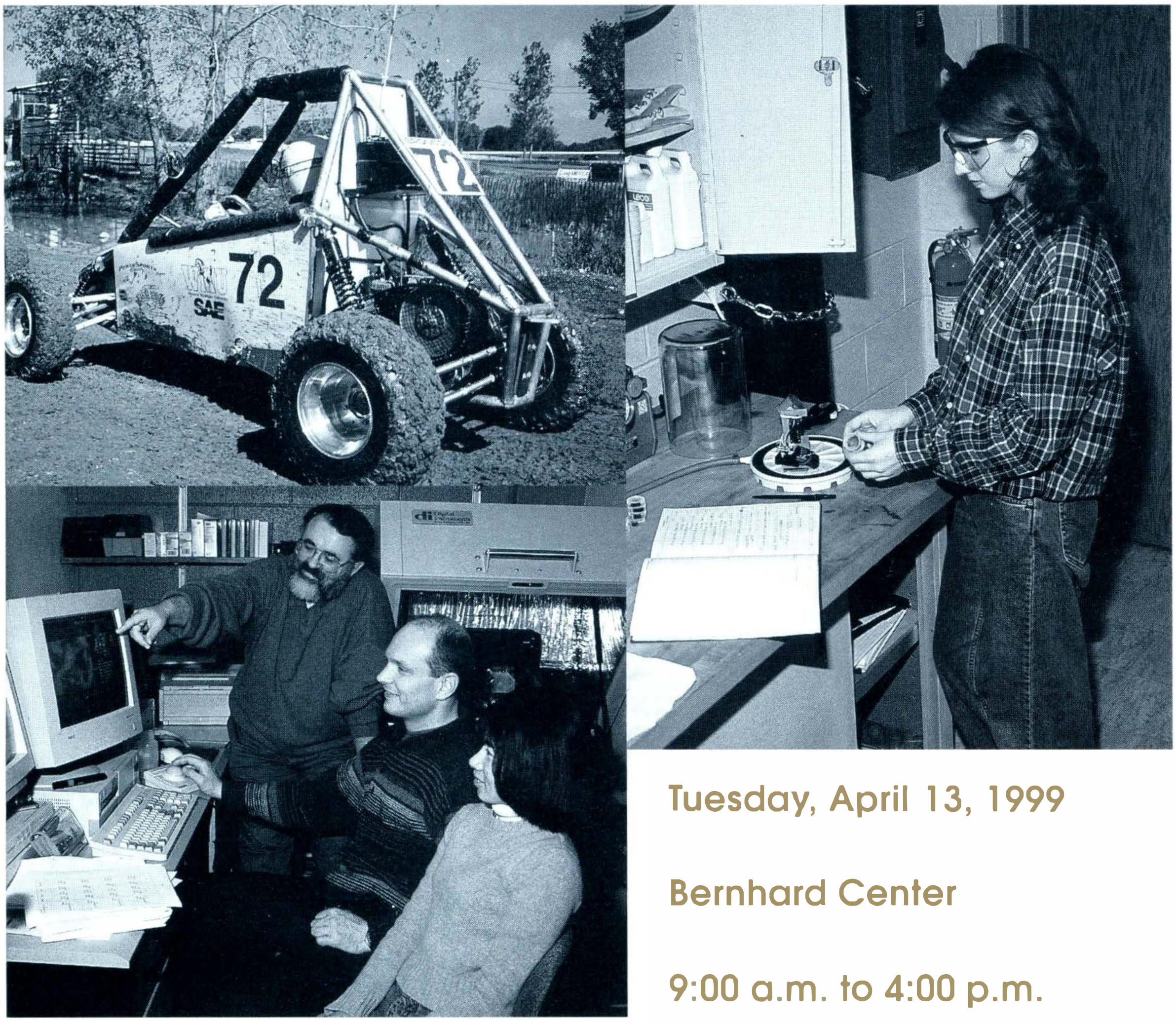
4-1999

24th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

24th Conference on Senior Engineering Design Projects



Tuesday, April 13, 1999

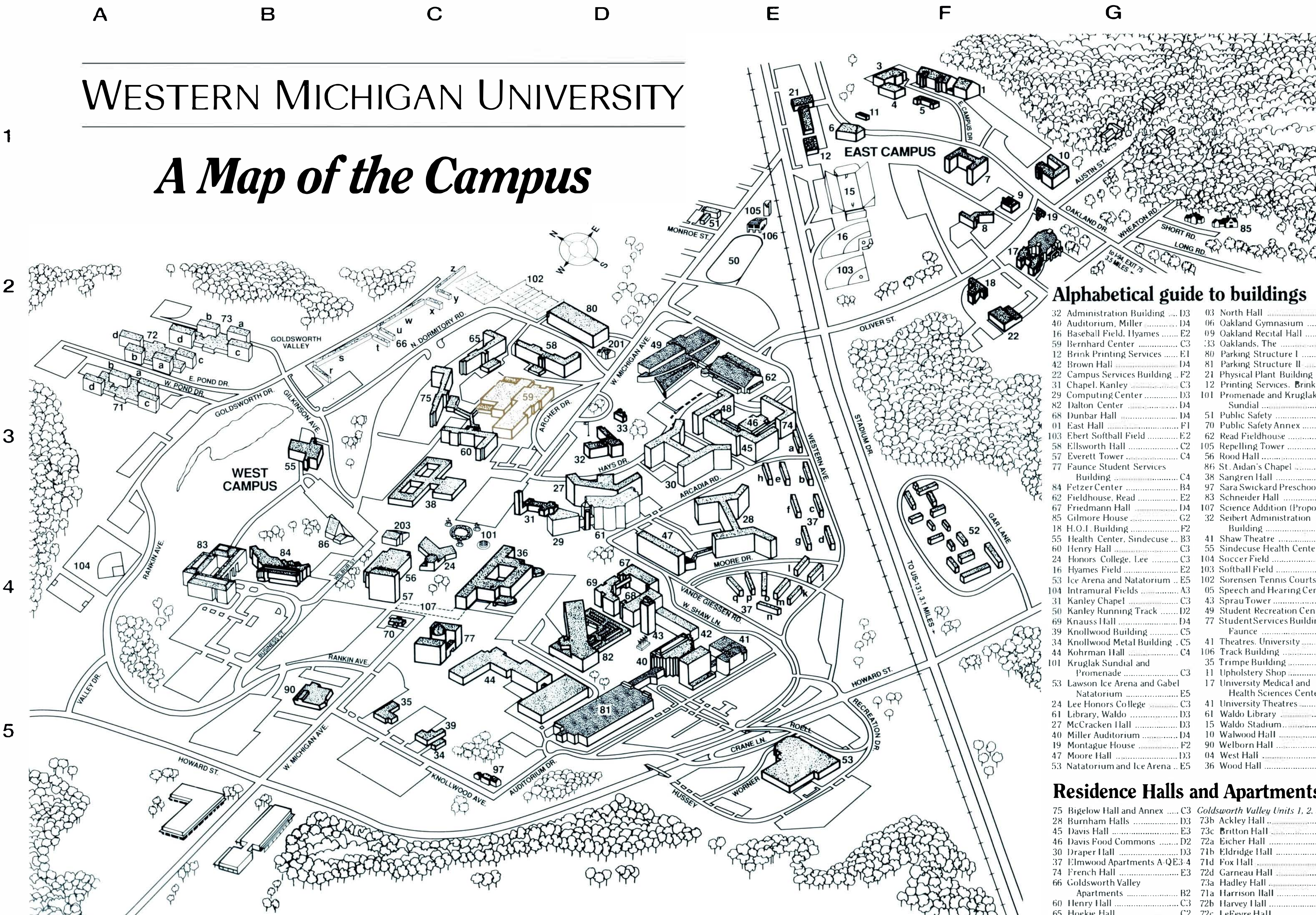
Bernhard Center

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

College of Engineering and Applied Sciences
Western Michigan University
Making a Difference

