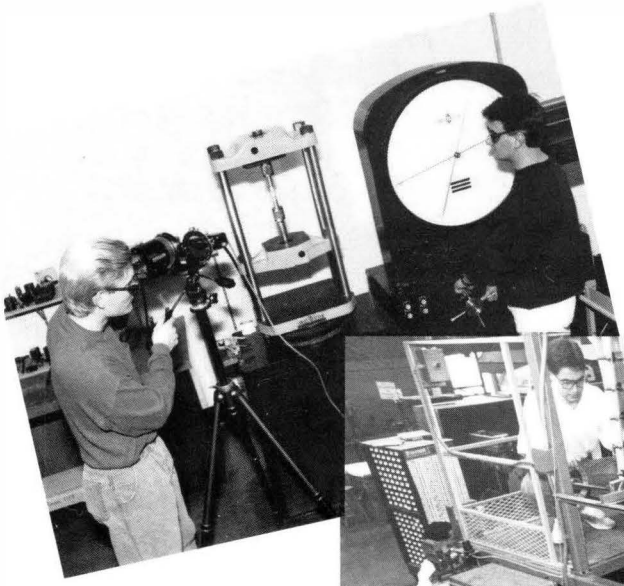
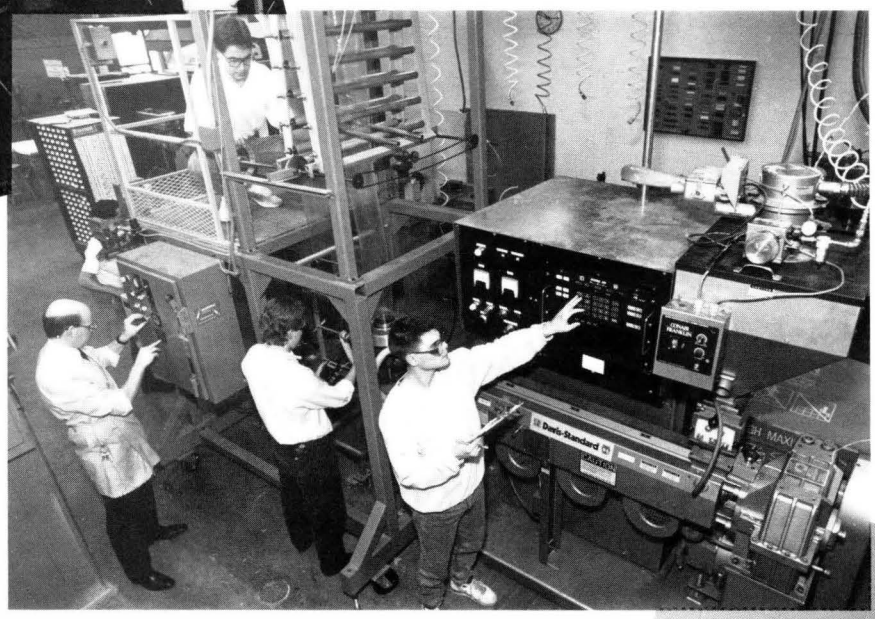
12-1992

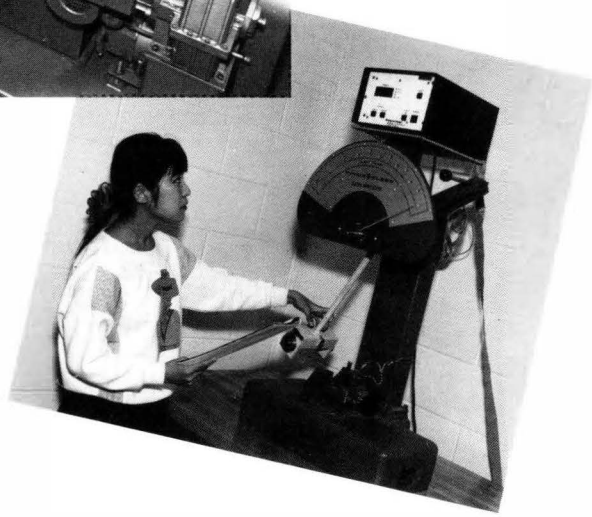
10th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

