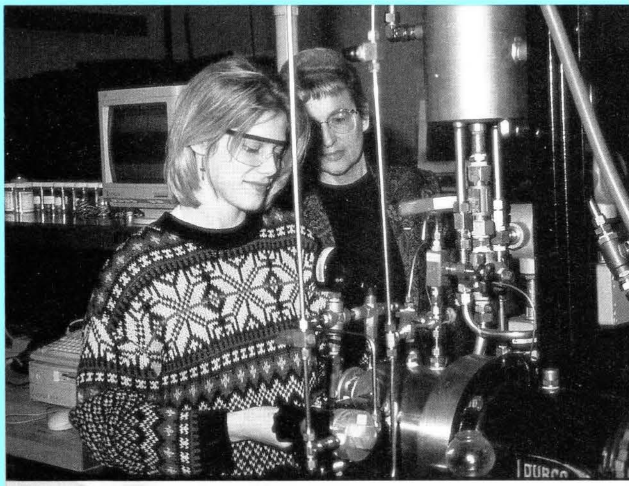
4-1998

22nd Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

22nd Conference on Senior Engineering Design Projects



Tuesday, April 14, 1998

Bernhard Center

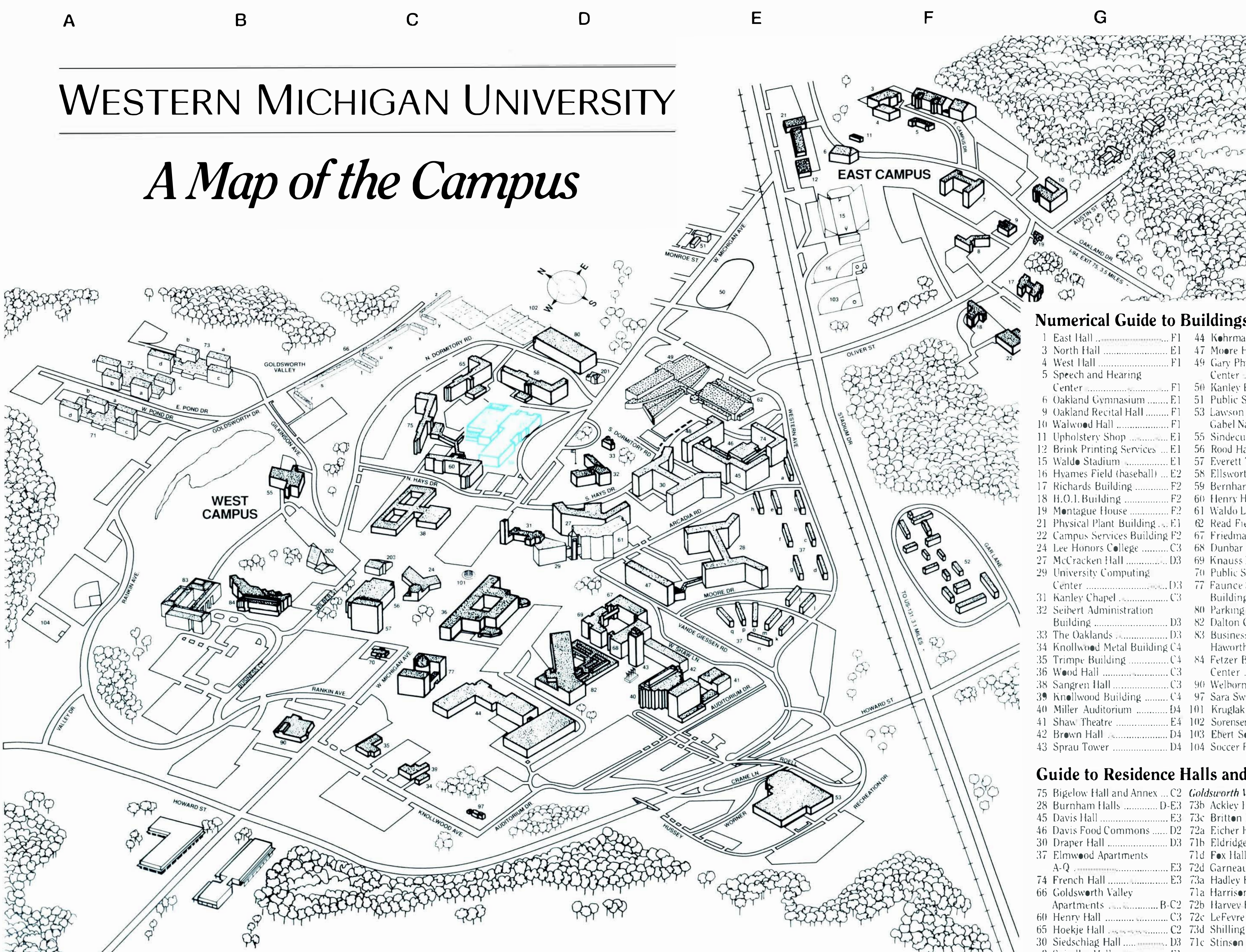
9:00 a.m. to 4:30 p.m.

College of Engineering and Applied Sciences

Western Michigan University

WESTERN MICHIGAN UNIVERSITY

A Map of the Campus



Numerical Guide to Buildings

- 1 East Hall ... F1
- 3 North Hall ... E1
- 4 West Hall ... F1
- 5 Speech and Hearing Center ... F1
- 6 Oakland Gymnasium ... E1
- 9 Oakland Recital Hall ... F1
- 10 Walwood Hall ... F1
- 11 Upholstery Shop ... E1
- 12 Brink Printing Services ... E1
- 15 Waldo Stadium ... E1
- 16 Hyames Field (baseball) ... E2
- 17 Richards Building ... F2
- 18 H.O.I. Building ... F2
- 19 Montague House ... F2
- 21 Physical Plant Building ... E1
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- 24 Lee Honors College ... C3
- 27 McCracken Hall ... D3
- 29 University Computing Center ... D3
- 31 Kanley Chapel ... C3
- 32 Seibert Administration Building ... D3
- 33 The Oaklands ... D3
- 34 Knollwood Metal Building C4
- 35 Trimpe Building ... C4
- 36 Wood Hall ... C3
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- 39 Knollwood Building ... C4
- 40 Miller Auditorium ... D4
- 41 Shaw Theatre ... E4
- 42 Brown Hall ... D4
- 43 Sprau Tower ... D4
- 44 Kohrman Hall ... C-D4
- 47 Moore Hall ... D3
- 49 Gary Physical Education Center ... E2
- 50 Kanley Running Track ... E2
- 51 Public Safety ... D1
- 53 Lawson Ice Arena and Gabel Natatorium ... E4
- 55 Sindecuse Health Center . B3
- 56 Rood Hall ... C3
- 57 Everett Tower ... C3
- 58 Ellsworth Hall ... D2
- 59 Bernhard Center ... C2
- 60 Henry Hall ... C3
- 61 Waldo Library ... D3
- 62 Read Fieldhouse ... E2
- 67 Friedmann Hall ... D3
- 68 Dunbar Hall ... D3
- 69 Knauss Hall ... D3
- 70 Public Safety Annex ... C4
- 77 Faunce Student Services Building ... C4
- 80 Parking Structure ... D2
- 82 Dalton Center ... D4
- 83 Business Building, Haworth College of ... B3
- 84 Fetzer Business Development Center ... B3
- 90 Welborn Hall ... B4
- 97 Sara Swickard Preschool . C4
- 101 Kruglak Sundial ... C3
- 102 Sorensen Tennis Courts ... C2
- 103 Ebert Softball Field ... E2
- 104 Soccer Field ... A3

Guide to Residence Halls and Apartments

- 75 Bigelow Hall and Annex ... C2
- 28 Burnham Halls ... D-E3
- 45 Davis Hall ... E3
- 46 Davis Food Commons ... D2
- 30 Draper Hall ... D3
- 37 Elmwood Apartments A-Q ... E3
- 74 French Hall ... E3
- 66 Goldsworth Valley Apartments ... B-C2
- 60 Henry Hall ... C3
- 65 Hoekje Hall ... C2
- 30 Siedschlag Hall ... D3
- 8 Spindler Hall ... F1
- 52 Stadium Drive Apartmts. . F3
- 7 Vandercook Hall ... F1
- 10 Walwood Hall ... F1
- 48 Zimmerman Hall ... D2

Goldsworth Valley Units 1, 2, 3:

- 73b Ackley Hall ... B2
- 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 ... B2
- 73d Shilling Hall ... B2
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Private Property

- 201 Lutheran Student Center D2
- 202 St. Aidan's Chapel ... B3
- 203 Wesley Foundation ... C3

Conference on Senior Engineering Design Projects

You are invited to attend the twenty-second Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 4:30 p.m. Tuesday, April 14, 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	205	9:00 to 10:00	p. 5
Electrical and Computer Engineering	210	9:00 to 4:00	p. 6
Industrial Design	242	9:00 to 12:00	p. 11
Industrial and Manufacturing Engineering - A-I	208	9:30 to 11:30	p. 14
Industrial and Manufacturing Engineering - A-II	208	1:00 to 3:00	p. 17
Industrial and Manufacturing Engineering - B-I	209	9:30 to 11:30	p. 19
Materials Engineering	205	1:00 to 1:30	p. 21
Mechanical and Aeronautical Engineering - A-I	212	9:30 to 11:30	p. 22
Mechanical and Aeronautical Engineering - A-II	212	1:00 to 3:30	p. 24
Mechanical and Aeronautical Engineering - B - I	213	9:30 to 11:30	p. 26
Mechanical and Aeronautical Engineering - B - II	213	1:00 to 3:30	p. 28
Mechanical and Aeronautical Engineering - C - I	215	9:00 to 11:30	p. 31
Mechanical and Aeronautical Engineering - C - II	215	1:00 to 3:30	p. 34
Paper Science and Engineering	211	9:00 to 3:30	p. 36