WESTERN MICHIGAN UNIVERSITY

A Map of the Campus



Alphabetical guide to buildings

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

Residence Halls and Apartments

75 Bigelow Hall and Annex C3
28 Burnham Halls ... D3
45 Davis Hall ... E3
46 Davis Food Commons D2
30 Draper Hall ... D3
37 Elmwood Apartments A-QE3-4
74 French Hall ... E3
66 Goldsworth Valley Apartments ... B2
60 Henry Hall ... C3
65 Hoekje Hall ... C2
30 Siedschlag Hall ... D3
8 Spindler Hall ... F2
52 Stadium Drive Apartments . F3
7 Vandercook Hall ... F1
48 Zimmerman Hall ... D3

Goldsworth Valley Units 1, 2, 3

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

Private Property

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

Conference on Senior Engineering Design Projects

You are invited to attend the twenty-fourth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 4 p.m. **Tuesday, April 13**, 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	10:00 to 10:30	p. 5
Construction Science and Management	242	11:00	p. 6
Electrical and Computer Engineering	210	9:00 to 3:30	p. 7
Industrial Design	242	1:00 to 3:00	p. 11
Industrial and Manufacturing Engineering A-I	208	9:00 to 11:30	p. 13
Industrial and Manufacturing Engineering A-II	208	1:00 to 3:30	p. 15
Industrial and Manufacturing Engineering B-I	209	9:00 to 11:30	p. 17
Materials Science and Engineering	242	9:00 to 9:30	p. 19
Mechanical and Aeronautical Engineering A-I	211	9:00 to 1:30	p. 20
Mechanical and Aeronautical Engineering B-I	212	9:00 to 2:00	p. 23
Mechanical and Aeronautical Engineering C-I	213	9:00 to 2:00	p. 26
Paper Science and Engineering	205	9:00 to 1:30	p. 29

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

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

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

CEM = Construction Engineering and Management
CSM = Construction Science and Management
ECE = Electrical and Computer Engineering
ID = Industrial Design
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	Digital Recording and Playback System
	208	IME A-I	Comparing Crucible Materials with Nonferrous Alloys
	209	IME B-I	WMU Sunseeker Race Team: A Project Management Study
	242	MSE	Environmental Additives and Green Sand Properties
	211	MAE A-I	Heavy Axle Housing and Pump Intake Line Integration
	212	MAE B-I	Drivetrain for SAE Mini Baja 2000 Competition
	213	MAE C-I	On-Board Servo-Assisted Steering Dynamometer
	205	PSE	The Effects of Fines on Coating Structure
9:30	210	ECE	Aqualert III (The Electronic Eye)
	208	IME A-I	Thermal Distortion of Chemically-Bonded Sands
	209	IME B-I	CAD/CAM Integration
	242	MSE	Innovative Nano-Composite Coatings
	211	MAE A-I	High Pressure Static Fluid Test Unit
	212	MAE B-I	Mini Baja 2000 Frame Design
	213	MAE C-I	Wind Tunnel Test for a Future Production Aircraft
	205	PSE	Evaluation of Emissions Modeling Software
10:00	242	CEM	Design, Cost-Estimate, and Scheduling of a Composite Steel-Concrete Overpass
	210	ECE	Targeting Device for Blind Bowlers
	208	IME A-I	Wear Study of Copper Alloy Tooling Components for Injection Molding
	209	IME B-I	Research and Development of an Ergonomic and Safety Curriculum
	211	MAE A-I	Energy Savings by Heat Recovery
	212	MAE B-I	Suspension System for Mini Baja 2K
	213	MAE C-I	Portable Tester for a Very Low Pressure Transducer
	205	PSE	New Immobilization Solids Test for Coatings

10:30	242	CEM	Schedule and Cost Estimate for a Network Hardware Facility
	210	ECE	Programming Station for a Speech Storage Integrated Circuit
	208	IME A-I	Diesel Fuel Line Vibration Analysis
	209	IME B-I	Modeling a Solar Car Suspension with ADAMS Software
	211	MAE A-I	Test Robot Improvements and Loading System Design
	212	MAE B-I	Guide Eliminating Device for Automated Coil Winding
	213	MAE C-I	Wind Tunnel Balance Calibration System
	205	PSE	Evaluation of Alternative Chlorine-Free Bleaching Sequences
11:00	242	CSM	Schedule and Cost Estimate for the Matthew Road Bridge Project
	210	ECE	Machinery Vibration Monitor (MVM)
	208	IME A-I	The Physical Effects of Cognitive Stress
	209	IME B-I	Evaluation System for CAD Software Comparison
	211	MAE A-I	Table Leg Folding Mechanism
	212	MAE B-I	Computer-Aided Flow Investigation of a Valve
	213	MAE C-I	Integrated Fan Balancing System
	205	PSE	Deinking Wastepaper by Agglomeration of Ink
11:30	210	ECE	Direction Guidance Employing a Sound Feedback System
	208	IME A-I	Process Control to Reduce Material and Labor Costs
	209	IME B-I	Design Database Transfer Capability Study
	211	MAE A-I	Rotator Cuff Strengthening Machine
	212	MAE B-I	High Speed Color Sorting Conveyor System
	213	MAE C-I	Acoustic Barrier to Reduce Road Noise
	205	PSE	Effects of Different Pigments on Ink Jet Printability
1:00	210	ECE	Energy Management System for Sunseeker Solar Car
	242	ID	Options Workspace
	208	IME A-II	Design of a Variable Weight Pogo Stick
	211	MAE A-I	Retaining Rings for Driveshaft Assembly
	212	MAE B-I	Corrosion Test Chamber Design
	213	MAE C-I	Top Wing Force Distribution on an ISMA Racecar
	205	PSE	Comparison of Single and Dual Polymer Retention Systems
1:30	210	ECE	Blind Bowler's Device for Evaluating Gutter Balls (B-DEG)
	242	ID	Acuity
	208	IME A-II	Efficient Torque Transfer System for Differentials
	211	MAE A-I	Ball Retriever for Goalball
	212	MAE B-I	Swinging Arm for the Removal of Test Specimen Grippers
	213	MAE C-I	Sagittal Saw Attachment for the Extraction of Bone
	205	PSE	Performance of Yankee Dryer Coating Chemicals

2:00	210	ECE	CNC Mill Table Positioning Control System
	242	ID	Narayan, The Alternative Office
	208	IME A-II	Triptik Management System
	212	MAE B-I	Axial Movement Testing Device for a Ball-Joint
	213	MAE C-I	Gripping System for Testing Surgical Cutting Tools
2:30	210	ECE	Electrical System for the Sunseeker 454 Solar Car
	242	ID	"Incline" Modular Alternative Office System
	208	IME A-II	Rotary Cell Design
3:00	210	ECE	Automated Pick and Carry System
	242	ID	Human-Powered Watercraft
	208	IME A-II	Production and Inventory Guidelines for Pre-Printed Cartons
3:30	210	ECE	The ACP Autonomous Land Robotic System
	208	IME A-II	Increasing the Productivity of a Perfect Binding Process

CONSTRUCTION ENGINEERING AND MANAGEMENT

Session Chair – Mohammed E. Haque
Room 242

DESIGN, COST-ESTIMATE, AND SCHEDULING OF A COMPOSITE STEEL-CONCRETE OVERPASS

by Perry Hausman
Faculty Advisor: Mohammed Haque
10:00 a.m. to 10:25 a.m., Room 242

Overpasses are seen throughout the landscapes of the world, but attention is rarely given to them as motorists' speed over their pavement. Here, the proper attention has been paid to the design of a single-span, structural steel and reinforced concrete composite overpass. Beyond the design considerations of the overpass, there was also the question of cost. The costs have been itemized in detail. The timeline for the construction of the project has also been developed.

SCHEDULE AND COST ESTIMATE FOR A NETWORK HARDWARE FACILITY

by Andy Bodo
Sponsor: Jeff Timmerman - Earthtech
Faculty Advisor: Osama Abudayyeh
10:30 a.m. to 10:55 a.m., Room 242

This project involved estimating and scheduling the construction of a network hardware facility in Holland, Michigan. A detailed schedule and cost estimate and a project management system were developed for the construction. The cost estimate involved performing a quantity take-off of the items. The project management system includes a project schedule, controls, a safety program, and a cost schedule.