Conference On
Senior Engineering Design Projects





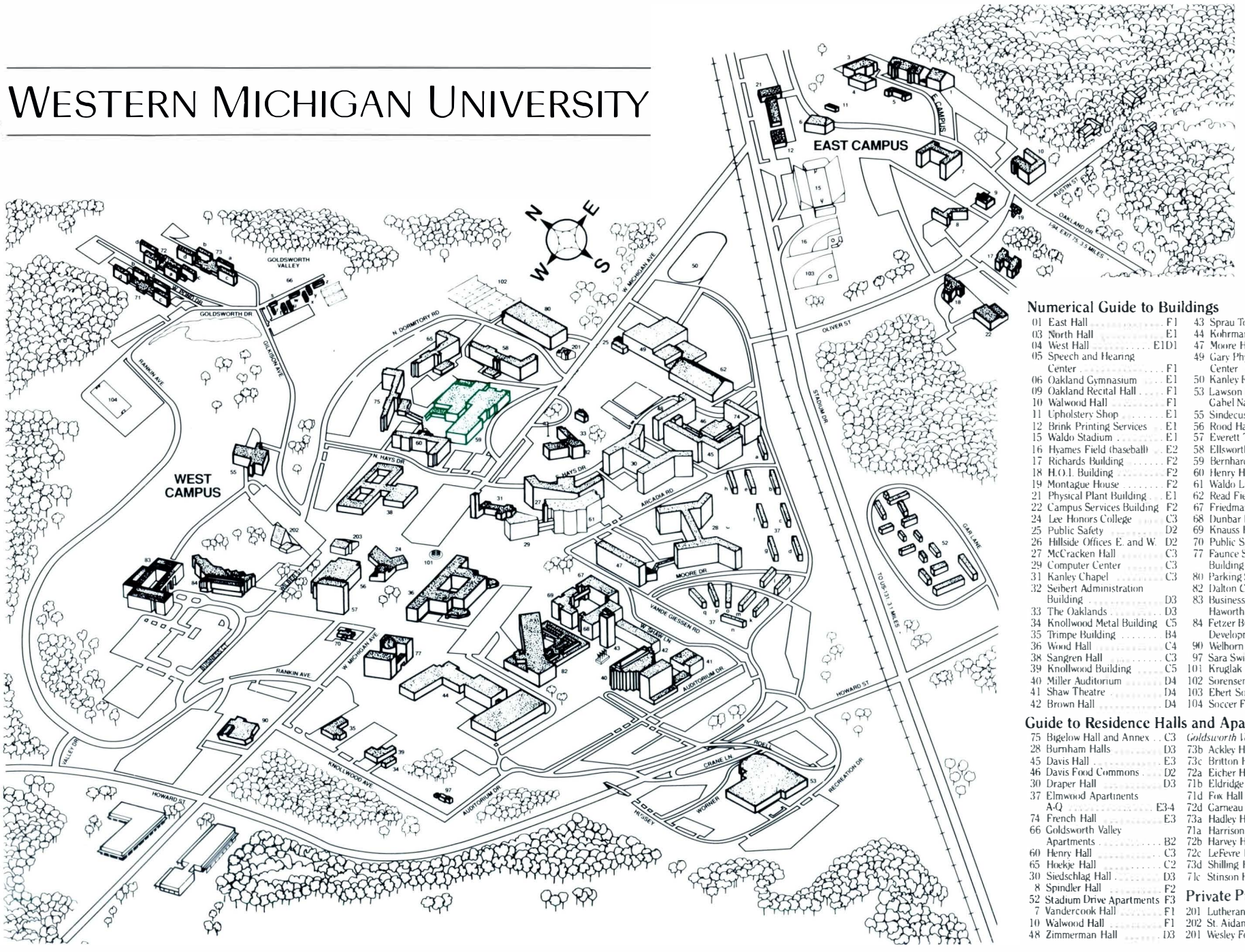


Tuesday, December 8, 1992
Bernhard Center

College of
Engineering and
Applied Sciences

WESTERN
MICHIGAN
UNIVERSITY

WESTERN MICHIGAN UNIVERSITY



Numerical Guide to Buildings

01	East Hall	F1	43	Sprau Tower	D4
03	North Hall	E1	44	Kohrman Hall	C4
04	West Hall	E1D1	47	Moore Hall	D3
05	Speech and Hearing Center	F1	49	Gary Physical Education Center	D2
06	Oakland Gymnasium	E1	50	Kanley Running Track	D2
09	Oakland Recital Hall	F1	53	Lawson Ice Arena and Gabel Natatorium	E5
10	Walwood Hall	F1	55	Sindecuse Health Center	B3
11	Upholstery Shop	E1	56	Rood Hall	B4
12	Brink Printing Services	E1	57	Everett Tower	B3
15	Waldo Stadium	E1	58	Ellsworth Hall	C2
16	Hyames Field (baseball)	E2	59	Bernhard Center	C3
17	Richards Building	F2	60	Henry Hall	C3
18	H.O.I. Building	F2	61	Waldo Library	D3
19	Montague House	F2	62	Read Fieldhouse	E2
21	Physical Plant Building	E1	67	Friedmann Hall	D4
22	Campus Services Building	F2	68	Dunbar Hall	D4
24	Lee Honors College	C3	69	Knauss Hall	D4
25	Public Safety	D2	70	Public Safety Annex	B4
26	Hillside Offices E. and W.	D2	77	Faunce Student Services Building	C4
27	McCracken Hall	C3	80	Parking Structure	D2
29	Computer Center	C3	82	Dalton Center	D4
31	Kanley Chapel	C3	83	Business Building, Haworth College of	A4
32	Seibert Administration Building	D3	84	Fetzer Business Development Center	B4
33	The Oaklands	D3	90	Welborn Hall	B4
34	Knollwood Metal Building	C5	97	Sara Swickard Preschool	C5
35	Trimpe Building	B4	101	Kruglak Sundial	C3
36	Wood Hall	C4	102	Sorensen Tennis Courts	C2
38	Sangren Hall	C3	103	Ebert Softball Field	E2
39	Knollwood Building	C5	104	Soccer Field	A3
40	Miller Auditorium	D4			
41	Shaw Theatre	D4			
42	Brown Hall	D4			

Guide to Residence Halls and Apartments

75	Bigelow Hall and Annex	C3		*Goldsworth Valley Units 1, 2, 3:*	
28	Burnham Halls	D3	73b	Ackley Hall	A2
45	Davis Hall	E3	73c	Britton Hall	B2
46	Davis Food Commons	D2	72a	Eicher Hall	A2
30	Draper Hall	D3	71b	Eldridge Hall	A2
37	Elmwood Apartments A-Q	E3-4	71d	Fox Hall	A2
74	French Hall	E3	72d	Garneau Hall	A2
66	Goldsworth Valley Apartments	B2	73a	Hadley Hall	B2
60	Henry Hall	C3	71a	Harrison Hall	A2
65	Hoekje Hall	C2	72b	Harwey Hall	A2
30	Siedschlag Hall	D3	72c	LeFevre Hall	A2
8	Spindler Hall	F2	73d	Shilling Hall	A2
52	Stadium Drive Apartments	F3	71c	Stinson Hall	A2
7	Vandercook Hall	F1			
10	Walwood Hall	F1			
48	Zimmerman Hall	D3			

Private Property

201	Lutheran Student Center	D2-3
202	St. Aidan's Chapel	B3-4
201	Wesley Foundation	B3-4

Conference on Senior Engineering Design Projects

You are invited to attend the tenth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 4 p.m. Tuesday, December 8, 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 invited 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 at Read Fieldhouse. School groups traveling in cars are invited to call Linda Hager at (616) 387-4017 at least one week before the conference to arrange for a parking permit.