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
ECE = Electrical and Computer Engineering
ID = Industrial Design
IME = Industrial and Manufacturing Engineering
MME = Materials Engineering
MAE = Mechanical and Aeronautical Engineering
PSE = Paper Science and Engineering

Time	Room	Dept.	Topic
9:00	205	CEM	Estimating and Scheduling of Kohrman Hall Chiller Plant Expansion Project
	210	ECE	Barcode Scanner Interface Module
	242	ID	"Driveright" Automotive Center Console and Seat Design
	215	MAE-C-I	Testing Stand for Combined Bending and Torsion Loading
	211	PSE	Eliminating Coating Flakes With Ultrasound
9:30	205	CEM	Estimating and Scheduling the Old US-31 and US-31 Bridge Project
	210	ECE	Harpoon® Early Warning Fault Detection System
	242	ID	"Hokusai" Floor Console System for a Mid-Size Sport Sedan
	208	IME-A-I	Determining Time Standards at a Manufacturing Facility
	209	IME-B-I	Design and Evaluation of Entry Level Graphics Course Curriculum
	212	MAE-A-I	Continuous Variable Valve Actuation System
	213	MAE-B-I	Optimum Design of Cooling Fins for a Vane Pump
	215	MAE-C-I	Automated Test Stand Facility for Pneumatic Regulators
	211	PSE	The Effects of Recycling on Kenaf Handsheet Properties
10:00	205	CEM	Construction Schedule and Cost Estimate for the Centre Street Bridge
	210	ECE	Water Filtration Control System
	242	ID	"UNO" Compact Dishwasher Design
	208	IME-A-I	The Evaluation and Modeling of Known System Variability on Inventory Requirements
	209	IME-B-I	Parametric Modeling of the Human Spine
	212	MAE-A-I	Rack and Pinion Steering System Dynamometer
	213	MAE-B-I	Noise Reduction Device for Pressure Reducing Valves
	215	MAE-C-I	Test Fixture for Dishwasher Panel Noise and Vibration Analysis
	211	PSE	The Recycling of Vacuum-Formed Products and the Effect on Use Characteristics

10:30	210	ECE	Drummer Emulator
	242	ID	"Horizon" Dishwasher Design
	208	IME-A-I	Evaluation of Space at a Spice Extraction Company
	209	IME-B-I	A Conceptual Prototype of a Hydraulic Regenerative Braking System
	212	MAE-A-I	Smart Opto-Electric Mirror Adjustment System
	213	MAE-B-I	Energy Management System for Landing Aircraft
	215	MAE-C-I	Experimental Determination of the Thermal Characteristics of a Mechanical Seal
	211	PSE	The Use of Borates in Wet End Chemistry
11:00	210	ECE	Automated Visual Memory Scan Tester
	242	ID	"Finger Touch" Home Dry Cleaning Machine
	208	IME-A-I	Increasing Productivity and Efficiency for a Blister Packaging Area
	209	IME-B-I	Automotive Passenger Compartment Heating System
	212	MAE-A-I	Modification of General Motors TH700R4 Automatic Transmission for High Powered Applications
	213	MAE-B-I	Flight Management Computer for Light Aircraft
	215	MAE-C-I	Conveyor Drive Mechanism to Power Skewed Rollers
	211	PSE	Comparison of the Effects of Silicate and Borate in the Peroxide Bleaching of Mechanical Pulp
11:30	210	ECE	Three Channel Sound Location Device
	242	ID	"Easywash" Micro Portable Laundry
	208	IME-A-I	Reducing Machine Downtime Through Improved Material Flow
	209	IME-B-I	Raising Disabled Hunters to New Heights
	212	MAE-A-I	A Solution to a High Tool Failure Rate
	213	MAE-B-I	Thrust Cell Validation
	215	MAE-C-I	Test System for Dynamic Characterization of Elastomers
	211	PSE	The Effect of Using Hemicellulase and Oxidase Consecutively as Pre-Bleaching Agents for Hardwood Kraft Pulp
12:00	242	ID	"Insignia" Clothing Synthesis 2050
1:00	210	ECE	Automated Psychological Testing Device
	208	IME-A-II	ISO-9001 Implementation Plan
	205	MME	Innovative Materials for Offset Printing
	212	MAE-A-II	Power Steering Dynamometer
	213	MAE-B-II	Redesign of Sealing Components for Doughnut and Pastry Filler Machine
	215	MAE-C-II	Redesign and Optimization of Piston Rod

1:00	211	PSE	The Effects of Multiple Recycles on Paper Produced with 70% Softwood and 30% Wheat Straw Fiber
1:30	210	ECE	Ultrasonic End-of-Lane Alert Device
	208	IME-A-II	Injection Mold Wear Study With Lights-Out Automation
	205	MME	Friction Welding of Aluminum Propeller Shafts
	212	MAE-A-II	Vacuum Filter Piping Optimization
	213	MAE-B-II	Analysis and Redesign of Internal Switching Valve for a Mechanical Pumping Trap
	215	MAE-C-II	Durability Test Equipment for Gas Springs
	211	PSE	Effects of Cationic Additives on Ink-Jet Coating Formulations
2:00	210	ECE	Infrared Straight Line Detector
	208	IME-A-II	Quality Improvement in Transmission Cable Assembly
	212	MAE-A-II	Redesign of Production Test Stand for Automation
	213	MAE-B-II	Atmospheric Tether Mission: Endmass Design
	215	MAE-C-II	Redesign of a Quick-Change Die Assembly
	211	PSE	Analysis of Ink-Jet Coating Formulation Variables
2:30	210	ECE	Electronic Pedometer
	208	IME-A-II	Advanced Tool Measuring System: From the Stone Age to Star Wars
	212	MAE-A-II	Integrating Mechanics of Materials into Designing a Goalball Goalpost
	213	MAE-B-II	Motor Lift Conveyor
	215	MAE-C-II	Cup Endurance Test Apparatus
	211	PSE	Use of Borax to Inhibit the Photoyellowing of Bleached CTMP
3:00	210	ECE	Sunseeker Cruise Control
	208	IME-A-II	Improving the Process for a Headliner Assembly
	212	MAE-A-II	Design of a Checkstand Conveyor System for the International Market
	213	MAE-B-II	Ball Returner for Goalball
	215	MAE-C-II	Adjustable Arm Cap Redesign
	211	PSE	Chemically Enhanced Wet Pressing
3:30	210	ECE	Engineering Investigation of Digital Filters
	212	MAE-A-II	Process for Attaching Cable Ends to Cable Core Wires
	213	MAE-B-II	Rear Door Child Security System With Adult Override Mechanism
	215	MAE-C-II	Design & Development of a Mechanical Cardiac Valve Prosthesis
	211	PSE	The Effects of Directional Drying on Binder Migration
4:00	210	ECE	Flash Programmer

CONSTRUCTION ENGINEERING AND MANAGEMENT

Session Chair - Osama Abudayyeh
Room 205

ESTIMATING AND SCHEDULING OF KOHRMAN HALL CHILLER PLANT EXPANSION PROJECT

by Mike Jones, Rick Parcheta, and Mark Rookus
Faculty Advisor: Anil Sawhney
9:00 a.m. to 9:25 a.m., Room 205

This project involved estimating and scheduling the Kohrman Hall Chiller Plant Expansion project during the winter 1998 semester. WinEstimator and Primavera software were used to develop a detailed project estimate and a schedule for completing the project. Quantity take-offs were obtained directly from the chiller plant blueprints using a digitizer and related software. Estimate and scheduling results were compared with the actual results of the completed project.

ESTIMATING AND SCHEDULING THE OLD US-31 AND US-31 BRIDGE PROJECT

by Brett Arrans and Ryan Roberts
Sponsor: Paul Steinman - Michigan Department of Transportation
Faculty Advisor: Osama Abudayyeh
9:30 a.m. to 9:55 a.m., Room 205

This project involved estimating and scheduling the multi-million dollar construction of an overpass bridge on the new US-31 highway over the old US-31. A detailed estimate, a schedule, and a project management system were developed for the bridge construction. The estimate involved performing a quantity take-off of the items and then matching them with appropriate values to come up with a total project cost. The management system includes a safety program, quality assurance guidelines, a cost schedule, project controls, and a project schedule.

CONSTRUCTION SCHEDULE AND COST ESTIMATE FOR THE CENTRE STREET BRIDGE

by Paul Kettleson, Ryan Lindman, and Jeff Timmerman
Faculty Advisors: Osama Abudayyeh and Anil Sawhney
10:00 a.m. to 10:25 a.m., Room 205

A cost estimate and construction schedule were developed for the renovation of a short-span bridge located on Centre Street. A project management system was also created. The cost estimate and construction schedule were compared to the actual working documents used on the bridge project and were used to forecast the duration and cost of future construction. The management system includes a safety program, a quality program, and a method for collecting, analyzing, and reporting data relevant to this type of construction.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair - John Gesink
Room 210

BARCODE SCANNER INTERFACE MODULE

by Angelo Emanuele, Eric Fox, and Mark Jacob
Sponsor: Anthony Tisler - Jabil Circuit, Inc.
Faculty Advisor: Ikhlas Abdel-Qader
9:00 a.m. to 9:25 a.m., Room 210

A Barcode Scanner Interface Module (BCSIM) was designed, built, and tested to reduce idle process time, which was causing lowered manufacturing output. The reduction in idle process time was achieved by allowing the test system operator to scan the next group of product barcodes while the current group of products was being tested. A microcontroller was used to store and verify the scanned barcode information. Without the BCSIM, the test operator could scan the next product array only when the testing of the current product array had been completed.