CONSTRUCTION SCIENCE AND MANAGEMENT

Session Chair – Mohammed E. Haque
Room 242

SCHEDULE AND COST ESTIMATE FOR THE MATTHEW ROAD BRIDGE PROJECT

by Ryan Bauer, Chris Jackson, and James Lewis
Sponsor: Jerry Anderson – Michigan Department of Transportation
Faculty Advisor: Osama Abudayyeh
11:00 a.m. to 11:25 a.m., Room 242

This project focused on the estimating and scheduling of the Matthew Road bridge project in Berrien Springs, Michigan. These tasks were successfully performed by using knowledge gained from coursework, estimating and scheduling software, a project control system, and the advice of an experienced field professional.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink
Room 210

DIGITAL RECORDING AND PLAYBACK SYSTEM

by Albert DiNatale II, Bradley Edgell, and James Seefurth
Faculty Advisor: Lambert Vander Kooi
9:00 a.m. to 9:25 a.m., Room 210

A portable unit which communicates with a personal computer was needed to store and play back messages using an information storage device microchip. A digital recording and playback system was designed, built, programmed, and tested to meet the sponsor's needs. Using a keypad, the recorded messages can be recalled and played back through a speaker or a set of headphones. The messages are recorded by the operator and can be changed at any time. Each message can be played back individually or all of the messages can be played back in sequential order.

AQUALERT III (THE ELECTRONIC EYE)

by Kevin Hau, Kelvin Ong, and Mun Loong Woo
Sponsor: Paul Ponchillia – WMU Department of Blind Rehabilitation
Faculty Advisor: Johnson Asumadu
9:30 a.m. to 9:55 a.m., Room 210

Aqualert III (The Electronic Eye) was designed to aid visually impaired swimmers to improve their swimming time and to help alert the swimmers when they are almost at the end of the pool. The Aqualert III alerts the swimmer that he/she is approaching the end of the pool by emitting a high pitched beep. This occurs as soon as he/she disturbs a stream of ultrasonic waves emitted by a transmitter. The sensor is placed at a strategic location across the lane of the pool, thus giving the swimmers adequate time to slow down.

TARGETING DEVICE FOR BLIND BOWLERS

by Maradona Khong Yau Chok, Yit Ti Liew, and Carlos Maldonado
Sponsors: Paul Ponchillia and David Guth – WMU Department of Blind Rehabilitation
Faculty Advisor: Raghvendra Gejji
10:00 a.m. to 10:25 a.m., Room 210

A system to aid blind bowlers was designed and built. The system consists of a direction-finding, hand-held receiver/pointer and an array of seven position-indicating infrared transmitting beacons. Each of the beacons is located above one of the seven position-marking arrows inlayed in the surface of the lane. The bowler estimates the direction of the targeted pin by pointing the hand-held receiver at the beacons. The receiver detects and tells the user, via electronically generated speech, which of the seven is being pointed at.

PROGRAMMING STATION FOR A SPEECH STORAGE INTEGRATED CIRCUIT

by Osama Bawazeer and How Kit Chow
Sponsor: John Gesink – WMU Department of Electrical and Computer Engineering
Faculty Advisor: John Gesink
10:30 a.m. 10:55 a.m., Room 210

Electronic devices, such as telephone answering machines, pagers, and toys use speech storage integrated circuits (voice chips) to store spoken messages. A system has been developed to program these integrated circuits. The recorded messages are first composed on a personal computer (PC) using speech recording and processing software. They are then transferred to the voice chips. The system provides flexibility in recording and playing back the messages as well as other features such as allowing the cascading of two or more voice chips and allowing the user to select the order in which messages are played back.

MACHINERY VIBRATION MONITOR (MVM)

by Troy Diller and Andrew Rowland
Faculty Advisor: Damon Miller
11:00 a.m. to 11:25 a.m., Room 210

In industry today, companies are looking for ways to save money and make higher profits. One of the areas of highest costs is downtime of equipment due to component failure. The failure may be due to wear or poor maintenance practices. This device reduces these costs by continuously monitoring equipment for early warning of impending component failures. The device was designed to monitor vibrations in equipment and compare them to baseline readings obtained when the equipment was running at optimal conditions. The MVM was tested at the component and system levels.

DIRECTION GUIDANCE EMPLOYING A SOUND FEEDBACK SYSTEM

by Kian Meng Khoo, Vui Yin Anthony Lai, and Prabin Pradhan
Sponsor: Paul Ponchillia – WMU Department of Blind Rehabilitation
Faculty Advisor: Raghvendra Gejji
11:30 a.m. to 11:55 a.m., Room 210

An electronic device was built to guide visually impaired individuals to important landmarks in an unfamiliar environment using a sound feedback system. A lightweight, handheld control module is held by the individual. The module contains a switch for each sound feedback system. When a switch is activated, the module sends radio frequency signals to the associated sound feedback system, which is placed in a desired location. The signals trigger the system, and the system emits a sound. The landmark is located by sensing the direction of the source of the sound.

ENERGY MANAGEMENT SYSTEM FOR SUNSEEKER SOLAR CAR

by Matthew Belanger, Leo Wilson, and Chris Winczewski
Sponsors: Ed Groninger – WMU Sunseeker 454 Solar Car Project, James O'Neal – National Instruments
Faculty Advisor: Frank Severance
1:00 p.m. to 1:25 p.m., Room 210

Optimal energy management is crucial to success during a solar vehicle competition. The best method for energy management is an algorithm based on current vehicle parameters, weather conditions, route information, and weather predictions. A highly reliable Energy Management System was developed for the Sunseeker solar vehicle using LabView and SCXI data-acquisition equipment. The Energy Management System provides for optimal energy management by combining vehicle data and route models to predict an optimal driving speed. To actively control vehicle speed, the Energy Management System interfaces directly with the motor controllers.

BLIND BOWLER'S DEVICE FOR EVALUATING GUTTER BALLS (B-DEG)

by Chong Chye Mah, Gobi Kannan Supramaniam, and Yih Haur Tan
Sponsors: Paul Ponchillia and David Guth – WMU Department of Blind Rehabilitation
Faculty Advisor: Dean Johnson
1:30 p.m. to 1:55 p.m., Room 210

A Blind Bowler's Device for Evaluating Gutter Balls (B-DEG) has been designed to assist visually impaired bowlers in determining the incidence and location of the occurrence of gutter balls. The B-DEG includes a Motorola MC68HC11E microcontroller that detects gutter balls that trigger tape switches, which are spread along the gutter. When the device detects a gutter ball, it sends an audible feedback to the blind bowler. The feedback is transmitted via an FM transmitter, allowing the blind bowler to receive the feedback using an FM receiver (radio).

CNC MILL TABLE POSITIONING CONTROL SYSTEM

by Joel Lay, Montgomery Morgan, and Christine Smith
Sponsors: David Figgins – Figgins Machine Company, Andrew Oswald – OZY Robotics
Faculty Advisor: Sanjeev Baskiyar
2:00 p.m. to 2:25 p.m., Room 210

A low cost CNC mill control system was designed and built to facilitate automated milling of machined metal parts. It includes a PC and software, a control box, and stepper motors. The software interprets G-Code, a standard language for machine tools, and sends table and cutter position commands to the control box via a serial communication link. The control box then moves the positioning table and the cutter. This movement is achieved by regulating the current supplied to the stepper motors. The prototype control system was designed and built at a significantly lower cost than similar systems on the market.

ELECTRICAL SYSTEM FOR THE SUNSEEKER 454 SOLAR CAR

by Dennis Boylon, Jonathon Schrader, and John Vieth
Sponsor: Matthew Belanger – WMU Sunseeker 454 Solar Car Project
Faculty Advisor: Damon Miller
2:30 p.m. to 2:55 p.m., Room 210

WMU sponsors a solar car (Sunseeker 454) that will compete in a race with other universities at Sunrayce 99. This project involved the design of a wiring network, driver information system, and vehicle controls for the solar car. The wiring network was constructed to be safe and efficient in terms of cost, weight, and power consumption. The driver information system acquires data on vehicle speed, battery pack voltage, motor current, and solar array current. The car utilizes regenerative braking, features a cruise control system, and is equipped with standard safety features such as turn signals and a horn.

