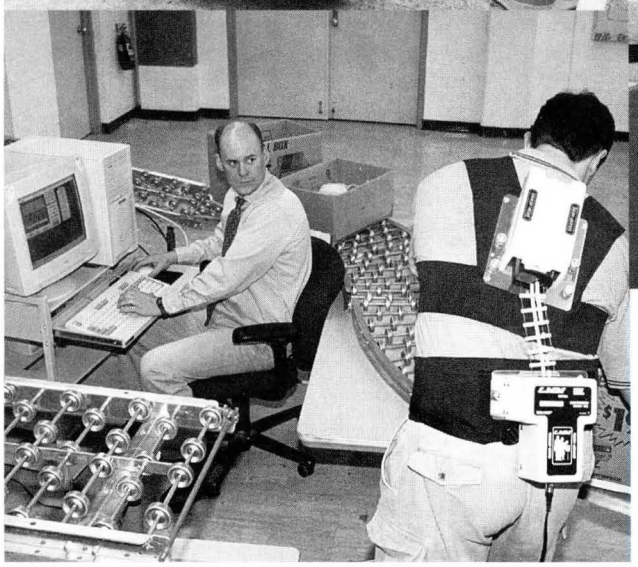
11-1999

25th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

25th Conference on Senior Engineering Design Projects



Tuesday, November 30, 1999

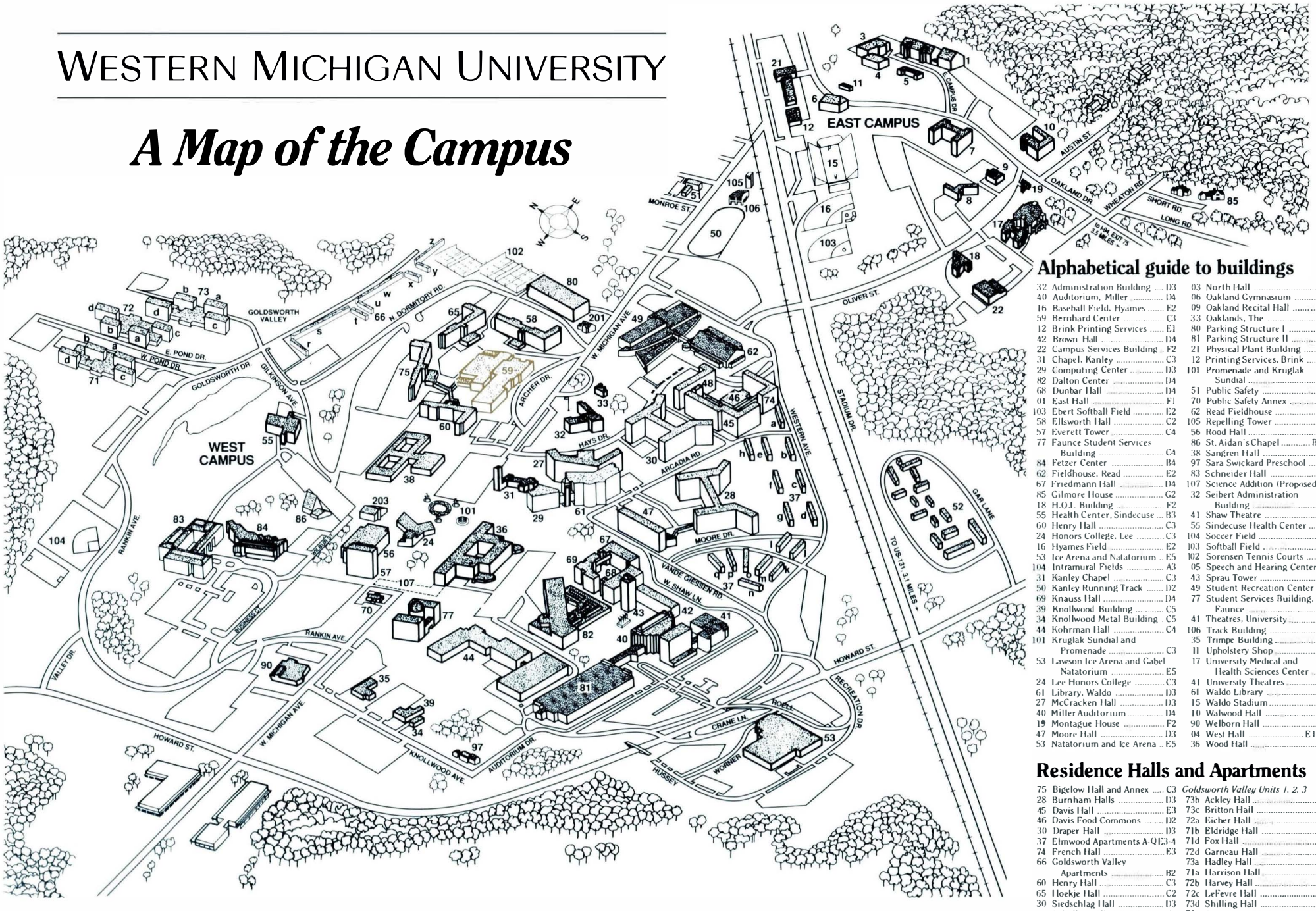
Bernhard Center

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

College of Engineering and Applied Sciences
Western Michigan University

WESTERN MICHIGAN UNIVERSITY

A Map of the Campus



Alphabetical guide to buildings

32 Administration Building ... D3
40 Auditorium, Miller ... D4
16 Baseball Field, Hyames ... E2
59 Bernhard Center ... C3
12 Brink Printing Services ... E1
42 Brown Hall ... D4
22 Campus Services Building ... F2
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29 Computing Center ... D3
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84 Fetzer Center ... B4
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67 Friedmann Hall ... D4
85 Gilmore House ... G2
18 H.O.I. Building ... F2
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69 Knauss Hall ... D4
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34 Knollwood Metal Building ... C5
44 Kohrman Hall ... C4
101 Kruglak Sundial and Promenade ... C3
53 Lawson Ice Arena and Gabel Natatorium ... E5
24 Lee Honors College ... C3
61 Library, Waldo ... D3
27 McCracken Hall ... D3
40 Miller Auditorium ... D4
19 Montague House ... F2
47 Moore Hall ... D3
53 Natatorium and Ice Arena ... E5
03 North Hall ... F1
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09 Oakland Recital Hall ... F1
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51 Public Safety ... D1
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62 Read Fieldhouse ... E2
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38 Sangren Hall ... C3
97 Sara Swickard Preschool ... C5
83 Schneider Hall ... A4
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41 Shaw Theatre ... D4
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49 Student Recreation Center D2
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41 Theatres, University ... D4
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35 Trimpe Building ... B4
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17 University Medical and Health Sciences Center ... F2
41 University Theatres ... D4
61 Waldo Library ... D3
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28 Burnham Halls ... D3
45 Davis Hall ... E3
46 Davis Food Commons ... D2
30 Draper Hall ... D3
37 Elmwood Apartments A-Q E3 4
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66 Goldsworth Valley Apartments ... B2
60 Henry Hall ... C3
65 Hoekje Hall ... C2
30 Siedschlag Hall ... D3
8 Spindler Hall ... F2
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7 Vandercook Hall ... F1