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. The sign-in sheets will be mailed to teachers the day after the conference.

Metered parking is available in the ramp near the Bernhard Center, in the lot behind the Center, and in the lot to the west of the center, off Michigan Avenue. Meters are checked regularly.

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 numbers for project descriptions:

Electrical and Computer Systems Engineering	210	9 to 2	p. 4
Engineering Technology	209	9 to 1:30	p. 7
Industrial Engineering	204	2 to 4	p. 9
Mechanical and Aeronautical Engineering-A	208	9 to 3:30	p. 11
Mechanical and Aeronautical Engineering-B	211	9 to 2	p. 15
Paper Science and Engineering	204	9 to 11:30	p. 18

Coffee will be available in the Faculty Lounge (across from 211) from 8:30 to 10:30. A **lunch** break is scheduled from noon to 1 p.m.

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

EE = Electrical and Computer Systems Engineering
ET = Engineering Technology
IE = Industrial Engineering
MAE = Mechanical and Aeronautical Engineering
PSE = Paper Science and Engineering

Time	Room	Dept.	Topic
9	210	EE	Ignition Timing Meter
	209	ET	Optimizing Flow Parameters for Investment Casting
	208	MAE	Self-Regulated and Maximum Thrust-Seeking Propeller
	211	MAE	Automated Micro Command Test Fixture
	204	PSE	Anaerobic Treatment of Effluent From a Semi-Chemical Pulp and Paper Mill
9:30	210	EE	Design of a Variable Differential Pressure Transducer
	209	ET	Concurrent Engineering System and Product Development
	208	MAE	Metallic Tubular Frame for Sunseeker 93
	211	MAE	Resistance Welding Assembly Fixture
	204	PSE	Heating of Paper Coatings in Viscosity Measurements
10	210	EE	Cockpit Recorder Prototype With Degradation Test
	209	ET	Setup Reduction for an Acme-Gridley Bar Machine Line
	208	MAE	Marine Rack and Pinion Steering System Design
	211	MAE	Multi-Loop Automatic Process Control System
	204	PSE	The Strength of Acid and Alkaline Papers Produced From Secondary Fibers
10:30	210	EE	Mini-Helmholtz Control System
	209	ET	Design of a Propulsion Unit for a Hovercraft
	208	MAE	Modification of a Lifting Mechanism
	211	MAE	Transmission Design for a Solar Vehicle
	204	PSE	Steam Explosion of Wastepaper as a Pulping Process
11	210	EE	Modular Practice Amplifier System
	209	ET	Design of a Manual Starting and Charging System Analyzer
	208	MAE	Re-Design of Upright Trunnion Bearing
	211	MAE	“Design of Experiments” for an I.D. Grinder
	204	PSE	The Effect of Stock Turbulence on Flotation De-Inking Efficiency

Time	Room	Dept.	Topic
11:30	210	EE	Process pH Calibration Device
	209	ET	Mountain Bike Frame With Rear Suspension
	208	MAE	Thermal Stresses in a Composite Disc Brake Rotor
	211	MAE	Study of Casting Process for a Truck Rear Differential Housing
	204	PSE	Use of Non-Wood Fibers in Currency Paper

LUNCH BREAK NOON TO 1 P.M.

1	210	EE	Power Supply Switchiing Regulator
	209	ET	Shot-to-Shot Repeatability for Injection Molding
	208	MAE	Design of a 350-Ton Brake Press Frame
	211	MAE	Evaluation of the Use of Solar Cells Under Sunseeker 93
1:30	210	EE	DC Motor Testing Device
	209	ET	Noise Affecting Shot-to-Shot Repeatability in Injection Molding
	208	MAE	Design of a Stator Mapper
	211	MAE	Design of a Composite Frame for Sunseeker 93
2	210	EE	Data-Acquisition System for Solar-Powered Vehicle
	204	IE	Analysis of Casting Quality on Heavy-Duty Pistons
	208	MAE	Design of a Gasket-Cutting Machine
	211	MAE	Design of a Bubble Gum Unwrap and Recovery System
2:30	204	IE	Service Time Optimization
	208	MAE	Design of a Lightweight Braking System for an Alternative Energy Vehicle
3	204	IE	Development of an Inventory System
	208	MAE	An Optimized Rear Suspension Design for a Solar-Powered Vehicle
3:30	204	IE	Improving Engineering Change Orders
	208	MAE	Re-Design of a Tunnel Ram Intake Manifold
4	204	IE	Improving the Assembly of an Aircraft Fluid Collar

ELECTRICAL AND COMPUTER SYSTEMS ENGINEERING

Session Chair - John Gesink
Room 210

IGNITION TIMING METER

by Christopher Baumgartner, Stan Tomczyk, and Dale Woodin
Sponsor: David Hensley
Faculty Advisor: S. Hossein Mousavinezhad
9 to 9:25 a.m., Room 210

Automobile manufacturers are striving to improve the performance of engines. An engine's ignition timing is directly related to its performance. Ignition timing describes the piston's position when the spark plug fires. A microprocessor-based Ignition Timing Meter was engineered to compute and display ignition timing of a gasoline engine. Using the ITM's output in correlation with other engine parameters, ignition timing can be adjusted for optimal performance.

DESIGN OF A LINEAR VARIABLE DIFFERENTIAL PRESSURE TRANSDUCER

by Sufiyn AL-Surkhi, Mike Hintz, and Don Kublick
Sponsor: John Ames
Faculty Advisor: John Mason
9:30 to 9:55 a.m., Room 210

A stable, linear, and inexpensive device is needed to measure accurately the pressure difference between two lines of fluid. The pressure difference may range from zero, when both lines are at equal pressure, to full deflection, when one line is at zero pressure with the other at maximum pressure. The device, known as a transducer, must have linear output with the change in pressure. A transducer was designed that uses the principles of magnetic reluctance and will meet the requirements more completely than the capacitance-type transducers that dominate the market.