AUTOMATED PICK AND CARRY SYSTEM

by Terrence Burrows and Jason Fletcher
Sponsor: Lynn Zimmer – General Motors Fabricating Division
Faculty Advisor: John Mason
3:00 p.m. to 3:25 p.m., Room 210

Throughout the industrial world, many companies have problems with production rates, equipment reliability, and employee work-related injuries. The Automatic Pick and Carry System was designed and built to increase production rates, improve equipment reliability, and reduce work-related injuries. Production rates increased due to automating the production process. Equipment reliability was improved by using a programmable logic controller (PLC) to control the automation. Automating this station in a production line reduced repetitive motion and heavy lifting performed by employees, diminishing work-related injuries.

THE ACP AUTONOMOUS LAND ROBOTIC SYSTEM

by Angel Gato, Charles Ganansia, and Pedro Burnay
Sponsor: Michigan Space Grant Consortium
Faculty Advisor: Frank Severance
3:30 p.m. to 3:55 p.m., Room 210

A robotic system composed of a personal computer and a robotic vehicle was designed and built to drive the robot autonomously to a user specified location. The robot consists of various components including a microcontroller, radio modules, DC motors, a gyroscope, sensors, and a Programmable Logic Device chip. The user inserts the destination's coordinates into a window-based program running on a PC. The PC transmits information to the robot that allows it to drive itself. The robot acquires data and sends it back to the computer, which processes the information and guides the robot to its destination.

INDUSTRIAL DESIGN

Session Chairs – David Middleton and Roman Rabiej

Room 242

OPTIONS WORKSPACE

by Bryon Vlier

Sponsor: Alan Rheault – Turnstone of Steelcase

Faculty Advisor: David Middleton

1:00 p.m. to 1:25 p.m., Room 242

The need for versatile home offices is growing. The Options workspace is a mobile solution that can be customized to meet the needs of the user. The user prioritizes components and places them within arm's reach. Accessories can be added, positioned, and repositioned as needed. The unit is self-contained and closes to ensure privacy when not in use. The Options workspace meets the needs of the family and the office while maintaining the aesthetics of the home.

ACUITY

by John DeLadurantaye, Laura Geisz and Jon Moroney

Sponsor: Alan Rheault – Turnstone of Steelcase

Faculty Advisors: David Middleton and Roman Rabiej

1:30 p.m. to 1:55 p.m., Room 242

"Acuity" is an alternative home office designed to meet the needs of the future consumer. By merging technology with organic shapes, "Acuity" makes working at home a more enjoyable experience. The design objective was to create an office, which met specific cost and size requirements and maximized the given space. With its ease of adjustment, "Acuity" meets any task demand, making it user friendly.

NARAYAN, THE ALTERNATIVE OFFICE

by Chad Dykgraaf and Jeffrey Klimas

Sponsor: Alan Rheault – Turnstone of Steelcase

Faculty Advisors: David Middleton and Roman Rabiej

2:00 p.m. to 2:25 p.m., Room 242

Designing the Narayan alternative office posed the difficult task of blending home décor with office functionality. The growth of alternative offices for the home has steadily increased in the 1990's, allowing manufacturers to expand their product lines to include this market. Cost, size, and assembly requirements were considered in the design process. Narayan was primarily designed to be built into a 60-inch wide by 24-inch deep residential closet, yet can be freestanding or mated with an optional armoire. Narayan was created for, but is not limited to the home, making it very versatile.

“INCLINE” MODULAR ALTERNATIVE OFFICE SYSTEM

by Chuan Li Chen and anDrew Smedley
Sponsor: Alan Rheault – Turnstone of Steelcase
Faculty Advisor: David Middleton
2:30 p.m. to 2:55 p.m., Room 242

As we begin the 21st Century, we as a society face many new and exciting technologies. This project investigated how these new technologies could be integrated into a home or alternative office. Research revealed the ergonomic needs for accommodating a variety of users, including those with different abilities. “Incline” uses an angled work surface to bring work closer to the user, allowing the user to arrange the immediate work area around that day’s activities. The overall system is modular, allowing the user to arrange the entire work area around the needs of the office. The design objectives were to look three years into the future, be functional within a 6' x 8' area, and have a retail price point of $525.

HUMAN-POWERED WATERCRAFT

by Wyatt Gregory and Josh Yoder
Sponsor: Dan Sommerfeld – KL Industries
Faculty Advisor: David Middleton
3:00 p.m. to 3:25 p.m., Room 242

This project improved existing human-powered watercraft for greater efficiency and comfort to the users. Emphasis was placed on the research of current pedal boats and on looking for ways to improve upon the existing stereotype of what a pedal boat looks like and how it is used. Activities such as swimming, fishing, and sunbathing were considered while designing the watercraft. Specific criteria that had to be met included size, number of passengers, cost, and type of propulsion.

INDUSTRIAL AND MANUFACTURING ENGINEERING A-I

Section on Test Procedures and Results
Session Chair – Liwana Bringelson
Room 208

COMPARING CRUCIBLE MATERIALS WITH NONFERROUS ALLOYS

by Brian Frisch, Adil Abdelwahab, and Eric Kuusisto
Faculty Advisors: Steven Butt and Sam Ramrattan
9:00 a.m. to 9:25 a.m., Room 208

In the metal casting of nonferrous alloys, a clay-graphite crucible is the conventional vessel used to produce molten metal. Recently, alternative crucible material like fused silica has emerged. This project compared the life expectancy of the two crucible materials against various nonferrous alloys. Several observations were made and data was collected. Statistical analysis was used to quantitatively determine changes that occurred from the melting process. The findings will have significant implications in the metal casting industry.

THERMAL DISTORTION OF CHEMICALLY-BONDED SANDS

by Robert Berger, Jason Hatmaker, and Thapelo Kalake
Faculty Advisors: Mitchel Keil, Sam Ramrattan, and Jorge Rodriguez
9:30 a.m. to 9:55 a.m., Room 208

In today's competitive markets, tolerances in chemically bonded sand castings have been shrinking rapidly. The thermal distortion tester (TDT) previously developed at Western Michigan University provides foundry engineers with new distortion data that helps forecast the behavior of sand castings under pouring conditions. This data was used to develop thermal distortion curves describing the thermomechanical behavior of foundry sand systems. Using these curves as process control tools will help engineers improve casting quality, thus lowering costs and preparing the foundry industry for the new millennium.

WEAR STUDY OF COPPER ALLOY TOOLING COMPONENTS FOR INJECTION MOLDING

by Ryan Brill, Jared Patterson, and Troy Winningham
Sponsor: Dale T. Peters – Copper Development Association Incorporated
Faculty Advisor: Paul Engelmann
10:00 a.m. to 10:25 a.m., Room 208

Copper alloys are the preferred materials for constructing injection mold components that require rapid heat removal. A barrier to the implementation of copper alloy tooling is the lack of knowledge about its long-term wear characteristics. This project continued a study of wear on injection mold components. Abrasive and adhesive ejection wear and erosive gate wear were studied. A series of measurements were taken and graphed to determine the effects that various hard coatings have on the wear rates of the copper alloys. These experiments provided data for the creation of future mold design guidelines.

DIESEL FUEL LINE VIBRATION ANALYSIS

by Marcus McCauley, Brian Schadowsky and David Thiel
Sponsors: Mike Moynihan and Dan Smith – General Dynamics Land Systems, Bill Wittliff – SPX Corporation
Faculty Advisors: Jorge Rodriguez and James VanDePolder
10:30 a.m. to 10:55 a.m., Room 208

Diesel engines use high-pressure fuel lines to minimize smoke. These fuel lines are believed to fail prematurely due to vibration at their natural frequency. A vibration apparatus was used to help prove that vibration causes fuel lines to fail. The electromagnetic vibration apparatus excited the fuel lines at their natural frequency, which simulated engine conditions. This frequency was then transmitted through a fuel line until fracture occurred. Supports and dampeners were then strategically applied to evaluate if the life cycle could be increased.