HARPOON® EARLY WARNING FAULT DETECTION SYSTEM

by Roger Austin, Tom Cornish, Joseph Fee, and Doug Fuller
Sponsor: Thomas Hudson - Parker Hannifin Corporation
Faculty Advisor: Frank Severance
9:30 a.m. to 9:55 a.m., Room 210

A manufacturer experienced significant production downtime due to obstructions and other faults in its reciprocating Harpoon® conveyor system used for removing brass scrap produced during the machining process. A fault detection system (EWS) was developed that monitors abnormal system conditions with specified tolerances in water level, hydraulic pressure, and linear conveyor motion. If these tolerances are exceeded, the EWS shuts down the conveyor when continued operation would compound damage and notifies the proper personnel.

WATER FILTRATION CONTROL SYSTEM

by James M. Goodnight, George Krenk, and Brian Watson
Sponsors: Donald E. Royster - Michigan Paperboard Company and
Frederic W. Rowe - Kendall Electric Incorporated
Faculty Advisor: Joseph Kelemen
10:00 a.m. to 10:30 a.m., Room 210

A paper company needed to control and monitor seven sand filters used to remove contaminates from river water. A control system was designed which incorporates a programmable logic controller (PLC), flow sensors, and differential pressure transducers. By continuously monitoring the differential pressure across the filters, the filter backwash schedule was fine-tuned so that elapsed times were reduced. The flow through each filter was also monitored to observe the condition of the total filter system. The system was designed for manual and automatic control using a PLC and an operator interface panel.

DRUMMER EMULATOR

by Ryan Giorio, Chong Ooi, and David Stoll
Sponsor: Brad Giorio - Lovehammer
Faculty Advisor: Frank Severance
10:30 a.m. to 10:55 a.m., Room 210

The Drummer Emulator is an alternative for a human band drummer. The Drummer Emulator decodes digital signals in Musical Instruments Digital Instruments (MIDI) format. These signals come from a computer, keyboard, or any other device capable of MIDI signal output. The MIDI signals contain information about the timing and volume at which a drum should be played. A striking device, known as an actuator, is programmed to then hit the drum at a specified time and with the correct strength to achieve a desired melody. A skilled keyboard player or computer programmer becomes an alternative to a human drummer.

AUTOMATED VISUAL MEMORY SCAN TESTER

by Michael Nasers, Tim Vandergeest, and Jyh-How Wong
Faculty Advisor: Garrison Greenwood
11:00 a.m. to 11:25 a.m., Room 210

The Visual Memory Scan (VMS) test is one sub-test of a standardized test designed to quantify human memory ability. The VMS test measures a person's ability to remember and repeat patterns of number sequences. The individual conducting the test enters a number sequence via a keypad and the individual being tested attempts to repeat this sequence exactly. The results are compared and displayed. To reduce human error involved in conducting the test, a microprocessor-controlled VMS tester was built.

THREE CHANNEL SOUND LOCATION DEVICE

by Maradona Khong Yau Chok, Dean A. Henry, and Mark Jonaitis
Sponsor: Paul Ponchillia - WMU Department of Blind Rehabilitation
Faculty Advisor: Damon Miller
11:30 a.m. to 11:55 a.m., Room 210

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.

AUTOMATED PSYCHOLOGICAL TESTING DEVICE

by Thian Loong Chong, Yin Keat Loh, and Kian Lam Tan
Faculty Advisor: Johnson Asumadu
1:00 p.m. to 1:25 p.m., Room 210

A microcontroller-based device was designed to improve an existing standard psychological test (Visual Memory Span, VMS). Prior to this, the examinee touched a series of squares printed on a card in sequence after the examiner had touched them. The newly designed, compact, portable device accurately records the series entered by both the examiner and examinee. This device then compares the two series and delivers a message indicating whether the sequence was correct or not. Data for one examinee's entire test sequence is held in the device and may be evaluated later by the examiner.

ULTRASONIC END-OF-LANE ALERT DEVICE

by Chin Yee Kho, Andrew Low, and Winston Majaham
Sponsor: Paul Ponchillia - WMU Department of Blind Rehabilitation
Faculty Advisor: Johnson Asumadu
1:30 p.m. to 1:55 p.m., Room 210

In the sport of swimming, the visually impaired need to be alerted that they are approaching the end wall of a swimming pool so they can prepare to turn around. The Ultrasonic End-of-Lane Alert (UELA) device was designed as an electronic solution to this issue. Incorporating ultrasonic technology, the device uses an underwater transmitter and receiver to determine when the swimmer is at a set distance from the end wall. A beeping sound from the UELA device's built-in speaker then alerts the swimmer of the upcoming wall. With practice, the swimmer can learn to judge the distance to the wall with perfection and accurately time his or her return.

INFRARED STRAIGHT LINE DETECTOR

by Wye Leong Cheok and Mustafa Mahmoud
Sponsor: Paul Ponchillia - WMU Department of Blind Rehabilitation
Faculty Advisor: Raghvendra Gejji
2:00 p.m. to 2:25 p.m., Room 210

A compact and accurate system was designed to guide blind bowlers to bowling pins. The system uses an infrared light beam, a reflector, and an audible noise to alert blind individuals when they have lined a beam up correctly to the pins. The hand-held device is reasonably small and lightweight (about the size of a remote control garage door opener). The size and the use of a simple push button to activate the system make the system very easy to set up and use. The total cost of the parts in the system is less than $300.

ELECTRONIC PEDOMETER

by Khalid Alageel, Adil Aldokhaiel, and Mahfoudh Mahfoudh
Faculty Advisor: John Gesink
2:30 p.m. to 2:55 p.m., Room 210

An electronic pedometer was designed and built using a single chip micromachined accelerometer. The design features a keypad input unit and a liquid crystal display (LCD) and is clipped to the user's belt. The device measures and displays the number of steps, stride length, distance traveled, and elapsed time of the user. The user enters his/her stride length via the keypad input unit.

SUNSEEKER CRUISE CONTROL

by Daniel P. Chartrand, James D. McCaskey, and Jimmie K. Tolliver
Sponsor: Matthew Belanger - Sunseeker 99
Faculty Advisor: Raghvendra Gejji
3:00 p.m. to 3:25 p.m., Room 210

The Sunseeker 99 Team currently controls the speed and current of their solar car manually. This project designed and built a command and control system into the vehicle to control the speed or current of the motor. This system accepts speed or current commands on a numeric keypad and adjusts and maintains the desired speed or current. Acceleration and deceleration are smooth, with minimal overshoot. The device uses a feedback control system consisting of an Intel 87C196KD microcontroller with speed and current sensor inputs.

ENGINEERING INVESTIGATION OF DIGITAL FILTERS

by Vinesh Thiruchelvam, Glen Wheaton, and Eric Wojtas
Faculty Advisor: Garrison Greenwood
3:30 p.m. to 3:55 p.m., Room 210

Digital filters are a common ingredient of many digital signal processing systems. Of particular importance is the finite impulse response (FIR) filter, which is always stable and has a linear phase. Unfortunately, there is no easy means of determining the filter's order, which is of critical importance in realtime systems. This project compared two different design techniques for FIR filters to determine which was better suited for designing a low-pass filter. The filter was implemented and tested using an Intel 80196 microcomputer.

FLASH PROGRAMMER

by Chee Chuan Cheong, Bedros Hanounik, and Douglas Walser
Sponsor: Michael Mason - Leco Corporation
Faculty Advisor: Dean Johnson
4:00 p.m. to 4:25 p.m., Room 210

A test fixture called the Flash Programmer was designed and built to test and program a customized SRAM/FLASH memory module used in a scientific instrument. The Flash Programmer tests and programs the memory module, which plugs into its circuit board and is controlled by software in a PC. Communication between the Flash Programmer and the PC is accomplished through a device called the PC Remote Chassis that was previously designed. This project involved the specification, design, development, and testing of both the test fixture and software.

INDUSTRIAL DESIGN

Session Chairs - Dmitry Azrikan and Roman Rabiej
Room 242

"DRIVERIGHT" AUTOMOTIVE CENTER CONSOLE AND SEAT DESIGN

by Vincent M. Novak and Cassandra A. Younts
Sponsor: Bill Fluharty - Prince Corporation
Faculty Advisors: Dmitry Azrikan and Roman Rabiej
9:00 a.m. to 9:25 a.m., Room 242

Sports coupes are limited in space and storage. Research proved that 75% of the time the driver is the only person in a sports car. This led to expanding the center console into the passenger seat space. The passenger seat folds down and the back becomes a usable surface for the driver. The center console was raised to provide the driver with more storage space and comfort. DRIVERIGHT is a combination of the center console and the back of the passenger seat, providing comfort, utility, storage, and safety for the driver of a sports coupe.

"HOKUSAI" FLOOR CONSOLE SYSTEM FOR A MID-SIZE SPORT SEDAN

by David M. Miller and Allen D. Wong
Sponsor: Bill Fluharty - Prince Corporation
Faculty Advisor: Dmitry Azrikan
9:30 a.m. to 9:55 a.m., Room 242

This project involved the design and layout of a floor console system for a mid-size sport sedan. The effects of ergonomics, comfort, and user utility were examined. Aesthetics and packaging were also considered for the defined consumer segment. The design objective was to maximize available space and create a new and innovative driving environment. The research and product concept were presented using computer-generated animation and modeling as well as hand-rendered drawings and a full scale model.