COCKPIT RECORDER PROTOTYPE WITH DEGRADATION TEST

by Jeffrey Fisher, Bill Jordan, and Cheryl Kuzee
Sponsor: Tim Terrioult
Faculty Advisor: S. Jalaleddine
10 to 10:25 a.m., Room 210

Cockpit voice recording plays a major role in information recovery after an aircraft mishap. New memory technology using analog storage devices was used to design a cockpit voice recorder prototype with internal degradation testing. The internal degradation test consists of both a power-up and a continuous test of memory recording. The purpose of these two tests is to determine if the recorder is active and functioning properly at all times. The objective is to determine in real time whether voice can be recorded and played back reliably within a pre-specified tolerance.

MINI-HELMHOLTZ CONTROL SYSTEM

by Joseph Chang, Jason F. Moser, and Steven C. Schmidt
Sponsors: Richard Fosmo and Mark Kramer
Faculty Advisor: Charles A. Davis
10:30 to 10:55 a.m., Room 210

Manufacturers of digital compasses have found it difficult to test the accuracy of their compasses, especially during the design stage. A desktop test apparatus was designed that uses a modified Helmholtz coil configuration and a microprocessor to produce a magnetic field in any direction, making it possible to verify the accuracy of a compass.

MODULAR PRACTICE AMPLIFIER SYSTEM

by Michael L. Cannady and J. Scott Ecie
Sponsor: David Colcome
Faculty Advisor: John Gesink
11 to 11:25 a.m., Room 210

Since the arrival of electric musical instruments, musicians have had to rely on amplification to hear their instruments in practice and in performance. The amplifiers used for live performances are cumbersome — neither light-weight nor portable. A practice amplifier system was built that consists of three compact portable modules: amplifier, audio effects, and loudspeaker. Each module is designed to work as part of the system and to function as an independent device. The final design was based on tests of the modules in the laboratory and by professional musicians for performance qualities.

PROCESS pH CALIBRATION DEVICE

by John Kantorowski, Todd A. Kline, and Jeff J. Kolp
Sponsors: James A. Gillis and Lawrence Davis
Faculty Advisor: Charles Davis
11:30 to 11:55 a.m., Room 210

The Process pH Calibration Device (CD) was designed to set the pH range of a 4-20 mA transmitter. During an actual chemical process, a pH probe senses the pH level of a solution and sends a voltage to a transmitter. The CD duplicates the voltages with compensation for the process' temperature and the probe's efficiency. The unit transmits the voltage through a coaxial cable to the transmitter. The transmitter can, therefore, be calibrated to the correct voltage.

LUNCH BREAK NOON TO 1 P.M.

POWER SUPPLY SWITCHING REGULATOR

by Baser Abdul Ghani, Fouad Aldossary, and Mohd Rashidy Jamaluddin
Faculty Advisor: S. Jalaleddine
1 to 1:25 p.m., Room 210

A power supply switching regulator was designed, without using existing integrated circuits, to convert a battery voltage to a specified fixed output voltage. The battery voltage can be either above or below the specified fixed output voltage. The regulator has low power consumption and delivers the required current with small output voltage ripple.

DC MOTOR TESTING DEVICE

by Johan Abu Chik and Rozieah Ahmad
Sponsor: Chris Philipp
Faculty Advisor: S. Hossein Mousavinezhad
1:30 to 1:55 p.m., Room 210

A DC motor testing device was designed to investigate whether the motor components under test are properly manufactured and assembled. The range of the phase angle and the peak voltage associated with the motor under test were observed. The hardware design uses an existing complete data acquisition board that features analog-to-digital conversion interfaced with a computer for displaying data. Software was written using a high-level language (BASIC) to analyze the characteristics of the waveforms.

DATA-ACQUISITION SYSTEM FOR SOLAR-POWERED VEHICLE

by Daniel P. Allen Jr., Jon P. Knorr, and Stephen L. Smith
Faculty Advisor: John Mason
2 to 2:25 p.m., Room 210

A data-acquisition system was designed and built to process information from several components of Western Michigan University's solar-powered vehicle. The components include the solar cells, batteries, motor, and motor controller. Information is collected from several transducers (devices that convert quantities such as temperature and frequency into an electrical signal), processed by a microprocessor, and transmitted to a chase vehicle for analysis.

ENGINEERING TECHNOLOGY

Session Chair - Sam Ramrattan
Room 209

OPTIMIZING FLOW PARAMETERS FOR INVESTMENT CASTING

by Jeff Barnes, Scott Boothroyd, and James Greilich
Sponsor: Dean Schmiedeknecht
Faculty Advisor: Pnina Ari-Gur
9 to 9:25 a.m., Room 209

A manufacturer of turbine blades has been using ceramic foam filters to screen tiny impurities from the molten metal. Use of the filter causes a reduction in fluid velocity, resulting in poor quality and incompletely filled castings. A water modeling system was designed and built to simulate metal flow. Conclusions reached from the water modeling were tested in metal castings. The castings were evaluated visually for fill completeness, and the filters were evaluated through optical microscopy for degree of impurity capture. An optimal system was developed to ensure complete fill and impurity capture.

CONCURRENT ENGINEERING SYSTEM AND PRODUCT DEVELOPMENT

by Bill Morey, Britt Mott, and Darla Warner
Faculty Advisor: Michael Atkins
9:30 to 9:55 a.m., Room 209

A concurrent engineering system was developed that integrates CAD/CAE/CAM technology. The "design to manufacture" environment incorporates Sun Microsystem SparcStations using CADKEY 5UX, CADKEY Analysis, and Cutting Edge software packages as well as a MAZAK NC milling machine to create the sample prototype. Instructional manuals exemplifying a case study in concurrent engineering were also created.

SETUP REDUCTION FOR AN ACME-GRIDLEY BAR MACHINE LINE

by John Coles, Kevin Hausermann, and Michael A. Selwa
Sponsor: Rick Koenig
Faculty Advisor: Charles Woodward
10 to 10:25 a.m., Room 209

Machine setup times for an Acme-Gridley bar machine line were excessive. Setup procedures were analyzed, and both machinery and setup procedures were modified to reduce the setup times.