THE PHYSICAL EFFECTS OF COGNITIVE STRESS

by Victor P. Calagias and Scott A. Smith
Faculty Advisor: Tycho Fredericks
11:00 a.m. to 11:25 a.m., Room 208

This project investigated the effects of cognitive load on keyboarding force. It was hypothesized that as cognitive stress increased, the force applied to a computer keyboard by an operator increased. To test this hypothesis, a computer workstation was configured to measure the force applied to the keyboard while software changed the cognitive stress experienced by test subjects. Results indicated that the cognitive stress had a significant effect on keyboarding force. This finding implies that keyboard users under stress may be at greater risk for developing a cumulative trauma disorder (CTD) such as carpal tunnel syndrome.

PROCESS CONTROL TO REDUCE MATERIAL AND LABOR COSTS

by Anthony Smoke, Taha Syed, and Julianne Whitehead
Sponsor: Kenji Higashi – Hi – Lex Corporation
Faculty Advisor: Larry Mallak
11:30 a.m. to 11:55 a.m. Room 208

A manufacturer of transmission cables, brake cables, and throttle cables has had problems with an increase in scrap, rework, and labor costs associated with two processes. These processes are die-casting and conduit assembly. For the die-cast process, there was flash left on the edges of the finished part. For the conduit assembly, there was friction between the inside liner and the metal wire that is inserted into the conduit. The Kaizen method was used to evaluate and improve these two processes. Implementing countermeasures decreased cost, improved quality, increased throughput, and reduced scrap and rework.

INDUSTRIAL AND MANUFACTURING ENGINEERING A-II

Section on the Design of Products and Processes
Session Chair – Liwana Bringleson
Room 208

DESIGN OF A VARIABLE WEIGHT POGO STICK

by John Hoss, Jeremy Iford, and Daniel Seelye
Sponsor: Thomas VanderHorst – Uncle Tom's Toys
Faculy Advisor: Mitchel Keil
1:00 p.m. to 1:25 p.m., Room 208

A toy company needed a pogo stick that could support a wide range of weights. This device was not available in today's market. This project designed and manufactured a pogo stick using a variable spring mechanism. Existing designs were researched to explore all possibilities. Dynamic modeling and finite element analysis were used to test possible ideas. A design was selected, and production materials were considered. A prototype was produced, and a survey was conducted to determine the effectiveness of the design. The toy company has plans to produce this pogo stick in the future.

EFFICIENT TORQUE TRANSFER SYSTEM FOR DIFFERENTIALS

by Steve Burns, Benjamin Clark, Brad Houser, and Toon Shin Tan
Faculty Advisor: James VanDePolder
1:30 p.m. to 1:55 p.m., Room 208

Heavy snowfall in Yellowstone National Park requires that vehicles be equipped with track and ski systems for over-the-snow use. One such vehicle is a conventional one ton, four-wheel-drive ambulance. Alone, the vehicle's skis do not provide enough steering force, so brakes are used on each track to help turn the vehicle. This project redesigned the differential to enable all power to be transmitted to one axle at a time or to both simultaneously, thus aiding in the maneuverability of the vehicle. The team researched many alternative drive systems, based on feasibility, and selected the best system for adaption to this project.

TRIPTIK MANAGEMENT SYSTEM

by Sarah Anderson, Amber Neumeyer, and Jennifer Taylor
Sponsors: Jane Johnson and Susan Compton – AAA Travel Agency
Faculty Advisor: David Lyth
2:00 p.m. to 2:25 p.m., Room 208

A more efficient inventory management system was devised for maps that make up a travel guide, called a "Triptik." The primary goal was to eliminate excess preparation time and unnecessary costs. This process consisted of three main procedures: forecasting the demand, tracking the inventory, and processing the order. A forecasting method was found for each map by analyzing historical demand patterns. A continuous inventory tracking system was implemented to reduce the time allocated for manually counting the maps each month. After careful research, an order processing method was created by combining various inventory control methods.

ROTARY CELL DESIGN

by Joel Baaitse, Saša Bjelica, and Ryan Smoots
Sponsor: Charles A. Wendling – Flowserve Incorporated
Faculty Advisor: Kailash Bafna
2:30 p.m. to 2:55 p.m., Room 208

Machinery was arranged in a traditional job shop layout, creating long and irregular flows of materials that resulted in waste within the system. This project designed a rotary manufacturing cell, which helped minimize wasted processing time and unnecessary travel and handling. To design the best possible layout, flow process charts, from-to charts, and production routing sheets were used to understand how parts are produced and how machines should be arranged for maximum efficiency. Several layouts were generated using CAD, and the best possible layout for the manufacturing cell was selected.

PRODUCTION AND INVENTORY GUIDELINES FOR PRE-PRINTED CARTONS

by Terry Dunham, KaLena Livingston, and Derek Schroeder
Sponsor: Tim Schultz – L. Perrigo Company
Faculty Advisor: Steven Butt
3:00 p.m. to 3:25 p.m., Room 208

This project evaluated the current carton production process to provide production and inventory ordering guidelines for pre-printed cartons. Inventory management, simulation, and mathematical programming techniques were used to develop an alternative methodology for achieving an optimum balance of press productivity, product costs, inventory costs, and stock keeping unit (SKU) obsolescence.

INCREASING THE PRODUCTIVITY OF A PERFECT BINDING PROCESS

by Jason Brown, Mark Fink, and Benjamin Laarman
Sponsor: Jeff Glasgow, Jason Tedrow, and Fred Effinger – Amway Corporation
Faculty Advisor: Bob E. White
3:30 p.m. to 3:55 p.m., Room 208

A manufacturer of printed and bound products recently purchased a Perfect Binder machine to create catalogs. This project increased efficiency by examining the binder for downtime and then correcting the reasons for mechanical failure. Ergonomic and safety issues were investigated for potential hazards to the machine operators. A limited workspace required the improvement of material handling methods. Time study analysis was used to evaluate and correct work methods for the Perfect Binder. The study resulted in training manuals for each individual workstation. Visual factory techniques also helped improve the overall performance of the Perfect Binder line.

INDUSTRIAL AND MANUFACTURING ENGINEERING B – I

Section on Manufacturing Graphics and Management
Session Chair – Ralph Tanner
Room 209

WMU SUNSEEKER RACE TEAM: A PROJECT MANAGEMENT STUDY

by Erica D. Mount, Mark A. Przybylski, and Garett R. Rozek
Faculty Advisor: Fred Sitkins
9:00 a.m. to 9:25 a.m., Room 209

This project developed three models for the Sunseeker team: a training and development program, formal documentation procedures and processes, and project review standards. These models will provide ongoing continuous improvement throughout the Sunseeker team's development. Current programs from industry were analyzed and used as benchmarks. Concepts from Project Management studies were also used to serve as fundamental guidelines for this project. Implementing these recommendations will result in increased documentation, team synergy, and more effective communication among team members during the Sunseeker's development.

CAD/CAM INTEGRATION

by Brandon Danks, Eduardo Ramos, and Eric Jamrog
Faculty Advisor: Ralph Tanner
9:30 a.m. to 9:55 a.m., Room 209

Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) integration can become a real problem for companies, especially small-to medium-sized companies with limited resources. The ability to achieve a fully integrated system decreases due to the complexity of today's programs, the training involved in learning the programs, and the costs involved. Having fully integrated software packages can increase the chances of accomplishing CAD/CAM integration, but the initial implementation can be expensive. This project researched and evaluated the translation process between different CAD and CAM systems to determine the problems involved with integration. A set of questions was formulated to establish techniques and possibilities for integration.

RESEARCH AND DEVELOPMENT OF AN ERGONOMIC AND SAFETY CURRICULUM

by Jodie Barringer, Matt Kovach, and Joy Staton
Sponsor: Society of Manufacturing Engineering
Faculty Advisors: Tycho Fredericks and Jorge Rodriguez
10:00 a.m. to 10:25 a.m., Room 209

Changes in legislation and work practice standards require that engineers have a thorough understanding of ergonomic and safety applications. This project researched and developed an ergonomic and safety minor for industrial engineering students. A survey was created and distributed to industry, students, and faculty throughout the country. The results were statistically analyzed and were compared to research on legislation trends and competing university programs to determine course-specific guidelines. A database of graduates was created to monitor program success and ensure a dynamically changing curriculum. A standard curriculum development methodology that can be applied independent of study area was developed.