48 Zimmerman Hall ... D3

Goldsworth Valley Units 1, 2, 3

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

Private Property

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

Conference on Senior Engineering Design Projects

You are invited to attend the twenty-fifth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 2:00 p.m. **Tuesday, November 30**, at the Bernhard Center on the campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry.

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

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

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

Parking is available in the ramp near the Bernhard Center.

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

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

Construction Engineering and Management	242	10:30 to 11:00	p. 4
Electrical and Computer Engineering	210	9:00 to 2:00	p. 5
Industrial and Manufacturing Engineering A-I	208	9:00 to 12:00	p. 8
Industrial and Manufacturing Engineering A-II	209	9:00 to 1:30	p. 11
Materials Science and Engineering	242	9:00 to 9:30	p. 14
Mechanical and Aeronautical Engineering A-I	211	9:30 to 12:00	p. 15
Mechanical and Aeronautical Engineering A-II	212	9:30 to 2:00	p. 17
Paper and Printing Science and Engineering	205	9:00 to 10:30	p. 20

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

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

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

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

Time	Room	Dept.	Topic
9:00	210	ECE	Smart Self-Illuminating Delineator II (SSID II)
	208	IME A-I	Efficient Production of Electrical Connectors
	209	IME A-II	Improving Injection Molding Changeover Time
	242	MSE	Electrodoposited Nano-Composite Coatings for Improved Wear Resistance
	205	PSE	Particle Size Modeling with Aspen Plus
9:30	210	ECE	Electric Controller for Airflow Management (ECAM) Port Expander
	208	IME A-I	Copper Tooling Wear Aspects of Injection Mold Components
	209	IME A-II	Spare Part Inventory Model and Storeroom Layout
	211	MAE A-I	Dynamic Weight Transfer Device for Race Cars
	212	MAE A-II	Monitoring System for a Turbine Engine Seal Tester
	205	PSE	The Effect of Photoyellowing of High Temperature and Pressure Treatment of Mechanical Pulp with Borates
10:00	210	ECE	Bus Identification System
	208	IME A-I	Part-To-CAD Reverse Engineering
	209	IME A-II	ISO/QS-9000 Preparation
	211	MAE A-I	Continuously Variable Transmission for Hybrid-Electric Vehicle (HEV)
	212	MAE A-II	Heat Transfer Analysis of a Jet Engine Seal Tester
	205	PSE	Ability of Borate Compounds to Bind with Lignin and Reduce Photoyellowing of Mechanical Pulps