DESIGN OF A PROPULSION UNIT FOR A HOVERCRAFT

by Timothy Carr, Michael J. Crowe, and Philip A. Senger
Sponsor: Gunter Senger
Faculty Advisor: Charles Woodward
10:30 to 10:55 a.m., Room 209

A hovercraft requires a propulsion system similar to an airplane's. Such a system was designed and built for an existing hovercraft. Factors considered included weight, stress, strain, and incorporating existing devices. Finite element analysis was used to determine the member sizes and safety. CADKEY was used to forecast interference of structure members with existing components by developing the design three-dimensionally.

DESIGN OF A MANUAL STARTING AND CHARGING SYSTEM ANALYZER

by Bill Costello, Lucas Dexter, Robert Eaton, Jeff Fuller, Dave Goddard, Chris Lynn, Hisham Mohammad, Jason Moody, and Tim VanAst
Sponsors: Frank Newton and Bill Cox
Faculty Advisors: Jim VanDePolder, John Walker, and Charles Woodward
11 to 11:25 a.m., Room 209

Three groups designed different manual automotive starting and charging system analyzers. Emphasis was placed on ease of use and marketability. The three designs were incorporated into one final design.

MOUNTAIN BIKE FRAME WITH REAR SUSPENSION

by Todd Baker, John J. MacArthur, and Darin J. Snider
Faculty Advisor: Charles Woodward
11:30 to 11:55 a.m., Room 209

A frame was designed, manufactured, and tested for a mountain bike that operates with a rear suspension system. The frame uses a non-traditional structural material. The rear suspension system incorporates the use of a shock absorber to help stabilize bicycle movement and give a more controlled ride.

LUNCH BREAK NOON TO 1 P.M.

SHOT-TO-SHOT REPEATABILITY FOR INJECTION MOLDING

by John P. Campbell, Scott N. Marshall, and Jonathan P. Sommers
Sponsor: Research & Technology Institute of West Michigan
Faculty Advisor: Paul Engelmann
1 to 1:25 p.m., Room 209

A large percentage of plastic parts are produced by injection molding. Consistent quality is maintained by part-to-part or "shot-to-shot" repeatability. A strategy was developed to control shot-to-shot repeatability. Literature was reviewed and a statistical design of experiments was conducted to isolate the critical variables affecting the control of injection molding. Sources of error were reduced by monitoring and controlling the variables. A control strategy was developed to reduce fluctuation in critical machine variables.

NOISE AFFECTING SHOT-TO-SHOT REPEATABILITY IN INJECTION MOLDING

by Andrew D. Bodfish, Andrew H. Dennison, and Lisa M. Howard
Sponsor: Research & Technology Institute of West Michigan
Faculty Advisor: Paul Engelmann
1:30 to 1:55 p.m., Room 209

Control of machine noise is crucial to machine stability in the injection molding process. Machine noise is defined as the uncontrolled and often unseen fluctuations of a machine variable without any change in the set point for that variable. Shot-to-shot (or part-to-part) repeatability aids in achieving quality parts. Various locations on an injection molder that are likely to produce machine noise were monitored by installing measuring devices. Data were collected through a computer attached to the machine. Companies can apply the results to optimize operations with a minimum of measuring equipment.

INDUSTRIAL ENGINEERING

Session Chairs - Liwana Bringelson and David Lyth
Room 204

ANALYSIS OF CASTING QUALITY ON HEAVY-DUTY PISTONS

by Johnell Funke, Hoyt Preis, and Jaime Suarez
Sponsor: Jerry Schenkel
Faculty Advisors: Liwana Bringelson and David Lyth
2 to 2:25 p.m., Room 204

Variations in the porosity of aluminum pistons occurred during casting at a product development and production facility. The percentage of scrapped pistons ranged from 2% to 50% of the total output per work cell. The methods, materials, machines, and workers were analyzed, and recommendations were made to decrease the percentage of defects.

SERVICE TIME OPTIMIZATION

by Tam Bui and Patrick Wundrach
Sponsors: Sydney Parker and Kris Garlick
Faculty Advisors: Liwana Bringelson and David Lyth
2:30 to 2:55 p.m., Room 204

A manufacturer of industrial reel mechanisms wants to optimize the sales order system to better serve direct customers, representatives, and distributors. Existing data were researched, new data were collected, customer satisfaction research was studied, direct observations were made, and computer simulations were performed. A revised system was developed that will reduce ordering errors, improve employee efficiency, and improve customer satisfaction.

DEVELOPMENT OF AN INVENTORY SYSTEM

by Tom Boeve, Tom Rohlwing, and John VanBragt
Sponsors: Rick Murphy and Ron Kelly
Faculty Advisors: Liwana Bringelson and David Lyth
3 to 3:25 p.m., Room 204

The maintenance department of a paper and packaging company had virtually no formal organized inventory system. The company also had poor storage space utilization. Maintenance records were used to determine which parts were used most frequently. A classification system was established which includes quantity and spatial requirements. A layout of the storage area was created based on these requirements. A procedure was developed to implement and use the proposed system. Finally, a plan was investigated, analyzed, and suggested for future improvements to maintain and upgrade the inventory system.

IMPROVING ENGINEERING CHANGE ORDERS

by Rob Bachula and Steven Gill
Sponsors: Jan Walter, David Truman, and David Tucker
Faculty Advisors: Liwana Bringelson and David Lyth
3:30 to 3:55 p.m., Room 204

A manufacturer of custom liquid filters makes changes to products and processes through engineering change orders (ECOs) in accordance with guidelines set by the International Standards Model (ISO 9001). Processing of an ECO from start to finish can take from two weeks to several months. Recommendations were made for changes that reduce the processing time of ECOs while maintaining the quality system as guided by ISO 9001.

