the truss rod produced undesirable deflections in the neck. Algor, a finite-element analysis program, was used to model a solid-body electric guitar neck. Accuracy of the computer model was determined by comparing its behavior under loading with that of the actual neck under the same conditions. An analysis was performed to determine the causes of the unwanted deflections. Based on the analysis results and a modified neck model, changes to the current neck design were proposed.

TOOL DESIGN FOR A COLD FORMED PART

by Mike Bevins and Brooks Boughton
Sponsor: Skip Swim - Net Shaped Solutions (NSS) Technologies
Faculty Advisor: Philip Guichelaar
9:30 a.m. to 9:55 a.m., Room 212

This project designed the manufacturing process for a new tubular shaped part to be made using cold forging. Models of the part and process were created to predict the strength and feasibility of the tool design. Detailed drawings of the tools and part were produced along with the process flow and bill of materials. The part, called a bearing spacer, is new technology that is used in wheel hubs. A final part was produced to meet the sponsor's needs.

COMPARISON OF WIND TUNNEL TESTS USING WMU'S 1997 SOLAR CAR

by Ryan Fortier and Erik Pederson
Faculty Advisor: Art Hoadley
10:00 a.m. to 10:25 a.m., Room 212

The Sunseeker Aerodynamics Team requested that tests be conducted to determine the accuracy of a full-scale model wind tunnel test as compared to a $1/12^{th}$-scale model wind tunnel test. WMU's 1997 Sunseeker Solar Car was tested in Lockheed Martin's 18' x 30' wind tunnel. These results were then compared to tests done in Western Michigan University's small scale wind tunnel. The data was compared using Reynold`s number modeling.

DESIGN AND CONSTRUCTION OF A CLASS F HIGH POWER ROCKET

by Craig Dillon
Faculty Advisor: Kasim Biber
10:30 a.m. to 10:55 a.m., Room 212

A class F rocket was designed, constructed, and launched in an attempt to break the current altitude record of 5,685 feet. Drag from pressure and frictional forces was considered in the design and was calculated in the subsonic, transonic, and supersonic regions. This drag was used to calculate stresses in the body to perform modeling on ALGOR stress analysis software. To receive clearance to launch this rocket, a Level One certification was obtained by completing a certified safety test and an ATF explosives test. An FAA waiver to fly to the expected height of 6,000 feet was also obtained.

LAMINAR AIRFLOW GRID

by James Kenney and David Sylver
Sponsor: Warren Terry - Summit Polymers Incorporated
Faculty Advisor: Iskender Sahin
11:00 a.m. to 11:25 a.m., Room 212

An experimental register system and duct work were created to provide a more efficient alternative for modern registers and duct work. Using an existing automotive instrument panel as the medium for research and development proved that such a system could be packaged. The Cowanda effect was used in the development of the duct. Flow experiments were performed for support and analyzing of the system. The attained goals were constant velocity and flow across the four exit points along the full instrument panel register and providing a laminar flow within the duct.

FLOW SEPARATION AROUND EXTERNAL REARVIEW MIRRORS OF A VEHICLE

by Christopher M. B. Hovland, Amanda J. Staelens, and Mun Him Yap
Sponsor: Matt Williams - Donnelly Corporation
Faculty Advisor: Iskender Sahin
11:30 a.m. to 11:55 a.m., Room 212

Fluttering of side mirrors can occur when vehicles travel at high speeds. This vibration is the result of a non-uniform, unsteady wake developed behind the mirror. This project involved the manipulation of the flow field around a side mirror through geometric alterations. The process involved varying several mirror shapes using the Computational Fluid Dynamic software packages Fluent and PMARC to study and visualize the flow field. Design improvements included changes in mirror geometry and mirror housing.

DESIGN AND DEVELOPMENT OF A GOLF SWING TRAINING DEVICE

by Jinan Cincilla
Sponsor: Deno Frier - West Hills Athletic Club
Faculty Advisor: Dennis Vanden Brink
1:00 p.m. to 1:25 p.m., Room 212

A golf swing training device was designed, developed, and tested. The device is attached to the universal type pull-down machine and home gym equipment to strengthen, tone, and improve the muscles associated with the golf swing. The nature of the design, the materials selection, and the manufacturing process were the main considerations, resulting in a simple, portable, and inexpensive tool.

RATCHETING CLUTCH REDESIGN

by Terry Freer and Steve Stewart
Sponsor: Scott Huff - Innovate, Incorporated
Faculty Advisor: Judah Ari-Gur
1:30 p.m. to 1:55 p.m., Room 212

Designers had concerns about a small appliance clutch designed by the company. The plastic injection molded ratcheting clutch was redesigned for increased strength and life span. Finite element analysis (FEA) and fatigue testing of the clutch were performed to provide an efficient redesign of the clutch. A fatigue testing machine used to cycle the clutch was designed and built as part of the project.