10:30	242	CEM	A Study of Metal Building Systems
	210	ECE	Electric Tool Balancer
	208	IME A-I	Analysis of the WMU Solar Car Suspension using ADAMS Software
	209	IME A-II	Proposal for Lockout Tagout Procedures (LOTO)
	211	MAE A-I	Reciprocating Engine Rod Testing
	212	MAE A-II	Rare Book Room Humidity and Temperature Control
11:00	210	ECE	Environmental Control System
	208	IME A-I	Implementation of an Automated Investment Casting Cell
	209	IME A-II	Study of Inpatient Surgical Processes at a Southwest Michigan Hospital
	211	MAE A-I	Design Modification of a Surgical Handpiece
	212	MAE A-II	Manufacture of a Seal Press for Bearing Cups
11:30	210	ECE	Power Switch
	208	IME A-I	Improving the Processing Parameters of an Aluminum Cast Metal Matrix Composite
	209	IME A-II	Building Design for the New College of Engineering
	211	MAE A-I	Design and Analysis of a Vibratory Finishing Machine
	212	MAE A-II	HVAC System for a Technological Facility
1:00	210	ECE	Wide Range Illuminator
	209	IME A-II	Efficiency Maximization of Production and Assembly
	212	MAE A-II	Development of a Mounting System for Vibration Analysis
1:30	210	ECE	Spindle Motor Digital Speed Control System
	212	MAE A-II	Computer Model of Refrigeration System

CONSTRUCTION ENGINEERING AND MANAGEMENT
CONSTRUCTION SCIENCE AND MANAGEMENT

Session Chair – Osama Abudayyeh
Room 242

A STUDY OF METAL BUILDING SYSTEMS

by Robert E. Kakoczki and Richard D. Valencia
Sponsor: James Dalley – Maverick Construction Company, Inc.
Faculty Advisor: Osama Abudayyeh
10:30 a.m. to 10:55 a.m., Room 242

This project involved the construction management aspects of a Metal Building System. The project included a complete cost estimate and the development of a project management system. The cost estimate was done by performing a quantity take-off of the work items, while the construction management system consisted of a detailed safety program and a completed project schedule.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink
Room 210

SMART SELF-ILLUMINATING DELINEATOR II (SSID II)

by Hairul Nizam Ismail, Hung Nguyen and Wayne Sevelen
Faculty Advisor: Johnson Asumadu
9:00 a.m. to 9:25 a.m., Room 210

Poor conditions (i.e. dense fog, smoke, heavy rains, and snow) reduce visibility and effectiveness of reflective devices on roads and highways. Smart Self-Illuminating Delineator II (SSID II) is a device that is placed on roads and highways to improve visibility during those periods. SSID II is an updated version of the SSID (Fall 98). SSID II uses a microcontroller and a solar cell. The microcontroller simplifies the circuit by eliminating a day/night sensor, and it also controls and provides the timing for an LED module. SSID II uses solar cells for recharging its batteries during daylight. SSID II was designed so that the power consumption is reduced and all maintenance work eliminated.

ELECTRIC CONTROLLER FOR AIRFLOW MANAGEMENT (ECAM) PORT EXPANDER

by Yi Huang, Rohit Pallegar and Lit Choon Seow
Sponsor: Mike D. Tuttle – Eaton Corporation (Fluid Power Division)
Faculty Advisor: Frank Severance
9:30 a.m. to 9:55 a.m., Room 210

The Fluid Power Division of a company needs a device to monitor eight different temperatures under the hood of an automobile in real time. This temperature data forms a basis from which the fan speed is controlled so as to prevent the radiator from overheating. The previous design, which uses five thermistors, lacked accuracy and flexibility. Improved accuracy and flexibility was accomplished by using thermocouples and expanding the number of data acquisition ports to eight. The new design includes a so-called *Port Expander* to read the eight different thermocouple temperature readings.

BUS IDENTIFICATION SYSTEM

by Kwan Hwa Goh, Cindy Shin Nee Liem and Yee Ping See
Sponsor: Paul Ponchilla – WMU Department of Blind Rehabilitation
Faculty Advisors: Raghvendra Gejji and David Guth
10:00 a.m. to 10:25 a.m., Room 210

Visually impaired individuals have difficulty getting on the correct bus. The Bus Identification System was designed to alleviate this problem. This system was built to automatically announce the bus number as the bus approaches the bus stop. The identification process was programmed into a microcontroller. An infra-red transmitter on the bus transmits the coded bus number to a receiver located at the bus stop. The receiver detects this signal and announces the bus number through a speaker via a voice chip.

ELECTRIC TOOL BALANCER

by Ganesan Kadirgama and Wee Sie Wong
Faculty Advisor: John Mason
10:30 a.m. to 10:55 a.m., Room 210

Tool balancers are used in industry to counterbalance the weight of production power tools, usually in assembly operations. Most balancers used in industry are made of spring or pneumatic components. An electric tool balancer was built to replace these balancers and make the assembly operation more efficient. The system uses a Programmable Logic controller (PLC) to control the AC gear motor as it raises or lowers the power tool.