"UNO" COMPACT DISHWASHER DESIGN

by Martin D. Kartawidjaja
Sponsor: Alvaro Correa - Whirlpool Corporation
Faculty Advisor: Dmitry Azrikan
10:00 a.m. to 10:25 a.m., Room 242

UNO dishwasher was designed to fulfill the needs of people who live alone and have a small kitchen space. The compact dishwasher design eliminates the use of an electrically powered motor by using a water turbine like those used in garden sprinkler systems.

"HORIZON" DISHWASHER DESIGN

by Russell Bunce and Jennifer Kanarr
Sponsor: Alvaro Correa - Whirlpool Corporation
Faculty Advisor: Dmitry Azrikan
10:30 a.m. to 10:55 a.m., Room 242

Current dishwashers offer many unique features. However, there were several areas that needed more attention. This project redesigned a dishwasher, focusing on the ergonomics. The problems associated with bending to load and unload the lower rack and reading a complicated panel were addressed in this design. The HORIZON dishwasher solves the bending problem by bringing the lower rack up to a more workable surface height, positioned next to the upper rack. A simple, interactive touch-screen was designed to eliminate user difficulties associated with today's dishwashers.

"FINGER TOUCH" HOME DRY CLEANING MACHINE

by Christopher Nohava and Zulkfli Md Yusoff
Sponsor: Alvaro Correa - Whirlpool Corporation
Faculty Advisors: Dmitry Azrikan and Roman Rabiej
11:00 a.m. to 11:25 a.m., Room 242

Over the years, dry cleaning has been done at the dry cleaners on an industrial scale. This project brought dry cleaning technology home for individuals who prefer to do their dry cleaning themselves. The system is based on current carbon dioxide technology. With this technology, the carbon dioxide is recycled after each use. The system is suitable for delicate fabrics and cleans one garment at a time. The garments are easily loaded through an inclined window display screen. The touch screen allows the user to easily control operation.

"EASYWASH" MICRO PORTABLE LAUNDRY

by Mohd Razlan Setik
Sponsor: Alvaro Correa - Whirlpool Corporation
Faculty Advisor: Dmitry Azrikan
11:30 a.m. to 11:55 a.m., Room 242

Current laundry machines were designed for large loads of laundry. There were no laundry machines designed for a single person with a small load of laundry. This project designed a portable laundry machine to make washing easier for an individual user. The micro portable laundry is suitable for a single person and fits in a small space. EASYWASH is easy and fast to operate. It is perfect for campers, boaters, travelers, students who live in small dormitories, and for anyone else with small loads of laundry.

"INSIGNIA" CLOTHING SYNTHESIS 2050

by Rebecca Johnson and Ken Reita
Sponsor: Alvaro Correa - Whirlpool Corporation
Faculty Advisor: Dmitry Azrikan
12:00 p.m. to 12:25 p.m., Room 242

Current clothing management is wasteful. The processes of purchasing, laundering, caring for, and storing garments are a poor use of resources and pollute the environment. Due to projected population growth, a better system will be needed. Based on advanced technologies, a futuristic system was developed to eliminate these problems. The system, INSIGNIA, eliminates current laundry processes and pollution while giving the user unlimited garment selection and individually tailored clothing.

INDUSTRIAL AND MANUFACTURING ENGINEERING - A - I

Section on Manufacturing/Process Economy
Session Chair - Liwana Bringelson
Room 208

DETERMINING TIME STANDARDS AT A MANUFACTURING FACILITY

by Jeffrey Guadagni, Abdulla Kalban, and Karen Powell
Sponsor: Virginia Colter - I I Stanley
Faculty Advisor: Tycho Fredericks
9:30 a.m. to 9:55 a.m., Room 208

A discrepancy between theoretical and actual cycle times was causing undesirable output at a manufacturing facility. A time study was performed on the specific production lines in question. A total of four production lines were separated into measurable elements. The elements were then individually described and standard times were determined for each line as well as all three shifts. Evaluation of the three shifts assisted in identifying inconsistency in the production lines. Once the standard times were established, comparisons to the theoretical cycle times were evaluated and the necessary recommendations were made to the engineering staff and management team.

THE EVALUATION AND MODELING OF KNOWN SYSTEM VARIABILITY ON INVENTORY REQUIREMENTS

by Carrie Canniff, Brian Fellabaum, Jeff Jacobs, and Aricka Pannell
Faculty Advisor: Azim Houshyar
10:00 a.m. to 10:25 a.m., Room 208

Inventory control is a concern to many companies. This project developed a model that gives a local food manufacturing company optimal inventory levels by SKU at each of its distribution centers throughout the United States. The current system was evaluated and the variables that affect the level of inventory were accounted for. The model was then validated using ProModel, a simulation software tool. The company can use the model to predict optimal inventory levels for several of its products.

EVALUATION OF SPACE AT A SPICE EXTRACTION COMPANY

by Simon Leong, Dan Roller, and Brandon Sturm
Sponsor: Kim Pence - Kalsec
Faculty Advisor: Bob White
10:30 a.m. to 10:55 a.m., Room 208

A local spice extraction company required a space utilization analysis in the finishing department, particularly for a specialized piece of processing equipment, storage tanks, and areas soon to be vacated. Information on bulking, storing, packaging, layout, and material handling was gathered and analyzed through the use of interviews, time studies, spreadsheets, charts, and cost analysis. Based on this information, a buffer of scheduled bulkings was created and lab approval time was shortened. In addition, a justification was created for purchasing additional bulk tanks. Work cells or additional storage racks were suggested to fill vacated floor space.

INCREASING PRODUCTIVITY AND EFFICIENCY FOR A BLISTER PACKAGING AREA

by Syed Askari, Vincent McGee, and John Nonthaweth
Sponsor: Scott MacArthur - L. Perrigo Company
Faculty Advisor: Steven Butt
11:00 a.m. to 11:25 a.m., Room 208

A manufacturer of pharmaceuticals sought to increase the productivity and efficiency of its blister packaging line. The plant was initially using five different types of machines. This project investigated what combination of machines would best meet the company's forecasted demands. The areas of scheduling, capacity, downtime, changeover time, production rate, product compatibility, feeding method, die-cutters, and web configuration were examined. ProModel simulation software was used to develop a model for scheduling the packaging lines and for determining solutions to the various alternatives considered. An optimal solution was recommended to the company based on the results.

REDUCING MACHINE DOWNTIME THROUGH IMPROVED MATERIAL FLOW

by Robyn Hoenle, Walter Teamer, and Steve Toner
Sponsor: Rick Murphy - Simplicity Pattern Company, Inc.
Faculty Advisor: David Lyth
11:30 a.m. to 11:55 a.m., Room 208

A manufacturer of garment and craft patterns for the home sewing market was experiencing unnecessary and costly downtime due to ineffective material flow in the packaging department. High inventory levels, varying order sizes, and inefficient use of floor space for handling work in process all contributed significantly to the ineffective material flow. Improved material handling methods and a workstation redesign were recommended after an extensive analysis of individual workstations, an evaluation of the material flow, and a thorough understanding of scheduling procedures. These recommendations illustrate techniques for reducing the downtime experienced in the packaging department and address the ergonomic issues of the individual workstations.

Section on Product and Process Quality
Session Chair - Liwana Bringelson
Room 208

ISO-9001 IMPLEMENTATION PLAN

by Ali Hatteea, Takiya Jenkins, Susan McIntosh, and Kristen Tadajewski
Sponsor: Michael Carl - Hammond Machinery and Roto-Finish
Faculty Advisor: David Lyth
1:00 p.m. to 1:25 p.m., Room 208

ISO-9001 is a quality standard obtained through an audit and registration process. With this registration, a company guarantees a certain level of quality to its customers. This project designed an implementation plan to bring a company's practices to the level of the standard. The plan was developed as a result of extensive research and an analysis of the twenty parts of the standard. With this information, the company was evaluated and recommendations for successful implementation were made.

INJECTION MOLD WEAR STUDY WITH LIGHTS-OUT AUTOMATION

by Dennis R. Creedon, Thomas S. Hall, Leslie Shaw, and Gregory A. Snitgen
Sponsor: Dale Peters - Copper Development Association Incorporated
Faculty Advisor: Paul Engelmann
1:30 p.m. to 1:55 p.m., Room 208

Using copper cores to help remove heat from a plastics injection mold is a proven method. Questions arise, however, about the wear resistance of copper components inside the mold. This project investigated the relative durability of coated and uncoated copper alloys. Data was collected to determine the number of cycles before specified amounts of wear occurred. Process automation was deemed essential to facilitate the production of the projected 25 million parts needed for the study. An indexing conveyor, emergency press and water shutdown, as well as automated dial-out to a response team were implemented. These automation systems allow continuous lights-out production and increased data collection.

QUALITY IMPROVEMENT IN TRANSMISSION CABLE ASSEMBLY

by Jason Degen, Meng Liang Lee, and Fernando Sanchiz
Sponsor: Kenji Higashi - Hi-Lex Corporation
Faculty Advisor: Larry Mallak
2:00 p.m. to 2:25 p.m., Room 208

Automotive suppliers have limited time to make changes in their assembly processes. These changes are necessary to meet the fluctuating demands of the automotive industry. This project studied the current processes on three different transmission cable assembly lines at a local supplier. Data was collected, compiled, analyzed, and evaluated on the basis of time studies, cost effectiveness, and Overall Equipment Efficiency. Quality improvement recommendations were developed using Kaizen, 5S, and other principles of manufacturing.