MODELING A SOLAR CAR SUSPENSION WITH ADAMS SOFTWARE

by Ken Leong, Raj Rajasingh, and Marcus Terry
Faculty Advisor: Mitchel Keil
10:30 a.m. to 10:55 a.m., Room 209

Today's engineers are looking for new ways to design and test models. ADAMS is a software package that contains tools for virtual prototyping to build models, run simulations, and read the results. The suspension elements of the Sunseeker solar car were modeled using ADAMS software. The computer model parts were then run through a variety of simulations. The results of the simulation process, along with a tutorial of ADAMS software, will be used by future Sunseeker design teams.

EVALUATION SYSTEM FOR CAD SOFTWARE COMPARISON

by Chris Kersman, Jared Constance, and Jerry Luchies
Faculty Advisors: Michael Atkins and Murari Shah
11:00 a.m. to 11:25 a.m., Room 209

This project developed a system for evaluating CAD software. The system was developed based on three major CAD packages: Pro/ENGINEER, SDRC-Ideas, and CATIA. The system development process involved an identification period, a general learning period, a grouping of functions and characteristics, and setting criteria for developing an evaluation checklist. The evaluation checklist was submitted to advisors and industry consultants for feedback and revision. The system evaluation can be used by CAD users, design managers, administrators, designers, teachers, and others who intend to compare or evaluate CAD systems.

DESIGN DATABASE TRANSFER CAPABILITY STUDY

by Chad A. Lewis, Kenneth D. Sherburn, and Nikki J. Whitney
Sponsor: Dan Morris and Dan Benning – Johnson Controls, Incorporated
Faculty Advisors: Michael Atkins and Murari Shah
11:30 a.m. to 11:55 a.m., Room 209

Today, there is not an efficient and effective way to transfer Computer-Aided Design (CAD) data between different systems. Companies lose valuable production time because of poor data transfers between CAD systems. This project tested several different systems available at WMU. Files containing 2-D and 3-D geometry and attributes were transferred between the systems for testing. Errors encountered during the testing process were documented to develop a Data Transfer Manual. This manual will assist companies by notifying them when and where errors occur. Overall, this manual will help companies reduce production time and costs.

MATERIALS SCIENCE AND ENGINEERING

Session Chair – Pnina Ari-Gur
Room 242

ENVIRONMENTAL ADDITIVES AND GREEN SAND PROPERTIES

by Jeremiah Fleischman
Faculty Advisors: Pnina Ari-Gur and Sam Ramrattan
9:00 a.m. to 9:25 a.m., Room 242

A standard additive in green sand for the cast iron industry is seacoal. Seacoal is used in green sand to promote an improved casting surface finish. However, this carbonaceous material can produce certain toxic by-products when experiencing the temperatures of molten iron. Developers of alternative additives desire to reduce or eliminate the toxicity problems. This project analyzed smoke and gas by-products during the green sand casting process and tested various additives. In addition, green properties of the sand system were monitored and documented.

INNOVATIVE NANO-COMPOSITE COATINGS

by Philip P. Skrzypek
Faculty Advisor: Pnina Ari-Gur
9:30 a.m. to 9:55 a.m., Room 242

Plates coated with 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 – Jerry Hamelink
Room 211

HEAVY AXLE HOUSING AND PUMP INTAKE LINE INTEGRATION

by Randy Gerken and Edward Groninger
Faculty Advisor: Iskender Sahin
9:00 a.m. to 9:25 a.m., Room 211

A heavy axle housing encloses truck transmissions. Currently both pump and non-pump models are being produced. To reduce costs, a single housing was developed to accommodate a pump or non-pump transmission. Analyses were performed using Bernoulli's equation, computer software, and laboratory experimentation to verify proper pump operation. Reducing the production to one housing resulted in significant cost savings to the sponsor.

HIGH PRESSURE STATIC FLUID TEST UNIT

by Paul M. Barton and Steve P. Comensoli
Sponsor: Nate Hunt – Parker Hannifin Pneumatics
Faculty Advisor: Chris Cho
9:30 a.m. to 9:55 a.m., Room 211

A high-pressure safety rating test stand for pneumatic products was needed to replace a temporary system. A test stand was designed to test units utilizing water pressure in excess of 2,000 psi. The stand was partially automated through the use of Programmable Logic Controllers (PLC) and a computer touch screen.

ENERGY SAVINGS BY HEAT RECOVERY

by Lorrie Dryer and Ian Stone
Sponsor: Kirk Dillery – WMU Physical Plant
Faculty Advisor: Chris Cho
10:00 a.m. to 10:25 a.m., Room 211

In Haenicke Hall, outside air is heated to room temperature and then exhausted out of the building. Energy can be saved when extracted heat from the exhaust air is transferred to the cold intake air. A simple design composed of heat exchangers, a working fluid, and a pump was used to transfer energy from the exhaust air to the supply air. With this system installed, the university recognized a significant decrease in energy usage by reducing the amount of steam needed to heat the supply air.

TEST ROBOT IMPROVEMENTS AND LOADING SYSTEM DESIGN

by James P. O'Neal and Robert J. Worden
Sponsor: Jason Allen – Stryker Instruments
Faculty Advisor: Jerry Hamelink
10:30 a.m. to 10:55 a.m., Room 211

A local manufacturer desired a more efficient test specimen loading system for their validation testing robots. To achieve the desired increase in efficiency, the implementation of a fully automated test sample loading mechanism was required. A 3-D software package aided in the design process by allowing complete modeling of the entire system. With the new loading mechanism, the time necessary for validation testing decreased significantly.

TABLE LEG FOLDING MECHANISM

by Matthew Johnson and Matthew Ruster
Sponsors: Charley Fair and Eric Conarton – Weber Specialties Company
Faculty Advisor: Jerry Hamelink
11:00 a.m. to 11:25 a.m., Room 211

A folding mechanism for a table leg was more expensive than desired, required excessive force to actuate, and was heavier than it ideally could be. This project revised the design of the components and used different materials, making the mechanism more economical to produce and easier to use. Physical testing and finite element analysis verified that the new design fulfills the requirements for the mechanism.

ROTATOR CUFF STRENGTHENING MACHINE

by Jason Johnson and Jake Rayner
Faculty Advisor: Jerry Hamelink
11:30 a.m. to 11:55 a.m., Room 211

Rotator cuff injuries are one of the most common physical ailments in any labor-intensive career. A weightlifting machine was designed to prevent these injuries by strengthening the rotator cuff. The design was then optimized using finite element analysis software and material properties and mechanics. This resulted in a durable and lightweight device that is effective and inexpensive.

RETAINING RINGS FOR DRIVESHAFT ASSEMBLY

by Ted Arens and Jeff Senk
Sponsor: Darrell Telgenhoff – American Axle and Manufacturing
Faculty Advisor: Judah Ari-Gur
1:00 p.m. to 1:25 p.m., Room 211

Retaining rings are used to hold universal joint components together in a driveshaft. The existing rings tend to occasionally snap out of place, thus slowing production. A new ring with an improved geometry was designed with the aid of finite element analysis. The improved ring design provides reliable assembly. With eight rings per driveshaft, the result of the new retaining ring design has the potential for reduced manufacturing cost.

BALL RETRIEVER FOR GOALBALL

by Kesava Rao Jaganatham and Kevin Tang
Faculty Advisor: Judah Ari-Gur
1:30 p.m. to 1:55 p.m., Room 211

Goalball is a sport for the visually impaired, played by two teams of three players. A portable device was designed to allow players to practice their throwing skills. This could not be performed previously because there was no device capable of stopping a fast-moving, 1.25-kilogram, basketball size ball and returning it back to the player. The device is capable of being assembled and disassembled within a short period of time. Finite element analysis aided in the design of a prototype that was both lightweight and strong.