ENVIRONMENTAL CONTROL SYSTEM

by Edmond Troy Delude, Bradley D. Johnson and Troy Redder
Sponsor: Gord Poll – Poll Farms, Inc.
Faculty Advisor: Damon Miller
11:00 a.m. to 11:25 a.m., Room 210

An Environmental Control System (ECS) for a livestock boarding facility was designed, built, and tested. This system enables temperature monitoring and control within a building. After the user specifies a temperature for the building, the ECS continuously monitors the temperature and makes any required adjustments to the environment. The ECS also collects and stores temperature data for later examination. The ECS consists of temperature probes, an analog temperature acquisition board, a PC with software for environmental control, a digital output board, and a series of relays and contact switches which control two heaters and twelve cooling fans.

POWER SWITCH

by Mustafa Albasha, Wui Meng Steven Chew and Kai Shen Phan
Sponsor: Larry Kaiser – Kalamazoo Community Mental Health
Faculty Advisor: Joseph Kelemen
11:30 a.m. to 11:55 a.m., Room 210

A remote-controlled power switch for household appliances rated for a maximum of 480W at 120V was designed, tested, and built. A detailed study and research regarding remote control signals needed to control the switch was carried out. When two consecutively numbered buttons on the remote control are pressed, the power switch automatically supplies or cuts off power to the attached appliance. A light indicates whether there is power to the appliance or not.

WIDE RANGE ILLUMINATOR

by Kar Hong Eddie Lum, Izwan Abdul Rashid and Fatt Nyen Wong
Faculty Advisor: Raghvendra Gejji
1:00 p.m. to 1:25 p.m., Room 210

A radio frequency (RF) remote control system was designed and built to enable muscular dystrophy patients to control light fixtures. The hand-held lightweight device enables a person to control up to four light fixtures within a 150 foot range, without moving around from switch to switch. The system consists of one transmitter unit and four receiver units. This system replaces the use of wall switches. The push button transmitter unit is powered by a DC battery, and the receiver units are powered by existing 120V AC.

SPINDLE MOTOR DIGITAL SPEED CONTROL SYSTEM

by Terrance Daniels, Michael Hawkins and Sean Sinotte
Sponsors: Andrew Oswald–OZY Robotics and David Figgins-Figgins Machine Co. Faculty Advisor: Joseph Kelemen
1:30 p.m. to 1:55 p.m., Room 210

When a part is machined in a lathe, the lathe spindle speed fluctuates with changes in force applied to the part. The Spindle Motor Digital Speed Control System (SMDSCS) eliminates this problem. The SMDSCS is designed to provide a constant spindle speed. The desired speed is input into the SMDSCS by a dial or by a computer. The speed is maintained by constantly measuring the angular velocity of the spindle and adjusting the current for more or less torque from the motor, which turns the lathe. The SMDSCS allows for a part to be machined more accurately and more easily than with conventional lathes.

INDUSTRIAL AND MANUFACTURING ENGINEERING A-I

Session Chair – Mitchel Keil
Room 208

EFFICIENT PRODUCTION OF ELECTRICAL CONNECTORS

by Steve Carr, Eric Jean-Charles, Subramaniam Karuppiah and Meenaloshini Satgunam
Sponsor: Lowern Keirn – The HOMAC Companies
Faculty Advisors: Sam Ramrattan and Steven Butt
9:00 a.m. to 9:25 a.m., Room 208

Electrical cable connectors are used in residential subdivisions and power sub-stations to distribute power from a single source. To provide an electrical connection that is insulated, the connectors are partially protected with PVC coating, and the remainder of the connector is covered with rubber fittings. It was determined that a bottleneck in the production of the connectors occurred in the coating process, specifically the time necessary to mount the connectors onto a bracket. This project involved designing and testing a new bracket that has quick-mounting and release capabilities. Other assembly and ergonomic issues concerning the production of the connectors were considered following the bracket development.

COPPER TOOLING WEAR ASPECTS OF INJECTION MOLD COMPONENTS

by Frank Asher, Richard Brothers, Michael Buckle and Adrian Sultana
Sponsor: John Cowie – The Copper Development Association, Inc.
Faculty Advisor: Paul Engelmann
9:30 a.m. to 9:55 a.m., Room 208

Copper alloys are desirable materials to use in the construction of injection molds due to their high thermal conductivity. The drawback of certain coppers is their low resistance to wear when compared to hardened tool steels. The results of this long term wear study determined the relative life of copper alloys with and without various coatings. Several hundred thousand shots of nylon were required to wear the mold components. The process was managed through lights-out automation. This research and data analysis allowed the plastics industry to gain a better understanding how to optimize the use of copper alloys in injection molds.