IMPROVING THE ASSEMBLY OF AN AIRCRAFT FLUID COLLAR

by Eric Hummel and Rick McKay
Sponsor: Jim Ritsema
Faculty Advisors: Liwana Bringelson and David Lyth
4 to 4:25 p.m., Room 204

A small machining job shop wanted to improve efficiency in its production of an oil transfer collar used for changing the pitch of propellers on small aircraft. The assembly process was analyzed and several new assembly methods were recommended that will improve efficiency while maintaining quality.

MECHANICAL AND AERONAUTICAL ENGINEERING - SESSION A

Session Chair - Philip Guichelaar
Room 208

SELF-REGULATED AND MAXIMUM THRUST-SEEKING PROPELLER

by Keith E. Southerton
Faculty Advisor: Arthur Hoadley
9 to 9:25 a.m., Room 208

A variable pitch propeller was designed for use on a model airplane. The standard fixed-pitch propellers vary rotational speed as a change in thrust is desired. The disadvantage is that blade efficiency varies with aircraft forward speed and engine power setting. A variable-pitch propeller maintains high efficiency at all speeds throughout the aircraft's flight. The variable-pitch propeller system monitors its thrust and automatically adjusts the propeller's blade angle to maximize thrust. Characteristics of the new propeller were verified in the Western Michigan University wind tunnel.

METALLIC TUBULAR FRAME FOR SUNSEEKER 93

by Samuel C. Sayles and Robert P. Yokabitus
Faculty Advisor: Judah Ari-Gur
9:30 to 9:55 a.m., Room 208

A metallic tubular frame was designed and constructed for WMU's new solar-powered vehicle, Sunseeker 93. It was designed for minimum weight, the required stiffness and rigidity, geometrical limitations of the aerodynamic profiles, and attachment points for the driveline and suspension. ALGOR finite element analysis software was used to optimize the stiffness and strength of the frame design.

MARINE RACK AND PINION STEERING SYSTEM DESIGN

by John C. Thomas and Christopher K. Wachowski
Sponsor: Ernie Waterhouse
Faculty Advisor: Dennis VandenBrink
10 to 10:25 a.m., Room 208

A marine rack and pinion steering system was designed to be cost-competitive and lightweight and to meet the American Boat and Yacht Council's P-17 standards for steering systems. Research was done on component materials and cost-effective manufacturing processes. After structural tests and gear tooth analysis had been performed on different materials, final materials and manufacturing processes were chosen for the rack, pinion gear, housing, and helm assembly. A design was chosen and a prototype system was built for testing in accordance with the American Boat and Yacht Council's standards for safety, durability, and strength.

MODIFICATION OF A LIFTING MECHANISM

by Rajan V. Vyas and Phong H. Tran
Sponsor: R. Scott Hand
Faculty Advisor: Dennis VandenBrink
10:30 to 10:55 a.m., Room 208

A height-adjustable work surface moves vertically by a gear arm mechanism. The mechanism wears out because of the high concentration of forces on the gear teeth, resulting in wear on the gear teeth, which leads to an unbalanced work surface and friction on the slide railing on which the work surface sits. In evaluating the current design, several modifications of the mechanism were considered, along with packaging, cost and manufacturing issues. A work surface incorporating these criteria was designed to standards set by the furniture manufacturing association.

RE-DESIGN OF UPRIGHT TRUNNION BEARING

by Nader Farhadi and Walter J. Girardi
Sponsors: Reed Vivatson and Jim Holder
Faculty Advisor: Dennis VandenBrink
11 to 11:25 a.m., Room 208

Many forklift trucks use metal trunnion bearings to carry the external loads and provide tilting rotation of the upright. Large external forces, high temperatures, manufacturing tolerances, surface pressure, and contamination cause premature failures of these bearings. The current metal bearings were re-designed using a light-weight, lubricant-free composite material to increase the bearing life expectancy.

THERMAL STRESSES IN A COMPOSITE DISC BRAKE ROTOR

by Paul E. Bassett and Bradley L. Busscher
Sponsor: Jay Easwaran
Faculty Advisor: Jay Easwaran
11:30 to 11:55 a.m., Room 208

Previous finite element analysis of a composite disc brake rotor (consisting of a grey iron wear surface bonded to an aluminum heat transfer core) had not considered differences in thermal coefficients of expansion and the resultant stresses at the interface. An analysis was performed of thermally induced stresses, and problems in the operation of the rotor were solved.

LUNCH BREAK NOON TO 1 P.M.

DESIGN OF A 350-TON BRAKE PRESS FRAME

by Rich H. Deskovitz and John B. Moran
Sponsor: Gary L. McNeil
Faculty Advisor: Philip Guichelaar
1 to 1:25 p.m., Room 208

A frame was designed for a 350-ton hydraulic brake press. The frame must maintain low deflections while providing a convenient working height for the press operator. The press is not permanently fixed to the floor, so it can be relocated throughout the working area. Finite element analysis software was used to model the frame and determine deflection and stress. Several frame structures were modeled to determine the optimal design.

DESIGN OF A STATOR MAPPER

by Adrian Dinescu and Christy Pingol
Sponsor: John Smiley
Faculty Advisor: Philip Guichelaar
1:30 to 1:55 p.m., Room 208

Rebuilding of damaged alternators requires the detection of shorts in stator windings. A device called a Stator Mapper was developed for measuring and locating the local magnetic field intensity in an alternator stator. The mechanical portion of the device was designed to quickly accommodate different sizes of the stator.

DESIGN OF A GASKET-CUTTING MACHINE

by David Byrne and Matthew Heintz
Sponsor: Kenneth Kakabaker
Faculty Advisor: Philip Guichelaar
2 to 2:25 p.m., Room 208

A gasket-cutting operation requires the gaskets to be accurate within .005 inch. The present machine requires three to four trials before dimensions are within tolerances, resulting in a 20 percent scrap rate. The machine must cut a wide range of sizes and a wide variety of materials. Capital investment must be kept to a minimum. A machine was designed to obtain dimensions within tolerances on the first trial. Other recommendations were made to improve the safety and dimensional stabiity of the machine.