ADVANCED TOOL MEASURING SYSTEM: FROM THE STONE AGE TO STAR WARS

by Jeffery S. Clifford, Melanie A. Langridge, Mark A. Romo, and Jeffrey N. St.Onge
Sponsor: Parker Hannifin Corporation
Faculty Advisor: Mitchel Keil
2:30 p.m. to 2:55 p.m., Room 208

The production of high quality parts is directly related to the accuracy and precision of the tools being used in Computer Numerical Control (CNC) machines. These tools must be measured accurately to compensate for the size and shape of the tool in the CNC program. A presetter is an instrument used to perform these measurements. This project studied and evaluated presetters that provide the precision needed for CNC high-speed machining. A recommendation and an implementation plan for changing a very outdated system to the latest in technology was presented to the company.

IMPROVING THE PROCESS FOR A HEADLINER ASSEMBLY

by Alywin Huang, Ketan Shah, Brian Switalski, and Jeff VanDenabeele
Sponsor: Paul Franz - Prince Corporation
Faculty Advisor: Liwana Bringelson
3:00 p.m. to 3:25 p.m., Room 208

An area supplier of automobile parts needed to improve the process of an existing headliner assembly line. This project aimed to improve the product by building quality into the process because integrating process and product in a system is key to effective production. Changes were made to jigs and fixtures, the product, and the process, improving the quality and output of the line. These changes were recommended to be within the constraints of the company's QS9000 quality documentation.

INDUSTRIAL AND MANUFACTURING ENGINEERING - B - I

Section on Design
Session Chair - Paul Engelmann
Room 209

DESIGN AND EVALUATION OF ENTRY LEVEL GRAPHICS COURSE CURRICULUM

by Mike R. Agurkis, Jason A. Cavanaugh, and Rich P. Shearing
Faculty Advisor: Michael Atkins
9:30 a.m. to 9:55 a.m., Room 209

This project's goal was to review current teaching practices in entry level graphics courses in relation to industrial engineering design. The course content was reviewed and evaluated to assess whether or not students were receiving the right tools to continue with their future in engineering design. A new course content sequence was developed with a balance of manual drafting and computer aided design. A CAD system was selected and implementation guides were created to further the student's understanding of basic graphical communication concepts.

PARAMETRIC MODELING OF THE HUMAN SPINE

by David Curtis, Malaika Johnson, and Schlida Young
Faculty Advisor: Jorge Rodriguez
10:00 a.m. to 10:25 a.m., Room 209

Presently, there are no acceptable computer representations of the entire human spine on which stress analysis and dynamic simulation can be performed. Through the use of a parametric modeling software system, a solid model was generated to provide a detailed interactive resource for study and analysis of the spine. The Computer-Aided Design (CAD) model has the capability to focus on specific segments of the spine or on the entire spine. Models for specific conditions can be generated and interactively manipulated on the computer screen. These models will assist researchers in the biomechanical field.

A CONCEPTUAL PROTOTYPE OF A HYDRAULIC REGENERATIVE BRAKING SYSTEM

by Thomas Back, Nathan Buford, Wiyono Harijanto, and Rhonda Merriman
Faculty Advisor: Jorge Rodriguez
10:30 a.m. to 10:55 a.m., Room 209

Regenerative braking systems were studied to determine if they would improve the efficiency and performance of today's small commuter vehicles. After considering different types of regenerative braking systems, a conceptual prototype of a hydraulic accumulator system was designed and built. A series of tests were developed and conducted on the prototype under various load conditions. From the results obtained, recommendations and conclusions were made about the effectiveness of this type of regenerative braking system.

AUTOMOTIVE PASSENGER COMPARTMENT HEATING SYSTEM

by Kurt Flowney, James Robertson, and Charles Tyus
Faculty Advisor: Fred Sitkins
11:00 a.m. to 11:25 a.m., Room 209

This project designed a radiant heating system for the passenger compartment of an automobile. The heat generated by an internal combustion engine, during the combustion process, is transferred into engine coolant. Instead of wasting this heat by immediately cooling the coolant in the radiator, this design utilized the hot coolant to heat the entire passenger compartment of an automobile. The heat was radiated from the coolant through metal tubes placed on the floor of the cabin, then through the vehicle's insulated carpeting. The heat then was released into the passenger compartment, causing even heating throughout the entire compartment.

RAISING DISABLED HUNTERS TO NEW HEIGHTS

by Jason Barkel, Tim Derengowski, Nate Koeze, and James Piesko
Sponsors: Todd Albaugh - Ted Nugent United Sportsmen of America (TNUSA)
Wayne Nicolen - Glassmaster Controls
Jershon, Incorporated
Faculty Advisors: Fred Sitkins and Mitchel Keil
11:30 a.m. to 11:55 a.m., Room 209

A self-elevating hunting stand was designed to aid physically challenged hunters. These individuals are often restricted from participating in outdoor climbing activities, such as getting in and out of a tree stand. The stand utilizes a unique lift unit to elevate a disabled person to a desired height. The hunting stand is lightweight, portable, and can be secured to a tree at a desired hunting location. The stand has been thoroughly field-tested for safety, reliability, and usability.

MATERIALS ENGINEERING

Session Chair - Abiodun Olowe
Room 205

INNOVATIVE MATERIALS FOR OFFSET PRINTING

by Philip P. Skrzypek
Faculty Advisor: Pnina Ari-Gur
1:00 p.m. to 1:25 p.m., Room 205

Metal-Matrix Composite (MMC) coated plates were developed in the lab to solve problems attributed to the limitations of current printing plate materials. The offset printing industry has a great demand for larger, more voluminous print runs due to shortcomings of other media. Material failure causes printing plates to have a considerably limited service life. Characterization of the new plates included optical microscopy and a surface analysis using scanning electron microscopy (SEM), interference microscopy, profilometry, and atomic force microscopy (AFM). The plates were tested on an actual print run to evaluate the improvement in their performance.

FRICTION WELDING OF ALUMINUM PROPELLER SHAFTS

by Michael K. Burgess and Kenneth J. Gembel II
Sponsors: Raymond J. Thompson and Theodore J. Joy - American Axle and Manufacturing
Faculty Advisor: Abiodun Olowe
1:30 p.m. to 1:55 p.m., Room 205

Aluminum propeller shafts manufactured for the automobile industry are currently bonded by metal inert gas welding, a process which is both energy intensive and necessitates multiple cleaning steps. Conversion to a friction welding process would increase the efficiency of the operation and eliminate redundant handling. Current production propeller shafts were modified to create a friction welded prototype. Welding parameters were established to achieve optimal weld integrity. The prototype shafts were subjected to current testing procedures including failure and metallographic analysis. With favorable results, friction welded propeller shafts will contribute substantial cost-savings to the automotive industry.

MECHANICAL AND AERONAUTICAL ENGINEERING A - I

Session Chair - Richard Hathaway
Room 212

CONTINUOUS VARIABLE VALVE ACTUATION SYSTEM

by Vince Cardella, Shawn Carnago, and John Keyser
Sponsor: Ron Stene - Chrysler Small Engines Division
Faculty Advisor: Richard Hathaway
9:30 a.m. to 9:55 a.m., Room 212

A Variable Valve Actuation System was designed to overcome the limitations of conventional valve-trains. Conventional valve-trains on internal combustion engines are limited by their lack of adjustment. Nonadjustable valve-trains are designed either for power, emissions, fuel economy, or some combination of the three. The Variable Valve Actuation System was designed to eliminate that lack of adjustment, thus improving power, emissions, and fuel economy for the entire range of engine speeds and loads. This system was designed for a 2.0-liter, 16 valve, single overhead cam engine.

RACK AND PINION STEERING SYSTEM DYNAMOMETER

by Scott C. Kemler, Patrick D. Lauer, and William J. Mullinix
Sponsor: Randy Sweet - Sweet Manufacturing Company
Faculty Advisor: Richard Hathaway
10:00 a.m. to 10:25 a.m., Room 212

A data collection system was designed and constructed to measure the performance of rack and pinion steering systems used on circle track stock cars. With the use of torque cells, pressure transducers, and strain gages, the torque, pressure, and loads acting on the steering system were measured and recorded using an on-board data collection system. The measuring system was adapted to the tie rods, steering column, and the power steering cylinders in a way that did not hinder the performance of the vehicle. The data that was gathered using this system will aid in designing future steering systems that better suit the customers needs.

SMART OPTO-ELECTRIC MIRROR ADJUSTMENT SYSTEM

by Steven M. Stewart
Faculty Advisor: Richard Hathaway
10:30 a.m. to 10:55 a.m., Room 212

A precision side-view mirror adjustment system was designed and developed for vehicles. By locating the maximum field of view with respect to the driver's eye position, the system minimizes blind spots associated with improper side-view mirror adjustment. Initial design concepts were modeled using optical design software to design for maximum field of view and universal installation. A benchtop model was then built and tested using data obtained from the modeled system. The Smart Opto-Electric Mirror Adjustment system minimizes blind spots and can therefore be used to prevent side impact collisions.

MODIFICATION OF GENERAL MOTORS TH700R4 AUTOMATIC TRANSMISSION FOR HIGH POWERED APPLICATIONS

by Terry Dekoninck and Hou Kit Sam
Sponsor: Greg Friend - TCI Automotive
Faculty Advisors: Jerry Hamelink and Richard Hathaway
11:00 a.m. to 11:25 a.m., Room 212

A four-speed automatic transmission was modified to withstand the power and torque of a high powered vehicle. The vehicle drive train and transmission were modeled and the power flow through each gear was determined. The failed units were studied to determine the critical components that required improvement. The input shaft was designed for reduced stress and increased fatigue life with the assistance of computer software. The clutch packs were modified for higher torque capacity. The improved components increased the torque capacity by 33% over the existing models.