PART-TO-CAD REVERSE ENGINEERING

by Brian Langan, Takita McFadden, Robert Morris and Nguyen Vy
Faculty Advisor: Jorge Rodriguez
10:00 a.m. to 10:25 a.m., Room 208

Modern engineering practices require access and use of CAD databases during the design and manufacturing phases. In many cases such CAD databases do not exist or they are inaccessible or usable by the engineers. A design concept to aide today's engineer challenged with this obstacle is know as Part-to-CAD Reverse Engineering (PCRE). PCRE is a process where a digitizer is used to collect various data points from a subject part. PCRE was applied to generate databases for a variety of components. The generated databases were brought into parametric modeling software where they were manipulated and modified. A generic procedure was created to utilize PCRE at a WMU lab.

ANALYSIS OF THE WMU SOLAR CAR SUSPENSION USING ADAMS SOFTWARE

by Scott Earl, Brian Hansen, Chad Paquin and Brett Reed
Faculty Advisor: Mitchel Keil
10:30 a.m. to 10:55 a.m., Room 208

The suspension of the WMU Solar Car was modeled using ADAMS software. Structural components were imported into ADAMS, assembled, and properties were determined for each component. Springs and shock absorbers were then placed on the vehicle, and test simulations were then run. Results were discussed with the WU Solar Car Design Team.

IMPLEMENTATION OF AN AUTOMATED INVESTMENT CASTING CELL

by Jeremy Cadwell, Mark Key and Doug Muenzer
Faculty Advisor: Sam N. Ramrattan
11:00 a.m. to 11:25 a.m., Room 208

This project involved the implementation of an automated investment casting cell in Western Michigan University's cast metals laboratory. Investment casting is a technology that is heavily used in industry. With the amount of investment castings being used in industry today, it is important for students to gain an understanding of this form of technology. The investment casting process began with a wax replica of the part to be produced. The wax was dipped into a ceramic slurry and coated with sand stuccoing. Dipping and stuccoing were performed using a robot. When the ceramic dried, it was fired and the wax was melted out, leaving a hollow mold. The mold was then filled with molted metal to produce the casting.

IMPROVING THE PROCESSING PARAMETERS OF AN ALUMINUM CAST METAL MATRIX COMPOSITE

by Juliane Alberding, Peter Anderson and Jason McIntyre
Faculty Advisors: Sam Ramrattan and Jorge Rodriguez
11:30 a.m. to 11:55 a.m., Room 208

Aluminum cast metal matrix composites (CMMC) are ideal materials for use in the automotive and aerospace industries. CMMC's are typically harder and lighter than standard grades of aluminum cast alloys, but these superior properties also make them difficult to cast. This project focused on the improvement of processing parameters in aluminum CMMC's. A method for casting the aluminum CMMC with simplified gating and improved yield was identified.

INDUSTRIAL AND MANUFACTURING ENGINEERING A-II

Session Chair – Sam Ramrattan
Room 209

IMPROVING INJECTION MOLDING CHANGEOVER TIME

by Robert Otis and Tam Vu
Sponsor: Atlantic Automotive Components
Faculty Advisor: Tycho Fredericks
9:00 a.m. to 9:25 a.m., Room 209

As industries strive to create lean operations with smaller lot sizes, there is an increased demand for frequent and quick machine tool changeovers. This project developed a standard procedure for injection molding machine changeover. The existing process was evaluated and the variables that affected the lengthy changeovers were accounted for. Worker and management interviews, video recordings, time and motion studies, and flowcharts were used to analyze the changeover process. Based on our test results, a standard procedure that reduced the changeover times for injection molding machines was developed.

SPARE PART INVENTORY MODEL AND STOREROOM LAYOUT

by Scott Fleming, Linda Krause, Gordon Lanker and Thomas McDonald
Sponsors: Bret Arnone and Cindy Collyer – Graphic Packaging Corporation
Faculty Advisor: David Lyth
9:30 a.m. to 9:55 a.m., Room 209

A major cost to a corporation is the repair and maintenance of their machinery. The storeroom's efficiency for the spare parts for this machinery is essential to continuous and smooth production. It is critical that the proper parts be ordered at the proper time and in the proper quantities. A spare parts inventory model was identified and a redesign of the storeroom layout which houses the spare parts inventory was completed.

ISO / QS-9000 PREPARATION

by Latasha Everett, Lanatic Killens, Ron Prouty and Kelley Tuchel
Sponsors: Doug Heystek and Frank Oros – Eaton Corporation-Reman/APC
Faculty Advisor: Fred Sitkins
10:00 a.m. to 10:25 a.m., Room 209

In order for automotive companies and their suppliers to be globally competitive, it is strongly recommended they be ISO or QS-9000 registered. This project entailed assisting the client in preparation of a third party certification and conducting internal audits of the quality system. The results of this internal audit were evaluated and used as a tool to compare past audits as a way to verify progress towards ISO / QS-9000 compliance.