MECHANICAL AND AERONAUTICAL ENGINEERING B-I

Session Chair – Philip Guichelaar
Room 212

DRIVETRAIN FOR SAE MINI BAJA 2000 COMPETITION

by Erik Dennis and James Pitts
Faculty Advisor: James Kamman
9:00 a.m. to 9:25 a.m., Room 212

A drivetrain was needed for WMU to compete in the 2000 SAE Midwest Mini Baja competition. A drivetrain was designed to be competitive in all four parts of the competition: safety, endurance, pull test, and ergonomics. This project benchmarked the 1997 car and applied state-of-the-art technology to establish a drivetrain that is faster and more powerful. The key components within the drivetrain system were studied thoroughly using multiple analysis software packages, such as Algor and Working Model.

MINI BAJA 2000 FRAME DESIGN

by Donald W. Finney and Dustin L. Worm
Faculty Advisor: James Kamman
9:30 a.m. to 9:55 a.m., Room 212

The WMU Mini Baja team needed a new frame for the 2000 Mini Baja vehicle. Structural changes were made, resulting in a more comfortable and competitive vehicle. This was accomplished through extensive research on material and structural options. Finite element analysis was used to help produce an optimal frame. This design gives the 2000 team a competitive advantage.

SUSPENSION SYSTEM FOR MINI BAJA 2K

by Kevin Breuker and Ruth Hamilton
Faculty Advisor: James Kamman
10:00 a.m. to 10:25 a.m., Room 212

WMU needed a new suspension system for the year 2000 Mini Baja vehicle. The suspension system had to be strong, lightweight, cost effective, and adjustable to handle rigorous tests and terrain. A functional suspension system was designed and tested using Working Model and Suspension Gen software. Individual parts were then computer-modeled and integrated into the other systems of the new vehicle. An analysis was performed on the computer models using Pro Mechanica to ensure that the parts were strong and functional.

GUIDE ELIMINATING DEVICE FOR AUTOMATED COIL WINDING

by John Holba and Clifford Lambarth
Sponsor: John Izenbaard – Stryker Instruments
Faculty Advisor: Dennis VandenBrink
10:30 a.m. to 10:55 a.m., Room 212

Endcaps used to guide wire were glued to DC motor components to allow the components to be manufactured by an automated process. A device was created that allowed the components to be manufactured without the endcap. A prototype was tested to compare the components wound with endcaps to those without. Incorporating the device saved money by eliminating excess components and reducing manual labor.

COMPUTER-AIDED FLOW INVESTIGATION OF A VALVE

by Demian Flores and John Lim
Faculty Advisor: Parviz Merati
11:00 a.m. to 11:25 a.m., Room 212

Recent studies have traced pipe ruptures in large paper mill pulp pumping systems back to pressure pulses produced at a V-ball valve used in medium-consistency pulp applications. Computer-aided computational fluid dynamics (CFD) software was used to correlate vibrations at the valve lip to flow rate, system pressure, fluid viscosity, and valve opening. The correlations can be used to set a fluid flow rate and given valve opening to reduce pipe ruptures.

HIGH SPEED COLOR SORTING CONVEYOR SYSTEM

by Jamie B. Calderwood and Melany M. Rezmer
Sponsors: Fred Li and Sasha Brown – Dunkley International
Faculty Advisor: Philip Guichelaar
11:30 a.m. to 11:55 a.m., Room 212

An existing color sorting system bruised or otherwise damaged items to be sorted, such as cherries. The rejection rate of the items was high due to varying speeds of the items as they were launched off the conveyor belt under the vision system. A stabilizer bar that helps to accelerate and level the items was redesigned and new materials were selected to improve the belt mechanism that accelerates the items. These changes resulted in an increased accuracy of the system, and ultimately, an increase in usable items.

CORROSION TEST CHAMBER DESIGN

by Jason M. Hallam and Daniel T. Lowary
Faculty Advisor: Daniel Kujawski
1:00 p.m. to 1:25 p.m., Room 212

A redesign of a salt spray chamber to better control environmental conditions was required. The salt spray test chamber uses a salt solution to test the resistance of a part to corrosion. The test chamber is used to test evaporators, condensers, and radiators. This project redesigned the chamber to control and record the necessary factors, ensuring a standardized test. Programmable controls allow the chamber to perform cyclic and continuous testing.

SWINGING ARM FOR THE REMOVAL OF TEST SPECIMEN GRIPPERS

by Ahmad E. Osman and Chin Lim Vong
Faculty Advisor: Daniel Kujawski
1:30 p.m. to 1:55 p.m., Room 212

A swinging arm for the removal of Axial – Torsional Testing Machine specimen grippers was designed. The grippers needed to be removed for maintenance purposes or to accommodate different shapes of test specimens. The swinging arm was used because the grippers are heavy and also to avoid possible damages. The arm holds and swings the grippers away from the machine. This swinging arm is also useful in installing new grippers on the machine. The design incorporates a vertical position adjuster to help the installation process. Analysis using computer software aided the design process.

AXIAL MOVEMENT TESTING DEVICE FOR A BALL-JOINT

by Joseph Paul Horner and Kevin W. Schmaeman
Sponsor: Michael T. Matsumoto – TRW Automotive
Faculty Advisor: Philip Guichelaar
2:00 p.m. to 2:25 p.m., Room 212

The inner-end of a power steering system is composed of a bar with a ball and socket at one end. Excessive axial movement of the ball in the socket after assembly indicates manufacturing problems. The system for checking the movement did not provide the required consistency. An analysis performed on the system identified several sources of error. This project redesigned the testing device within industry standards for repeatability.

MECHANICAL AND AERONAUTICAL ENGINEERING C-I

Session Chair – Richard Hathaway
Room 213

ON-BOARD SERVO-ASSISTED STEERING DYNAMOMETER

by Chin Hock Soh and Sze Kee Chin
Sponsors: Randy Sweet and Tom Hillenburg – Sweet Manufacturing
Faculty Advisor: Richard Hathaway
9:00 a.m. to 9:25 a.m., Room 213

A servo-assisted steering dynamometer was designed to measure the performance of the power steering system in racecars. The system was designed to accommodate the steering of a late model racecar by using transducers to measure input torque from the driver, axial tie-rod loads, and pressure in the steering system. The transducers located in the steering components monitor the actual performance of the steering and send the data to a computer. The output results from the computer are then analyzed to determine the best steering ratio, the optimum servo size, and the steering system response on different racetracks.

WIND TUNNEL TEST FOR A FUTURE PRODUCTION AIRCRAFT

by Daniel M. Blakeslee and Matthew J. Macelt
Sponsor: Arthur Ogness – Incisive Engineering
Faculty Advisor: Arthur Hoadley
9:30 a.m. to 9:55 a.m., Room 213

Before an aircraft can be put into production, its aerodynamic characteristics must be extensively tested. Wind tunnel testing accomplishes this in a safe, cost-effective, and accurate way. A series of tests were designed to meet these goals. A one-tenth-scale model of a prototype aircraft was built. It was tested in the large wind tunnel at WMU's Applied Aerodynamics Lab. Performance characteristics of the model were calculated from the data gathered.

PORTABLE TESTER FOR A VERY LOW PRESSURE TRANSDUCER

by Chee Ping Lim, Chow Min Tan, and Wan Sin Ngeow
Sponsor – WMU Applied Aerodynamics Laboratory
Faculty Advisor: Arthur Hoadley
10:00 a.m. to 10:25 a.m., Room 213

Pressure transducers are used to measure very low pressures in a wind tunnel facility. To determine the accuracy of the readings, calibration was conducted to ensure that each of the transducers was functioning properly. An incline manometer was used to perform the calibration. Due to the bulk of the manometer, portability was not achievable. A portable device was constructed to calibrate these transducers while maintaining the level of accuracy that was previously achieved by using the incline manometer.

WIND TUNNEL BALANCE CALIBRATION SYSTEM

by Andrew Eischeid and Mark Stangeland
Faculty Advisor: Arthur Hoadley
10:30 a.m. to 10:55 a.m., Room 213

A system was developed to calibrate the six-component, floor-mounted, wind tunnel balance used in Western Michigan University's subsonic, closed-loop wind tunnel. Using several weights and a loading stand designed to be either bench or floor mounted, forces and moments were applied to the balance in three dimensions. Force and moment data was collected and the wind tunnel's LabView software was calibrated.