A SOLUTION TO A HIGH TOOL FAILURE RATE

by Erik Ausland and Andrew Szydlowski
Sponsor: Bob Kornic - Tower Automotive
Faculty Advisor: Pnina Ari-Gur
11:30 a.m. to 11:55 a.m., Room 212

This project investigated a solution to a high tool failure rate for a progressive die at an automotive stamping plant. Punches were failing after a relatively small lot of production. Failure often caused a halt in production and damaged the die. New heat treatments and cryogenics were selected to enhance the manufacturing process by increasing punch life. A different tool steel was examined for potential benefits and contrasts. Test runs were performed to confirm the results of an improved punch. Data from an electron microscope and an X-ray diffractometer further supported the conclusion. A cost analysis was performed to determine whether the solution was feasible.

MECHANICAL AND AERONAUTICAL ENGINEERING - A - II

Session Chair - Jerry Hamelink
Room 212

POWER STEERING DYNAMOMETER

by Matthew R. Niemi and William R. Widman
Faculty Advisor: Richard Hathaway
1:00 p.m. to 1:25 p.m., Room 212

A power steering dynamometer was designed to obtain data from a race car either during testing or during an actual race. The dynamometer measures steering input forces and driver input work to further the advancement of race car design. The designed system consists of strain gages directly connected to the tie rods, pressure transducers in the fluid feed, and return lines and a torque cell on the steering input shaft from the driver. Data collected from these devices was gathered into an acquisition system and analyzed in a 'windows' environment.

VACUUM FILTER PIPING OPTIMIZATION

by John C. Aittama and Kevin M. Taylor
Sponsors: Robert G. Brown and Dan Thomas - Monlan Corporation
Faculty Advisor: Iskender Sahin
1:30 p.m. to 1:55 p.m., Room 212

An optimized vacuum-relief piping system was designed to better service vacuum breaking needs in an industrial coolant filter. The previous arrangement required excessive material and labor. The new layout performs the same function with half as many fittings and significantly less fabrication time. The piping solution was developed using traditional fluid flow analysis, computer simulation, and construction and testing of a physical model.

REDESIGN OF PRODUCTION TEST STAND FOR AUTOMATION

by Martin Pfannes and Chad Sikkenga
Sponsor: Rory Adams - FEMA Corporation
Faculty Advisor: Jerry Hamelink
2:00 p.m. to 2:25 p.m., Room 212

An existing test stand was labor-intensive, introducing operator error into the testing process. The test stand was redesigned using programmable software to perform the required tests. A test fixture was designed to incorporate the different body sizes of the production units, eliminating fixture changeover time. The new design allows the operator to insert the test unit into the test block, start the system, and remove the unit when the testing is completed. The redesigned system minimized error and improved working conditions.

INTEGRATING MECHANICS OF MATERIALS INTO DESIGNING A GOALBALL GOALPOST

by Eng Lee Chew and Adam J. Fernandez
Sponsor: Paul Ponchillia - WMU Department of Blind Rehabilitation
Faculty Advisor: Jerry Hamelink
2:30 p.m. to 2:55 p.m., Room 212

The current goalball goalpost manufactured in Europe can run up to a whopping $2,000/pair. A redesigned prototype goalpost was built to the same specifications using lightweight, cost effective, and safe materials. It was also designed for portability. The design was put through rigorous testing using ALGOR Finite Element Analysis software. The prototype costs under $1,000/pair.

DESIGN OF A CHECKSTAND CONVEYOR SYSTEM FOR THE INTERNATIONAL MARKET

by Darylelamonica Jamssens and Thanh Nguyen
Sponsor: Daniel Mehren - Burroughs Corporation
Faculty Advisor: Jerry Hamelink
3:00 p.m. to 3:25 p.m., Room 212

The current model checkstand is expensive to ship to foreign countries. Other problems include the checkstand's being too bulky, too heavy, and having too many fasteners, causing the assembly process to be very slow. Also, because of international regulations, a chair has to be attached to the checkstand. To reduce the number of fasteners, the checkstand was redesigned so that one type of fastener could be used to hold the checkstand unit together. A lighter gauge steel was used to reduce the weight of the checkstand. A support block made of steel was designed to hold the chair at its fixed supports.

PROCESS FOR ATTACHING CABLE ENDS TO CABLE CORE WIRES

by Mark D. Mieloch and Rocky L. Smith
Sponsor: Michael Brown - Hi-Lex Corporation
Faculty Advisor: Jerry Hamelink
3:30 p.m. to 3:55 p.m., Room 212

A process was developed to attach cable ends to cable core wires in a marine application. Current processes involved extended manufacturing time and added material costs with respect to methods used in non-marine applications. The alternate process was developed to maintain engineering standards for strength, durability, and corrosion resistance while reducing overall manufacturing costs. Testing was performed to establish process standards for the current and alternate attachment methods. The alternate method uses corrosion resistant materials and minimizes assembly time to reduce manufacturing costs.

MECHANICAL AND AERONAUTICAL ENGINEERING - B - I

Session Chair - Srinivas Garimella
Room 213

OPTIMUM DESIGN OF COOLING FINS FOR A VANE PUMP

by Kar Keong Low, Keat Boon Mah, and Eric Kah Boon Ng
Sponsor: Paul Coskie - Gast Manufacturing Corporation
Faculty Advisor: Srinivas Garimella
9:30 a.m. to 9:55 a.m., Room 213

This project designed a new cooling fin configuration to replace the existing one for optimum heat transfer on a vane pump. Temperature readings on several points were obtained from the body of the existing pump and the rate of heat transfer was calculated using the derived heat transfer equations. Heat distribution on the body of the pump was determined and an entire new configuration of cooling fins was conceived. The new design decreased the pump surface temperature considerably and also prolonged the life of the pump and its components.

NOISE REDUCTION DEVICE FOR PRESSURE REDUCING VALVES

by James McKenzie and Craig Trierweiler
Sponsor: Rex Scare - Armstrong-Yoshitake, Incorporated
Faculty Advisor: Srinivas Garimella
10:00 a.m. to 10:25 a.m., Room 213

Reducing the pressure of steam at large flow rates using pressure reducing valves often causes extremely high levels of noise. Therefore, an orifice plate was designed to be used in conjunction with the pressure-reducing valve for the purpose of noise reduction. A program was developed to select appropriate plate geometries for various system parameters.

ENERGY MANAGEMENT SYSTEM FOR LANDING AIRCRAFT

by Sinil Chai and Anil Verma
Faculty Advisor: Arthur Hoadley
10:30 a.m. to 10:55 a.m., Room 213

A device was needed to enable general aviation aircraft to safely land in the event of an engine failure. This device provides the pilot with sufficient flight information to make a successful landing. This project integrated a global positioning system (GPS), a laptop computer, and data-acquisition software. This, in conjunction with pre-programmed airport information and aerodynamics calculations, provides the pilot with ample feedback. This energy management system is designed to significantly increase general aviation safety and to improve fuel efficiency in non-emergency situations.

FLIGHT MANAGEMENT COMPUTER FOR LIGHT AIRCRAFT

by Matt Hall and Chris Warner
Sponsor: Rich Oom - Smiths' Industries
Faculty Advisor: Arthur Hoadley
11:00 a.m. to 11:25 a.m., Room 213

A flight management software program was developed to provide information to assist in the operation of an aircraft in the most efficient manner. The software program takes data from a Global Positioning Unit and other sensors to determine factors such as fuel usage and stall speeds. This program can be installed in any laptop computer and requires minimal pilot input during flight. In addition, a flight simulator was used to test the program along with actual flight testing at Western Michigan University's Applied Aerodynamics Laboratory.

THRUST CELL VALIDATION

by Jeff Shorkey and Kim Van Singel
Faculty Advisor: Arthur Hoadley
11:30 a.m. to 11:55 a.m., Room 213

A thrust cell mounted behind the engine of a Flight Test Cessna 182 was redesigned and calibrated to provide thrust and torque. The design consists of two displacement transducers located on the right and left side of the engine. As the engine moved, the transducers measured forward and torsional displacements. The data was entered into a computer within the airplane. An algorithm was developed to analyze the inputs and provide thrust and torque from the given data.

MECHANICAL AND AERONAUTICAL ENGINEERING - B - II

Session Chair - James Kamman

Room 213

REDESIGN OF SEALING COMPONENTS FOR DOUGHNUT AND PASTRY FILLER MACHINE

by Andrea Golm and Mike Zamora
Sponsor: Mark Zyzelewski - Parametric Solutions
Faculty Advisor: Philip Guichelaar
1:00 p.m. to 1:25 p.m., Room 213

The sealing components of a doughnut and pastry filler machine were redesigned to eliminate the possibility of failure due to over-tightening. A clamping mechanism was designed and constructed. Validation was completed through the use of finite element analysis and empirical testing. Component materials and manufacturing processes were selected to minimize the overall cost of the completed assembly.

ANALYSIS AND REDESIGN OF INTERNAL SWITCHING VALVE FOR A MECHANICAL PUMPING TRAP

by Garret Achenbach and Neal Newhof
Sponsor: Charles M. Reynolds - Armstrong International Incorporated
Faculty Advisor: James Kamman
1:30 p.m. to 1:55 p.m., Room 213

The internal switching valve system for a mechanical pumping trap was analyzed and redesigned. The existing design failed occasionally because of friction caused by corrosion. Using the redesigned switching valve, the life of the pumping trap was extended. Most manufacturers of mechanical pumping traps experience similar problems. This new design has given the sponsor company an advantage over its competitors.