PROPOSAL FOR LOCKOUT TAGOUT PROCEDURES (LOTO)

by Soh Ng, Jeff Rutkowski, Shahmad Zakie Shantin and Heath Trerice
Sponsor: Johnson Corporation
Faculty Advisor: Fred Sitkins
10:30 a.m. to 10:55 a.m., Room 209

Lockout Tagout (LOTO) is a standard operating procedure that covers the servicing and maintenance of machines and equipment for the unexpected startup or release of stored energy that could cause injury to employees. There are two types of energy isolating devices: tags and locks. Tags are used to identify the individual(s) servicing the equipment, and locks are used for power isolation of the equipment. In collaboration with a company in need of LOTO, this project identified and recommended a proper Lockout Tagout procedure.

STUDY OF INPATIENT SURGICAL PROCESSES AT A SOUTHWEST MICHIGAN HOSPITAL

by Rachel Burgan, Yolanda Dowe, Ryan Kamerad and Kari Makarewicz
Faculty Advisor: Larry Mallak
11:00 a.m. to 11:25 a.m., Room 209

Customer satisfaction is an important aspect of the health care industry. In order to be successful, a company must shift its focus to making improvements based upon customer input. A southwest Michigan hospital had an interest in improving customer satisfaction for inpatient surgical procedures. Surveys measuring customer satisfaction were analyzed to determine areas for improvement. These areas were then studied using industrial engineering and management tools to identify specific causes of patient dissatisfaction and to determine recommendations for improvement.

BUILDING DESIGN FOR THE NEW COLLEGE OF ENGINEERING

by Christina Ciucci, Tracey Gardanier, Bianca Hale and Aletha Rosine
Sponsor: Evie Asken – WMU Campus Planning
Faculty Advisor: Kailash Bafna
11:30 a.m. to 11:55 a.m., Room 209

This project involved the layout of the new College of Engineering and Applied Sciences building to be located on Western Michigan University's (WMU's) Lee Baker Farm. This new facility will house classrooms, laboratories, and departmental and faculty offices. Our group worked with WMU's Campus Planning Office and used the data provided by them to design the layout focusing on the needs of the students and the faculty within the College. Information on specific facilities and area requirements was gathered from the students, the faculty, the department chairpersons, and the dean. The information was then analyzed and incorporated in the development of the layout. In addition to academic facilities such as classrooms and laboratories, provisions were made for adequate restroom, study room, and break room facilities.

EFFICIENCY MAXIMIZATION OF PRODUCTION AND ASSEMBLY

by Joseph H. Frikken, Dehraj Gulia, Daniel Lang and Michael Lothamer
Faculty Advisor: Bob White
1:00 p.m. to 1:25 p.m., Room 209

A local company desired greater efficiency from their brake pad manufacturing and assembly process. The primary area of focus was reduction of downtime and redundant material handling. The secondary focus was eliminating problems which cause damaged work in progress (WIP) and reducing the overall WIP from seven to three days. The result of the project was a complete redesign of the shop floor layout, which relocated and reclassified machinery and modified process flows. The new layouts and process flows designed by the group are scheduled for implementation before January 2000.

MATERIALS SCIENCE AND ENGINEERING

Session Chair – Pnina Ari-Gur
Room 242

ELECTRODEPOSITED NANO-COMPOSITE COATINGS FOR IMPROVED WEAR RESISTANCE

by Philip P. Skrzypek
Faculty Advisor: Pnina Ari-Gur
9:00 a.m. to 9:25 a.m., Room 242

Plates coated with a nano metal matrix composite (MMC) were developed to solve the problem of excessive wear of aluminum. Characterization of the new plates included a pin-on-disc wear test, optical and scanning electron microscopy, interference microscopy, and atomic force microscopy (AFM).

MECHANICAL AND AERONAUTICAL ENGINEERING A-I

Session Chair – Richard Hathaway
Room 211

DYNAMIC WEIGHT TRANSFER DEVICE FOR RACE CARS

by Riyadh Alekhwan and Abdullah Alkhater
Sponsor: Brian Alegreso – Dunigan Motor Racing
Faculty Advisor: Richard Hathaway
9:30 a.m. to 9:55 a.m., Room 211

A transient weight transfer device was designed to improve the dynamic response of the vehicle during deceleration, cornering, and acceleration. The device had to be lightweight, but high in strength, adjustable for different tracts, a passive system and with a neutral and predictable failure mode. It was designed to be connected to the suspension system. The device was designed based on aerodynamic and static forces analyses. A computer model was used to test, evaluate, and verify the final design.

CONTINUOUSLY VARIABLE TRANSMISSION FOR HYBRID-ELECTRIC VEHICLE (HEV)

by Don Dickerson and Adam C. Massie
Faculty Advisor: Richard Hathaway
10:00 a.m. to 10:25 a.m., Room 211

A parallel Hybrid-Electric Vehicle (HEV) transmission system was designed to permit the simultaneous use of two separate power sources to propel a vehicle. The design allowed the vehicle to be driven by either or both of the power sources. This permitted the drive train to be optimally configured for the driving conditions. The use of varying configurations allowed for improvement in performance and efficiency over existing HEV's.