DESIGN OF A LIGHTWEIGHT BRAKING SYSTEM FOR AN ALTERNATIVE ENERGY VEHICLE

by Kevin Brogan
Faculty Advisor: Richard Hathaway
2:30 to 2:55 p.m., Room 208

A lightweight, low-drag braking system was designed for a solar-powered car which will be raced across America in Sunrayce 93. Finite element analysis techniques were used to examine stresses and heat dissipation performance. A sensitivity analysis was conducted to determine the influence of design parameters on braking performance factors such as smoothness, braking capacity, and resistance to fading.

AN OPTIMIZED REAR SUSPENSION DESIGN FOR A SOLAR-POWERED VEHICLE

by Dean Notter
Faculty Advisor: Richard Hathaway
3 to 3:25 p.m., Room 208

An optimized rear suspension was designed for the solar-powered vehicle Sunseeker 93 to meet the overall design constraints of a 92-inch wheel base, 60-inch wheel track, and an overall vehicle height of 40 inches. The suspension utilizes high-strength, light-weight, and high-fatigue-life materials. Emphasis is placed on efficiency, weight, and vehicle handling using a systems approach which included considerations of the placement of critical forces into the vehicle frame structure. Finite element analysis of stress and deflection, and prototype testing resulted in high strength to weight ratio, decreasing the overall size and weight of suspension members.

RE-DESIGN OF A TUNNEL RAM INTAKE MANIFOLD

by Shawn Bryan and Sherry Graham
Sponsor: Ken Hassing
Faculty Advisor: Richard Hathaway
3:30 to 3:55 p.m., Room 208

A local company wanted more horsepower information for a tunnel ram intake manifold. The intake manifold is intended for use on a Ford 351 w engine to increase horsepower up to 25 percent. Various changes in the manifold design were tested. Design modifications were recommended for improved performance.

MECHANICAL AND AERONAUTICAL ENGINEERING - SESSION B

Session Chair - Iskender Sahin
Room 211

AUTOMATED MICRO COMMAND TEST FIXTURE

by Dave Goodwin
Sponsor: Jim Kerr
Faculty Advisor: Jerry Hamelink
9 to 9:25 a.m., Room 211

An automated fixture was designed to reduce test lab technician involvement in product development and validation testing of medical instruments. The automated fixture can hold and test two different instruments simultaneously. Blades attached to the instruments cut off pieces of test boards which are positioned on the fixture by board advance mechanisms. The fixture approximates normal use by a surgeon or dentist. A programmable logic controller sequences the hardware/software for the required motions and is completely modifiable. Possible testing with the fixture includes instrument drivetrain life testing, blade cutting efficiency, and temperature rise in the instrument.

RESISTANCE WELDING ASSEMBLY FIXTURE

by Dwight D. Smith
Sponsors: Tito Garcia and John Izenbaard
Faculty Advisor: Jerry Hamelink
9:30 to 9:55 a.m., Room 211

A resistance welding fixture was designed and built to assemble two small trigger components used in drills, reamers, and saws. Previous fixtures did not align components correctly or place welds as specified by the assembly print. The engineering plastic Techtron was used to meet electrical and thermal resistance requirements. Techtron also allowed for tight tolerances on the moving fixture parts for consistent component retention. A large cost reduction was realized from elimination of weld process scrap and returns because of trigger failures.

MULTI-LOOP AUTOMATIC PROCESS CONTROL SYSTEM

by Lynley Palmer
Sponsor: Pete M. Spry
Faculty Advisor: Jerry Hamelink
10 to 10:25 a.m., Room 211

Automatic control systems for machinery and processes optimize efficiency and quality control. A system was devised to automatically manipulate the output of a viscous material, based on the flow rate and percent concentration changes of a fluid over time. Process characteristics were analyzed, and equipment specifications were developed to implement the process change effectively. The system was tested to validate all design criteria and to ensure quality control standards.

TRANSMISSION DESIGN FOR A SOLAR VEHICLE

by Matthew Evans, Daniel Modzeleski, and Curtis Owens
Faculty Advisor: Jerry Hamelink
10:30 to 10:55 a.m., Room 211

Factors taken into account in the design of a transmission for Sunseeker 93, Western Michigan University's new solar-powered car, must include weight, efficiency, reliability, manufacturability, and pre-determined design requirements. Based on these factors and motor selection, different types of transmissions were investigated. Given the performance requirements of the vehicle, various loads were calculated to assist in the sizing of components and the selection of reduction ratios and appropriate materials.

"DESIGN OF EXPERIMENTS" FOR AN I.D. GRINDER

by Dennis Bateman and Michael Smith
Sponsors: Eugene Smith and William Hess
Faculty Advisor: Jerry Hamelink
11 to 11:25 a.m., Room 211

A "design of experiments" test was performed on an internal diameter grinder to determine the variables that affect the accuracy and quality of the grind. Tolerances are 20 millionths of an inch. Using factorial design techniques, the variables that have the greatest influence upon the tolerances were found, and an equation was developed relating the effect of each variable to the quality of the grinding operation.

STUDY OF CASTING PROCESS FOR A TRUCK REAR DIFFERENTIAL HOUSING

by Jerrold Kung and Peter J. Szczesny
Sponsor: Jim Falconer
Faculty Advisor: Jerry Hamelink
11:30 to 11:55 a.m., Room 211

A reduction was proposed in the weight of the sand core for the rear differential housing of a truck. Various dimensions were compared with and without the extra weight to ensure that the weight had no effect on the final casting. Factors governing the variability of these dimensions were considered. Changes were proposed and implemented based on statistical data to produce the desired casting.

LUNCH BREAK NOON TO 1 P.M.