ATMOSPHERIC TETHER MISSION: ENDMASS DESIGN

by Michael A. Deming and Danielle J. Fritsch
Sponsor: Les Johnson - National Aeronautics and Space Administration
Faculty Advisor: James Kamman
2:00 p.m. to 2:25 p.m., Room 213

Research is currently being conducted on possible methods to study the Earth's atmosphere. One plan is for an Atmospheric Tether Mission to study the plasma and atmosphere in the lower regions of the mesosphere and lower thermosphere and ionosphere. An endmass probe, which houses eleven on-board instruments, was designed for exploration of this region. The endmass was designed to be aerodynamically efficient and capable of maneuverability in both free molecular flow and continuum flow regions. This endmass probe can be deployed from an orbiting space shuttle for a six-day mission to collect data.

MOTOR LIFT CONVEYOR

by Brian Connolly and Alicia Varenhorst
Sponsor: Joel Markucki - Denso Manufacturing Michigan, Incorporated
Faculty Advisor: Dennis VandenBrink
2:30 p.m. to 2:55 p.m., Room 213

A lift conveyor system was redesigned to reduce cost and required floor space. This system supplies motors in totes to an associate on the assembly line and exists to reduce injury from lifting. In addition, a conveyor was designed to hold the empty totes.

BALL RETURNER FOR GOALBALL

by Lye Kit Ooi and Leng Kang Teh
Faculty Advisor: Dennis VandenBrink
3:00 p.m. to 3:25 p.m., Room 213

A ball returning device was built to allow a blind person to practice goalball by himself or herself. The device is inexpensive and designed to be easily assembled and disassembled for being transported.

REAR DOOR CHILD SECURITY SYSTEM WITH ADULT OVERRIDE MECHANISM

by Dave Parks and Ben Schultheiss
Sponsor: Dave Sedlak and David Hlavaty - Delphi Interior and Lighting
Faculty Advisor: Dennis VandenBrink
3:30 p.m. to 3:55 p.m., Room 213

Currently, when a child security mechanism is engaged, no one may exit the rear of the car without assistance. This project designed a passive child security mechanism that allows an adult to override the child security system while seated in the back of a vehicle.

MECHANICAL AND AERONAUTICAL ENGINEERING - C - I

Session Chair - Koorosh Naghshineh
Room 215

TESTING STAND FOR COMBINED BENDING AND TORSION LOADING

by Rajiv George and Phong Tran
Faculty Advisor: Daniel Kujawski
9:00 a.m. to 9:25 a.m., Room 215

A testing stand was built to enable bending and torsion stress on a hollow shaft. As the distances of the weight were varied along the loading beam (which was perpendicular to the shaft), the directions and values of principal stresses experienced by the shaft varied. This was easily observed as stresses were projected using Mohr's circle. Rosette strain gages were used to measure strains on the surface of the shaft. Lab View software was used to analyze the stresses and strains on Mohr's circle diagrams.

AUTOMATED TEST STAND FACILITY FOR PNEUMATIC REGULATORS

by Michael Muday II and Jonathon Opel
Sponsors: Lou Bruska and James Budnar - Parker Hannifin Corporation
Faculty Advisor: Daniel Kujawski
9:30 a.m. to 9:55 a.m., Room 215

An automated test stand for air regulators was designed to improve productivity of an assembly cell. A motion control mechanism was designed and programmed using a PLC controller. Fixtures were designed to allow for different sizes and types of regulators. This test stand reduced material handling and changeover time when compared to the manually-operated testing procedure.

TEST FIXTURE FOR DISHWASHER PANEL NOISE AND VIBRATION ANALYSIS

by Chris Jaques and Shane Niswander
Sponsor: Steve Balinski - Whirlpool Corporation
Faculty Advisor: Koorosh Naghshineh
10:00 a.m. to 10:25 a.m., Room 215

A manufacturer wanted to reduce the noise created by the impact of the cleaning water jets spraying against interior dishwasher panels. The majority of the noise was created in the top panel, where most of the water impact occurred. This project designed and constructed a test fixture to measure noise and vibration on the top panel. This fixture can be used with various panel types and with various water jet and flow characteristics. The fixture was isolated from the pump to ensure that only the water jet spray impact on the test panel was measured. The information gained from the fixture will allow the company to reduce the dishwasher's water impact noise.

EXPERIMENTAL DETERMINATION OF THE THERMAL CHARACTERISTICS OF A MECHANICAL SEAL

by David Fernandez, Kevin Laczkowski, and Matt Lister
Sponsor: Flow Serve Corporation
Faculty Advisor: Parviz Merati
10:30 a.m. to 10:55 a.m., Room 215

Mechanical seals undergo thermal and hydrostatic stresses in operation. Designers of mechanical seals need to know heat transfer coefficients between seal surfaces and the chamber fluid to determine the thermal stresses developed at the seal faces. This project obtained experimental heat transfer coefficients for a typical mechanical seal. Forty-seven thermocouples were inserted at different locations in the seal to measure temperatures required to obtain heat transfer coefficients. Laser Doppler Velocimetry and Particle Image Velocimetry were used to measure flow velocities in the seal chamber. The flow velocities were used as boundary conditions in FLUENT, to verify the computational techniques needed to calculate the heat transfer coefficients. The heat transfer and flow characteristics for water at several pump rotational speeds were obtained.

CONVEYOR DRIVE MECHANISM TO POWER SKEWED ROLLERS

by Michael McGettigan and Dennis Pasco
Sponsor: Dennis Schuitema - Rapistan Systems
Faculty Advisor: Koorosh Naghshineh
11:00 a.m. to 11:25 a.m., Room 215

The shipping industry sorts and orients packages using a conveyor with skewed rollers. The belt used to drive these skewed rollers suffered from premature wear and misalignment. A mechanism was designed to transfer the straight-line motion of the belt to the skewed rollers. A prototype was constructed and tested under simulated conditions. This mechanism was found to drastically improve system life and reliability.

TEST SYSTEM FOR DYNAMIC CHARACTERIZATION OF ELASTOMERS

by Jeff Glodich and Dan Selvidge
Sponsor: James P. Carow - Whirlpool Corporation
Faculty Advisors: James Kamman and Koorosh Naghshineh
11:30 a.m. to 11:55 a.m., Room 215

A fixture, testing instrumentation, data analysis procedure, and a test procedure were developed to determine the complex spring rate of elastomeric vibration isolators. The fixture and procedures conform to SAE Recommended Practice: SAE J1085 Test For Dynamic Properties of Elastomeric Isolators. This standard covers testing procedures for defining and specifying the dynamic characteristics of simple (i.e. non-hydraulic) vibration isolators using forced vibration. The validity of the test procedure was verified by testing a sample with known properties and comparing values calculated using the test data to the known properties of the sample.

MECHANICAL AND AERONAUTICAL ENGINEERING - C - II

Session Chair - Judah Ari-Gur
Room 215

REDESIGN AND OPTIMIZATION OF PISTON ROD

by Choon Yin Fung and Shih Gio Robin Soon
Sponsor: Edward Faulkner - Gast Manufacturing Corporation
Faculty Advisor: Judah Ari-Gur
1:00 p.m. to 1:25 p.m., Room 215

An air compressor's piston rod was redesigned to reduce mass and increase its natural frequencies. A new polymer with a nonlinear stress-strain relationship was selected for the improved design. The new piston rod was analyzed using Pro-Engineer/Mechanica and ANSYS Finite Element Analysis software.

DURABILITY TEST EQUIPMENT FOR GAS SPRINGS

by Jonelle A. Manz and David W. Scott
Sponsor: Stuart Atwater - SUSPA, Incorporated
Faculty Advisor: Philip Guichelaar
1:30 p.m. to 1:55 p.m., Room 215

Current durability testing equipment for gas springs uses a linear motion, which does not replicate the arc motion that most gas springs undergo in service. A new test fixture was designed to simultaneously force twelve finished assemblies to their closed positions and allow the springs to rise to their extended positions. This new design tests a wider range of gas springs than the current design.

REDESIGN OF A QUICK-CHANGE DIE ASSEMBLY

by Heather Atwood and Beth Roeseler
Sponsor: Pete Seibert - General Motors Kalamazoo MFD
Faculty Advisor: Philip Guichelaar
2:00 p.m. to 2:25 p.m., Room 215

The rolling bolster portion of a large quick-change die set used for forming large sheet metal parts was failing prematurely. A failure analysis was performed, focusing on the self-lift wheel assembly, jack piston packing, jack seals, bolster stop blocks, and drive train. Impact loading equations were used to determine which components were critically loaded. Components found to be under critical loads were redesigned to prolong bolster life.

CUP ENDURANCE TEST APPARATUS

by Jasris Jasnie and Wong Kok Ming
Sponsor: Delbert L. Thomas - Gast Manufacturing Corporation - Remark Facility
Faculty Advisor: Judah Ari-Gur
2:30 p.m. to 2:55 p.m., Room 215

An apparatus was designed to test the wear rate of cylinder seals ("cups") in rocking piston pumps and compressors. The apparatus facilitates wear tests of the seals for different piston and cylinder designs. The testing apparatus was designed with the aid of finite element analysis.

ADJUSTABLE ARM CAP REDESIGN

by Scott Medendorp and Glen Wilkinson
Sponsor: Tim Wiersma - Steelcase
Faculty Advisor: Judah Ari-Gur
3:00 p.m. to 3:25 p.m., Room 215

An adjustable arm cap mechanism was redesigned to ease assembly, eliminate pinch points, and reduce cost. A better design was achieved with the aid of finite element analysis. The new design satisfied all the required specifications and allowed the part to be manufactured and assembled at one location, ultimately reducing the cost of manufacturing.