RECIPROCATING ENGINE ROD TESTING

by John Eiler and Chris Jablonski
Faculty Advisor: Richard Hathaway
10:30 a.m. to 10:55 a.m., Room 211

A machine was designed to test the integrity of reciprocating engine connecting rods. High performance engines often require specially designed connecting rods. Most engine builders have no means of testing different rods; they must simply rely on the reputation of the manufacturer. Some manufacturers test rods in independent laboratories, some test in-house, and some do no testing at all. The designed testing machine and methods will allow an engine builder to effectively test rods and aid in selection of rods for different engines.

DESIGN MODIFICATION OF A SURGICAL HANDPIECE

by Benjamin McKinney
Sponsor: Jason Allen – Stryker Instruments
Faculty Advisor: Koorosh Naghshineh
11:00 a.m. to 11:25 a.m., Room 211

A circuit board was previously developed to allow a medical manufacturer to record performance data on surgical handpieces during customer use. It was necessary to implement this board into handpieces used in various product lines. The board was rubber coated to protect its integrity during sterilization. Autoclave life-testing then certified proper performance after instrument sterilization. Coating optimization allowed sufficient protection without compromising space within the handpiece. Reconfiguration of the hand piece was then required to accommodate the board while maintaining aesthetics. Handpiece validation assured that correct instrument performance was maintained. This redesigned handpiece will allow critical data to be captured, which will help improve future products.

DESIGN AND ANALYSIS OF A VIBRATORY FINISHING MACHINE

by Brian Burroughs and Jeremy Hammond
Sponsor: Gary McNeil – Hamilton Mfg., Inc. and Hammond Machinery/Roto-Finish
Faculty Advisor: Koorosh Naghshineh
11:30 a.m. to 11:55 a.m., Room 211

Vibratory machines are used in industry for finishing components. The basic elements of a vibratory finishing machine were studied in an effort to improve existing equipment. The machines consist of a channel suspended by springs and excited by rotating eccentric masses on a driveshaft driven by a motor. The motion of the eccentric masses causes the abrasive media in the channel to tumble, thus finishing the parts. A scale model of a linear vibratory machine was designed and manufactured to test the effects of changing the elements. The motor speed, eccentric mass, driveshaft location, and springs were all variables that were studied. The machine was also simulated using Working Model ™ software, and the results were compared to the scale model. From this research, guidelines for improving the existing machines were developed.

MECHANICAL AND AERONAUTICAL ENGINEERING A-II

Session Chair – Jerry Hamelink
Room 212

MONITORING SYSTEM FOR A TURBINE ENGINE SEAL TESTER

by Elizabeth Perez
Sponsor: WMU Tribology Laboratory
Faculty Advisor: Philip Guichelaar
9:30 a.m. to 9:55 a.m., Room 212

A gas turbine engine seal tester that operates at 30,000 RPM and 1000F needed a monitoring system to record seal performance and to shut the tester down in case of malfunction. Transducers were selected to measure temperature, pressure, shaft speed, vibration, and air leakage. A program was written that uses commercially available data acquisition software to display and permanently record signals from the various transducers. An independent system that monitors bearing temperatures and housing vibration can shut the system down in a case of malfunction during unattended operation.

HEAT TRANSFER ANALYSIS OF A JET ENGINE SEAL TESTER

by Jason Hoover and Karen Klepack
Sponsor: WMU Tribology Laboratory
Faculty Advisor: Jerry Hamelink
10:00 a.m. to 10:25 a.m., Room 212

The heating time of a testing machine that simulates the operating conditions of jet engine seals had to be determined. A computer program was used to calculate temperature profiles in the tester body at different times, taking into account conductive, convective and radiative heat loss. The temperature profiles were used to determine if the tester would reach and maintain the required temperatures in a reasonable length of time.

RARE BOOK ROOM HUMIDITY AND TEMPERATURE CONTROL

by Greg Herbst and Andre Thangam
Sponsor: WMU Physical Plant
Faculty Advisor: Jerry Hamelink
10:30 a.m. to 10:55 a.m., Room 212

Waldo library has a rare book collection estimated at $14 million, and the collection is still expanding. Some of these materials date back to the 15th century. In order to preserve these materials, a stable temperature and humidity environment is required, which means temperature and humidity fluctuations are less than five percent. The current system is unable to maintain the required temperature and humidity. Various analyses were conducted on the system capabilities and modifications to the system were recommended.

MANUFACTURE OF A SEAL PRESS FOR BEARING CUPS

by Matt Fielbrandt and Anthony Reinartz
Sponsor: Kevin Szeszulski – American Axle and Manufacturing
Faculty Advisor: Jerry Hamelink
11:00 a.m. to 11:25 a.m., Room 212

The manufacture of a manual seal press for bearing cups that includes an automatic seal greaser allows a local manufacturing company to repair universal joint bearing cups in a timely manner while meeting required specifications. Tooling and fixturing were designed to allow a predetermined amount of grease to be placed in the seal of the new Generation II bearing cup as it was pressed into position on the seat of the bearing cup with the proper amount of force. This saves manufacturing time, money, and scrap, as well as exceeds set quality standards.