INTEGRATED FAN BALANCING SYSTEM

by Edward Clifford and Jennifer Siegel
Sponsors: Kurt Lentner and Luis Diaz– Stryker Instruments
Faculty Advisor: Koorosh Naghshineh
11:00 a.m. 11:25 a.m., Room 213

A fan used in a personal cooling system worn by surgical personnel must be precisely balanced to minimize noise and vibration of the fan during use. A new balancing system was designed to measure imbalance, correct the detected imbalance, and verify the correction. The balancing system design involved an analysis of the fan/motor assembly, the calculation of balancing-related equations, and the development of equipment for balance adjustments and overall system integration. This system was engineered to reduce the required production time by eliminating a large portion of the mass adjustment iterations.

ACOUSTIC BARRIER TO REDUCE ROAD NOISE

by Matthew Holuszko and George J. Ponchaud
Sponsor: Mike Campbell – Sound Alliance
Faculty Advisor: Koorosh Naghshineh
11:30 a.m. to 11:55 a.m., Room 213

Road noise entering the cabin of an automobile can be disturbing to passengers. To reduce road noise that enters through the front wheel wells, a simple and practical acoustic barrier was designed. This barrier is installed on the front interior wheel wells during the manufacturing process. Sound and vibration measurements were performed to evaluate the effectiveness of the barrier. A test vehicle was fitted with the final product for road testing. By using the acoustic barrier, vehicle cabin noise was greatly reduced.

TOP WING FORCE DISTRIBUTION ON AN ISMA RACECAR

by Ron Bender, Todd Piwowar, and Myung Seop Shim
Faculty Advisor: Richard Hathaway
1:00 p.m. to 1:25 p.m., Room 213

The high-speed stability of a racecar using a top-mounted airfoil was enhanced by an optimized distribution of airfoil forces. Distributing the forces between the chassis and the rear wheels completed this optimization. The forces that result from the airfoil were analyzed using Sub-2D software. Algor® was used to perform a finite element analysis on the mechanism to test reliability. The final design resulted in better control and stability of the vehicle at high speeds.

SAGITTAL SAW ATTACHMENT FOR THE EXTRACTION OF BONE

by Matthew B. Maurin and Matthew T. Powell
Faculty Advisor: Koorosh Naghshineh
1:30 p.m. to 1:55 p.m., Room 213

A sagittal saw is used in anterior cervical fusion surgeries to remove bone from a patient's hip. This bone graft can later be used to create space between vertebrae in the patient's back. Through solid modeling, testing, and evaluation, a sagittal saw attachment was designed to effectively remove bone from the hip.

GRIPPING SYSTEM FOR TESTING SURGICAL CUTTING TOOLS

by Ted Bloomfield and Tim Bozung
Sponsor: Jason Allen – Stryker Instruments
Faculty Advisor: Koorosh Naghshineh
2:00 p.m. to 2:25 p.m., Room 213

Previous life testing methods of surgical cutting tools proved to be inconsistent with actual field usage. A new gripping system was needed to better replicate the hand-tool interface. A system was designed to accurately replicate the cutting tool vibrations and loads. This was accomplished by performing vibration measurements on a number of cutting tools. This new system allows a more accurate prediction of a tool's life expectancy.

PAPER SCIENCE AND ENGINEERING

Session Chair - Peter Parker
Room 205

THE EFFECTS OF FINES ON COATING STRUCTURE

by Steven L. Cochran
Faculty Advisor: Dewei Qi
9:00 a.m. to 9:25 a.m., Room 205

Fines concentration strongly influences the swelling ability of paper in the Z-direction. The migration of coating particles affects the dewatering and drying process. The interaction between the fines and the coating particles determines the final packing of the pigments. This project shows how fines concentration affects the coating structure and optical properties.

EVALUATION OF EMISSIONS MODELING SOFTWARE

by Katherine Pershell
Faculty Advisor: C. Van Maltby
9:30 a.m. to 9:55 a.m., Room 205

Predicting the potential effects of an accidental emission is a complex process requiring several factors to be combined into complex equation systems. Often, software programs are developed to integrate all the various components and simplify the prediction process. This project compared the results for four software programs (two public and two private) and generic tables published by the EPA for various releases scenarios. The results were analyzed to determine the causes of differences.

NEW IMMOBILIZATION SOLIDS TEST FOR COATINGS

by Paul Allen Woodward
Faculty Advisor: Margaret Joyce
10:00 a.m. to 10:25 a.m., Room 205

A new, cost effective, predictable immobilization solids test was developed. Using the Kaltec (AA) Gravametric Water Retention tester, complete drainage curves were plotted, and immobilization solids points were indicated by the drainage slope. Multiple drainage curves of the same coating indicated the variance within the test method. Other accepted immobilization test methods were compared with this method. Different pigment and thickener types were explored using this new method. Several coating formulations were optimized by finding the immobilization solids point, thus reducing binder migration. The effectiveness and efficiencies of several thickeners were explored.

EVALUATION OF ALTERNATIVE CHLORINE-FREE BLEACHING SEQUENCES

by William Henagan
Faculty Advisor: Raja Aravamuthan
10:30 a.m. to 10:55 a.m., Room 205

This project examined the effectiveness of elemental chlorine-free and totally chlorine-free bleaching sequences. OZD (oxygen, ozone, and chlorine dioxide) and OZP (oxygen, ozone, and hydrogen peroxide) bleaching sequences were used to bleach a kraft commercial hardwood pulp. Then their relative effectiveness was compared. These results were also compared to the same pulp bleached with a conventional CED (chlorine, alkaline extraction, and chlorine dioxide) bleaching sequence. The OZD sequence was comparable to CED as an elemental chlorine-free bleaching sequence and the OZP was equally effective as a totally chlorine-free sequence.

DEINKING WASTEPAPER BY AGGLOMERATION OF INK

by Kyle Zielinski
Faculty Advisor: John Cameron
11:00 a.m. to 11:25 a.m., Room 205

This project examined the use of polypropylene as a collector of ink in the pulping process. Removing ink particles for the recycling of paper is a very important step for the recovery of fibers in the paper industry. Polypropylene was used with a collecting chemical for an efficient agglomeration of ink. The project studied how well the gravure ink was effectively removed, final paper brightness, opacity, and L, a, b. The results were compared to those obtained from other deinking techniques and methods used in the industry.

EFFECTS OF DIFFERENT PIGMENTS ON INK JET PRINTABILITY

by Jason P. Barron
Faculty Advisor: John Cameron
11:30 a.m. to 11:55 a.m., Room 205

Little has been published about the effects that different coating pigments have on ink jet paper printability. To determine these effects, simple ink jet coating formulas were made with three commonly used pigments. The coatings were applied to a general paper grade using a size press. Test patterns were printed on the coated paper and were analyzed by a human panel as well as by image analysis. Physical and optical properties of the coated papers were also compared.

COMPARISON OF SINGLE AND DUAL POLYMER RETENTION SYSTEMS

by Mandy S. Daniels
Faculty Advisor: John Cameron
1:00 p.m. to 1:25 p.m., Room 205

A retention system must have a resistance to disruption by turbulent forces. If the flocs are sensitive to hydrodynamic forces, they will break down and accumulate in the white water, causing low first pass retentions on the paper machine. When turbulence was applied at two different speeds, the first pass retention capabilities of single and dual polymer systems were different. A ratio was determined, showing that the dual polymer system is more efficient than the single polymer system. A cost comparison between the single and dual polymer retention system was also performed.

PERFORMANCE OF YANKEE DRYER COATING CHEMICALS

by Joseph Yech
Faculty Advisor: Peter Parker
1:30 p.m. to 1:55 p.m., Room 205

This project compared different Yankee Dryer coating formulations and how they reacted to changes in wet end chemistry variables. Papers were made with different wet end chemistries and applied to metal plates using the Yankee Dryer coating formulations. The force required to pull the paper off of the plate was then recorded. An Instron tensile tester with a special jig was used to perform the tests.

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