DESIGN & DEVELOPMENT OF A MECHANICAL CARDIAC VALVE PROSTHESIS

by Seyed M. Mirmiran
Faculty Advisor: Judah Ari-Gur
3:30 p.m. to 3:55 p.m., Room 215

Mechanical failures of mechanical cardiac valve prostheses are directly related to material properties as well as loading conditions. A bi-leaflet mechanical cardiac valve prosthesis was designed. A finite element analysis of this cardiac valve prosthesis was performed to evaluate the possible modes of mechanical failure under realistic static and dynamic pressures and to estimate the magnitude of these pressures at failure.

PAPER SCIENCE AND ENGINEERING

Session Chairs:
Raja Aravamuthan
John Cameron
Peter Parker
David Peterson
Dewei Qi
Room 211

ELIMINATING COATING FLAKES WITH ULTRASOUND

by Ryan Zarbaugh
Faculty Advisors: Brian Scheller and Peter Parker
9:00 a.m. to 9:30 a.m., Room 211

Throughout the paper industry, paper mills recycle internal waste. Coated paper mills experience unique problems when recycling internal waste. One problem associated with coated waste is the presence of coating flakes after pulping. These flakes are pieces of coating that fail to break into small particles. Since these flakes are visible in the final product, it is essential to eliminate the coating flakes. For this project, samples of coated paper were pulped and subjected to ultrasound waves. This was done to test the ability of ultrasound waves to break apart coating flakes. Strength properties of the ultrasonically treated fibers were then tested to determine whether the treatment had any effects on strength.

THE EFFECTS OF RECYCLING ON KENAF HANDSHEET PROPERTIES

by David B. Willoughby
Sponsor: John Stahl - The Evanescent Press
Faculty Advisor: David K. Peterson
9:30 a.m. to 10:00 a.m., Room 211

This project established trends of kenaf paper properties through repeated levels of recycling. Handsheets were produced from kenaf CTMP utilizing the Noble and Wood apparatus, and several levels of recycling were accomplished. Handsheets reserved from each level of recycling were then conditioned and tested for burst, tensile, tear, opacity, fold, and brightness. Finally, the test results were analyzed to establish trends of kenaf handsheet properties during recycling and to determine the feasibility of using kenaf as an alternative or reinforcement pulp in recycled paper grades.

THE RECYCLING OF VACUUM-FORMED PRODUCTS AND THE EFFECT ON USE CHARACTERISTICS

by Robert J. Miles
Sponsor: Willamette Industries - West Coast Development Lab
Faculty Advisor: David Peterson
10:00 a.m. to 10:30 a.m., Room 211

Vacuum-formed products are becoming more common in packaging materials. There is, however, a lack of technical information available on the use of such products as a viable fiber source for recycled grades of paper and paperboard. This project provided background data on typical fiber characteristics and runnability criteria for fiber sources derived from the manufacture of vacuum-formed products, commonly referred to as molded pulp. By comparing fiber length distribution, freeness, and reject rates, an analysis of repulping was done on a variety of products. These samples were also recycled into sheets and compared to typical industry specifications. The information provided by this work can be applied to any industrial application where these products are used.

THE USE OF BORATES IN WET END CHEMISTRY

by Rolland R. Elliott
Faculty Advisor: Dewei Qi
10:30 a.m. to 10:55 a.m., Room 211

The loss of fibers and fillers is an expensive problem in the paper industry, and the use of borates may help retain these commodities. This project investigated the effects of borates on retention, and studied how borates affect the dimensional stability of a sheet. Three different borates were used to study their effects on the retention of fibers. Handsheets were made with the addition of microparticle retention aids and borates to test the dimensional stability. These tests showed that borate can be used to retain fines and increase the stability of a sheet.

COMPARISON OF THE EFFECTS OF SILICATE AND BORATE IN THE PEROXIDE BLEACHING OF MECHANICAL PULP

by Corey Bishop
Faculty Advisor: Raja Aravamuthan
11:00 a.m. to 11:25 a.m., Room 211

Metal ions present in the pulp in the peroxide bleaching process catalyze the decomposition of hydrogen peroxide, reducing the efficiency of the process. Sodium silicate is currently used to control these ions. However, the addition of sodium silicate can cause scaling and fouling of equipment, wires, and felts. This in turn causes expensive downtime for scale removal. This project involved replacing sodium silicate with a non-scale-forming borate. This study investigated whether borate can economically replace silicate as a stabilizer in the peroxide bleaching process with an equivalent bleach response. Rates of bleaching reactions were also determined in various cases.

THE EFFECT OF USING HEMICELLULASE AND OXIDASE CONSECUTIVELY AS PRE-BLEACHING AGENTS FOR HARDWOOD KRAFT PULP

by Bryan R. Moore
Sponsor: Lee Honors College - Western Michigan University
Faculty Advisor: Raja Aravamuthan
11:30 a.m. to 11:55 a.m., Room 211

This project examined the potential applications that the multi-stage enzymatic pre-treatment of pulp may have in Elemental Chlorine Free (ECF) and Totally Chlorine Free (TCF) bleaching sequences. These sequences are currently being developed to reduce the environmental hazards associated with conventional bleaching processes. This project studied the use of two enzymes, hemicellulase and oxidase, by evaluating the bleaching effluent properties, final pulp brightness and viscosity, and degree of delignification after the enzymatic treatment followed by a D-E-D bleaching sequence (ECF). The results were compared with those obtained from untreated pulps and from pulps treated with one or the other enzyme, but not both.

THE EFFECTS OF MULTIPLE RECYCLES ON PAPER PRODUCED WITH 70% SOFTWOOD AND 30% WHEAT STRAW FIBER

by Jeffrey S. Greaves
Faculty Advisor: Raja Aravamuthan
1:00 p.m. to 1:25 p.m., Room 211

The use of wheat straw pulps is a common practice in paper mills located outside the continental United States. Typical grades produced with wheat straw fibers include printing and writing papers, which contain approximately 30% wheat straw fibers and 70% softwood fibers. These types of grades have already been seen coming into recycling operations. Therefore, an understanding of how paper properties change through multiple recycling stages when non-wood fibers are present is needed. This project involved making handsheets with 30% wheat straw pulp and recycling them successively four times. With each recycle, these handsheets displayed a definite change in paper properties. The properties of recycled paper with and without wheat straw fibers were also compared as a reference.

EFFECTS OF CATIONIC ADDITIVES ON INK-JET COATING FORMULATIONS

by Sean Frank
Faculty Advisors: Brian Scheller and John Cameron
1:30 p.m. to 1:55 p.m., Room 211

The recent popularity of ink-jet printers has led to the invention of an entire new line of paper coatings. These formulations often require cationic additives to achieve proper print quality. The effect of these cationic additives and their interaction with latexes was studied. This project investigated whether a high solids ink-jet coating applied via blade coating can give satisfactory print quality, and the extent of interactions among latex and cationic additives. The experimental design consisted of two different base formulations that were varied by addition levels of polyvinylpyrollidone (PVP), silica, latex, and a cationic polymer. These formulations were evaluated by assessing their runnability on a cylindrical laboratory coater and determining the coating rheology as well as the overall optical, structural, and print properties.

ANALYSIS OF INK-JET COATING FORMULATION VARIABLES

by Bryan Olmsted
Faculty Advisors: Brian Scheller and Peter Parker
2:00 p.m. to 2:25 p.m., Room 211

Since coating paper is a complex science, understanding the variables involved is important to achieve the desired parameters. The base formulations for each of the ten runs consisted of relatively low percentages of silica along with ground calcium carbonate, calcined clay, polyvinylpyrollidone, polyvinyl alcohol, and latex. The effects of latex charge and replacement of precipitated silica gel were examined. The effects of coat weight and time fading on the properties of the coated substrate were also determined. The coating formulations and coated paper were evaluated based on rheology, water retention, optical properties, strength characteristics, and printability.

USE OF BORAX TO INHIBIT THE PHOTOYELLOWING OF BLEACHED CTMP

by Chad Longcore
Faculty Advisor: John Cameron
2:30 p.m. to 2:55 p.m., Room 211

This project evaluated the ability of borax to inhibit the yellowing process of paper made from bleached chemithermomechanical pulp (BCTMP). Paper made from BCTMP has a tendency to lose brightness (photoyellow) when exposed to ultraviolet (UV) light. The light initiates a series of chemical reactions to take place which results in the formation of yellow ketone and quinone products. Borax was applied to the surface of the paper to interfere with these chemical reactions and prevent the formation of the yellow products that cause photoyellowing.

CHEMICALLY ENHANCED WET PRESSING

by Timothy Mishark
Faculty Advisor: John Cameron
3:00 p.m. to 3:25 p.m., Room 211

This project evaluated chemicals that may be helpful in curtailing rewetting. The bulk of the work was concerned with achieving a proper press nip impulse. This was achieved using a drop press. The literature confirms the use of kerosene in this application. The chemicals tested were compared with the effectiveness of kerosene.

THE EFFECTS OF DIRECTIONAL DRYING ON BINDER MIGRATION

by Bruce Johnston
Faculty Advisor: Brian Scheller
3:30 p.m. to 3:55 p.m., Room 211

Binder migration causes various printing defects. Extra dryer capacity cannot be utilized in drying the paper due to excessive binder migration at high drying rates. For this project, a base sheet was coated with a formula containing styrene-butadiene as the binder. After doing a drawdown with the coating, the sheet was dried with a specially built dryer to dry the sides of the sheet separately. After varying the amount of drying on each side of the sheet, samples were evaluated by UV analysis for binder migration. The objective was to find a top to bottom side drying ratio that immobilizes the binder and minimizes migration.

THANK YOU

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

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