HVAC SYSTEM FOR A TECHNOLOGICAL FACILITY

by Jason C. Hamilton and Jamie A. Rich
Sponsor: Hans Korendyke, PE – Tower Pinkster Titus, Associates
Faculty Advisor: Jerry Hamelink
11:30 a.m. to 11:55 a.m., Room 212

A new technological center required the design of a HVAC system. An evaluation of the building was done to determine the scope of the project. The building was then divided into areas with similar design requirements and the heat loss, heat gain and ventilation of the facility was calculated. Utilizing this information, the HVAC equipment was then selected based on space constraints, cost limitation, and application. Comparisons were made to determine the types of boilers, chiller, and cooling tower necessary to supply the HVAC equipment used in controlling the facility environment with the appropriate heat transfer media.

DEVELOPMENT OF A MOUNTING SYSTEM FOR VIBRATION ANALYSIS

by Edward F. Hines and Scott Martin
Sponsor: Terrance Camilleri – American Electric Power Corporation
Faculty Advisor: Jerry Hamelink
1:00 p.m. to 1:25 p.m., Room 212

Consistent, stable mounting points on rotating machinery for vibration monitoring is a challenge for accurate fault diagnosis. Magnetic steel discs were installed to rotating machinery using a two-part epoxy bonding agent to provide a stable, consistent location for vibration analysis. Analysis of two distinct epoxies and metal types was performed to determine the frequency response, in order to quantify the effect of the epoxy on measured vibration. The mounting system developed provides the ability to magnetically mount transducers for quick, multi-machine routes, as well as to permanently affix these same transducers for both extreme low and high frequency analysis.

COMPUTER MODEL OF REFRIGERATION SYSTEM

by Fan Shen Hong, Michelle Sutianto Lourdes and Malaythip Watthanasintham
Sponsor: Andrew Veldt – Thermotron
Faculty Advisor: Jerry Hamelink
1:30 p.m. to 1:55 p.m., Room 212

A computer model was needed to be able to predict the cooling capacity of an elementary cascade refrigeration system. A computer model was designed that allows the user to vary the volume of the high and low stage compressors, evaporator temperatures, condensing temperatures, and heat exchanger temperatures. The computer model also takes into account the amount of refrigerant gas left in the compressor during the compression process. The model may also be used for design and production of cooling chambers.

PAPER AND PRINTING SCIENCE AND ENGINEERING

Session Chair – Peter Parker
Room 205

PARTICLE SIZE MODELING WITH ASPEN PLUS

by Amy Vought
Faculty Advisor: Peter Parker
9:00 a.m. to 9:25 a.m., Room 205

Paper quality and paper machine runnability are influenced by fiber and debris size distributions. Systems that manipulate the fiber size distribution are used to control paper properties. This work used Aspen Plus simulation software as a predictive tool to determine the particle size distributions of centrifugal cleaner flows. The simulated results were verified with pilot plant data. Modeling tools such as this could help engineers monitor performance of cleaner systems. This could improve paper quality by improving the performance of papermaking systems that depend on the cleaner system to fractionate fiber streams.

THE EFFECT OF PHOTOYELLOWING OF HIGH TEMPERATURE AND PRESSURE TREATMENT OF MECHANICAL PULP WITH BORATES

by Shawn Mortimore
Faculty Advisor: John Cameron
9:30 a.m. to 9:55 a.m., Room 205

Photoyellowing is the degradation of paper brightness as a result of exposure to light. This project provided new information on increasing the ability of boric acid and sodium borate to reduce photoyellowing. Mechanical pulps can undergo brightness reversion through thermal means or through exposure to light. This project covered both aspects of photoyellowing by treating an aspen chemithermomechanical pulp (CTMP) sample with a solution of borates at different temperatures and pressures. After treatment, the pulp was made into handsheets and exposed to UV light to determine the effect of the borates on inhibition of photoyellowing.

ABILITY OF BORATE COMPOUNDS TO BIND WITH LIGNIN AND REDUCE PHOTOYELLOWING OF MECHANICAL PULPS

by Kimberlee Rumler
Faculty Advisor: John Cameron
10:00 a.m. to 10:25 a.m., Room 205

Mechanical pulps have not been used in long lived products because they yellow with time. The yellowing occurs in mechanical pulps due to the oxidation of lignin by UV rays. Borate and boric acid were reacted with mechanical pulp in a reaction vessel, which controlled the temperature. After the pulp was reacted with the borate and boric acid, free reagents were removed by washing, and the residue borate levels were determined. This prevented the free borate and boric acid from inhibiting photoyellowing. The borate and boric acid inhibited the photoyellowing of the mechanical pulps by bonding with the lignin structures.

THANK YOU

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