EVALUATION OF THE USE OF SOLAR CELLS UNDER SUNSEEKER 93

by Leigh Lindsey and Bret Seelinger
Faculty Advisor: Richard Schubert
1 to 1:25 p.m., Room 211

Solar cells were tested for use under the rear portion of Sunseeker 93, Western Michigan University's new solar-powered vehicle, with the objective of adding power to the battery. A half-scale model was built for test purposes. The cells were positioned to pick up diffused and reflected light. A study was done with four different cells on three separate surfaces under varying weather conditions. Energy gain from each type of cell was determined.

DESIGN OF A COMPOSITE FRAME FOR SUNSEEKER 93

by Kevin Bell and Ralph Nelson
Faculty Advisor: Richard Schubert
1:30 to 1:55 p.m., Room 211

A study was conducted of the use of high-strength, light-weight composite materials for the primary structure of Sunseeker 93, Western Michigan University's new solar-powered vehicle. Design requirements were optimization of stiffness and weight and integration with overall vehicle needs. The study included research of material properties, development of geometric forms, extensive computer simulation, and manufacture of a model.

DESIGN OF A BUBBLE GUM UNWRAP AND RECOVERY SYSTEM

by Brian Clayborne, Steve Schenten, Mohd Isa Yahaya, and Mohd Akhbar Yahya
Sponsor: Ronald Rouse
Faculty Advisor: Chris Cho
2 to 2:25 p.m., Room 211

A confectionery company produces a chunk-style bubble gum. A relatively large amount of package waste is created during the wrapping process. A cost-effective method was needed to unwrap, recover, and re-process the gum. The present system was redesigned to reduce manpower, improve working conditions, improve the stripper unit, and improve overall efficiency.

PAPER SCIENCE AND ENGINEERING

Session Chair - Ellsworth Shriver
Room 204

ANAEROBIC TREATMENT OF EFFLUENT FROM A SEMI-CHEMICAL PULP AND PAPER MILL

by Maria A. Shea
Sponsors: Keith Kling
Faculty Advisor: David Peterson
9 to 9:25 a.m., Room 204

Anaerobic treatment is proposed and implemented as a viable alternative to aerobic treatment of industrial wastewaters. Anaerobic wastewater treatment involves the bacterial process of converting organic wastes to methane and carbon dioxide. An Upflow Anaerobic Sludge Blanket Reactor was used to reduce the amount of biological oxygen demand and total suspended solids from the effluent stream from a semi-chemical pulp and paper mill.

HEATING OF PAPER COATINGS IN VISCOSITY MEASUREMENTS

by Amy Lauckner
Sponsor: Jon T. Dean
Faculty Advisor: Nick Triantafillopoulos
9:30 to 9:55 a.m., Room 204

Coatings are viscous suspensions used to modify the surface properties of paper for printing. The viscosity of coatings is measured in order to predict and control application and coated paper performance. These measurements are limited, however, by inaccuracies that arise from heat generated during the measurement of coating viscosity. The viscous heating reduces coating viscosity, making it difficult to control applications dependent upon viscosity. Heating effects were quantified to develop a relationship between shear and viscosity. The relationship can be used to correct viscosity measurements.

THE STRENGTH OF ACID AND ALKALINE PAPERS PRODUCED FROM SECONDARY FIBERS

by Peter E. Fernstrum Jr.
Sponsors: Donald Booker and Thomas Rienzo
Faculty Advisor: Nick Triantafillopoulos
10 to 10:25 a.m., Room 204

Limited work has been done in studying the strength of paper made with 100 percent reclaimed fibers. An investigation was done on the effect of reclaimed fibers on the strength properties of acid and alkaline papers.

STEAM EXPLOSION OF WASTEPAPER AS A PULPING PROCESS

by Edward G. Schmitt III
Sponsors: Howard Spalt and Phillip Hoekestra
Faculty Advisor: Ellsworth Shriver
10:30 to 10:55 a.m., Room 204

The effect of high pressure steam on recycled fiber properties was studied in an attempt to develop a new pulping process. Ink particles in the resulting pulp are extremely small and dispersed, lowering de-inking requirements, and less energy is used. The goal was to achieve a pulp that is equal to or better than comparable pulp from existing methods but with smaller and better dispersion of ink particles.

THE EFFECT OF STOCK TURBULENCE ON FLOTATION DE-INKING EFFICIENCY

by Mark J. Zempel
Faculty Advisor: William Forester
11 to 11:25 a.m., Room 204

The recent emphasis on recycling has led to greater interest in the fundamental mechanisms involved in the de-inking of waste paper, specifically the flotation de-inking process. By adjusting air flow, bubble size, and other variables, the effect was studied of changing stock turbulence on flotation de-inking efficiency; the goal was to provide de-inking mills with better information on how to run flotation de-inking cells. Using a modified rotameter to measure density and a force bar to determine flow force in the pilot flotation cell, the effect was evaluated of changing these parameters while keeping others constant. An image analyzer was used to note pulp brightness change and ink speck removal. Optimum operating ranges were found.

USE OF NON-WOOD FIBERS IN CURRENCY PAPER

by Barbara Ness
Faculty Advisor: Ellsworth Shriver
11:30 to 11:55 a.m., Room 204

Recent estimates show that the circulation life of the dollar bill has dropped 50 percent since 1986. To increase circulation life of currency paper, specifically dollar bills, and thereby also reduce production costs, the paper must be strengthened. In an effort to accomplish this goal, natural non-wood fibers were added to the currency paper pulp. Strength properties, especially folding strength, of paper depend on the fiber length present in the paper, and the key property of natural non-wood fibers is their great length. The longer the fibers, the stronger the paper, provided that sufficient bonding occurs between fibers. The addition of longer fibers increased the folding strength significantly.

Thank You

The College of Engineering and Applied Sciences is grateful to the following firms, which have provided or cooperated in Senior Engineering Design Projects being presented in December 1992. If you have a project for our students, or if you would like more information about a specific project, please call Linda Hager at (616) 387-4017.

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College of Engineering and Applied Sciences
Western Michigan University
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