AUTOMATIC AUTOCLAVE LOADING OF SURGICAL TOOLS

by Chan Sow Keong, Leh Kok Hong, and Teoh Wen Han
Sponsor: Tony Sanchez - Stryker Instruments
Faculty Advisor: Judah Ari-Gur
2:00 p.m. to 2:25 p.m., Room 212

The sterilization of surgical tools is done with the use of an autoclave. The existing method used to test sterilized surgical tools required manual labor. A new autoclave tray was designed and built to fully automate the testing process. The new and improved tray was tested and found to be successful.

PAPER SCIENCE AND ENGINEERING

Session Chair - Raja Aravamuthan
Room 205

DETERMINATION OF GROUNDWOOD FIBER CONTENT USING UV LIGHT ABSORPTION

by Scott Dixon
Sponsor: Jim Ittner - Georgia Pacific Corporation
Faculty Advisor: Raja Aravamuthan
9:00 a.m. to 9:25 a.m., Room 205

In the past, fibers were stained and counted under a microscope to determine the groundwood content of an unknown sample. This process is extremely time consuming and requires a knowledgeable technician to obtain accurate results. To remedy this problem, this project used UV light absorption in the 200-250 nanometer range to determine the lignin content. The result is an absorption number that correlates to the amount of lignin present. This provides a quick, accurate test that any technician should be able to perform. The lignin present then can be correlated to a theoretical groundwood content.

STUDY OF KENAF FIBER FOR OPTIMIZATION OF STRETCH IN PAPER

by Greg Lougen
Faculty Advisor: Raja Aravamuthan
9:30 a.m. to 9:55 a.m., Room 205

This project examined kenaf fiber as a substitute for hardwood fiber in board grades. The stretch percentage was the main focus of the study. Several process variables were changed to optimize the stretch percentage. These process variables included pulping methods, fiber mix, pulp chemical concentrations, and refining time. In order to closely examine the development of stretch, measurement of the fibril angle was necessary. A confocal microscope was used to determine the fibril angle and correlate the fibril angle with the mechanical properties of the fiber.

THANK YOU

The College of Engineering and Applied Sciences is grateful to these sponsors which have provided or cooperated in Senior Engineering Design Projects being presented in December 1998. If you have a project for our students or if you would like more information, please call Yvonne Steffler at (616) 387-4017.

American Axle and Manufacturing
Benteler Automotive Corporation
Bosch Braking Systems
Copper Development Association Incorporated
Denso Manufacturing, Incorporated
Donnelly Corporation
FEMA Corporation
Ronald J. Fredericks, P.E.
Georgia Pacific Corporation
Hammond Machinery
Heritage Guitar Incorporated
Humphrey Products Company
I. I. Stanley Co., Incorporated
Imagyn Surgical
InAmation, Incorporated
Innovate, Incorporated
Michigan Department of Transportation
Net Shaped Solutions (NSS) Technologies
Petroliam Nasional Bhd., Malaysia (PETRONAS)
Stryker Instruments
Summit Polymers Incorporated
Weber Specialties Company / Redco
West Hills Athletic Club
WMU Department of Blind Rehabilitation
Wolverine Construction Management Incorporated

The College of Engineering and Applied Sciences offers a wide variety of programs.

School of Aviation Sciences

- Aviation flight science
- Aviation maintenance technology
- Aviation science and administration

Construction Engineering, Materials Engineering, and Industrial Design

- Construction engineering and management
- Industrial design
- Materials engineering

Electrical and Computer Engineering

- Computer engineering
- Electrical engineering

Industrial and Manufacturing Engineering

- Automotive engineering technology
- Engineering graphics and design technology
- Engineering management
- Industrial engineering
- Industrial management
- Manufacturing engineering technology

Manufacturing Engineering

- Manufacturing engineering (Muskegon only)

Mechanical and Aeronautical Engineering

- Aeronautical engineering
- Mechanical engineering

Paper and Printing Science and Engineering

- Chemical engineering
- Paper engineering
- Paper science
- Printing

The **Master of Science in engineering** is offered in computer, electrical, mechanical, and industrial engineering. The **Master of Science** is offered in construction engineering and management, engineering management, manufacturing engineering, materials science and engineering, operations research, and paper and imaging science and engineering. The **Ph.D.** is offered in industrial engineering, mechanical engineering, and paper and imaging science and engineering.

Office of the Dean
College of Engineering and Applied Sciences
Western Michigan University
Kalamazoo, MI 49008