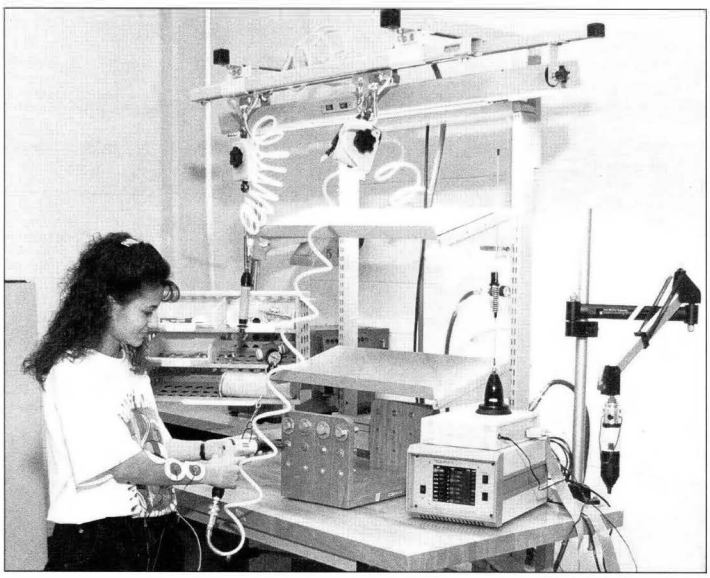
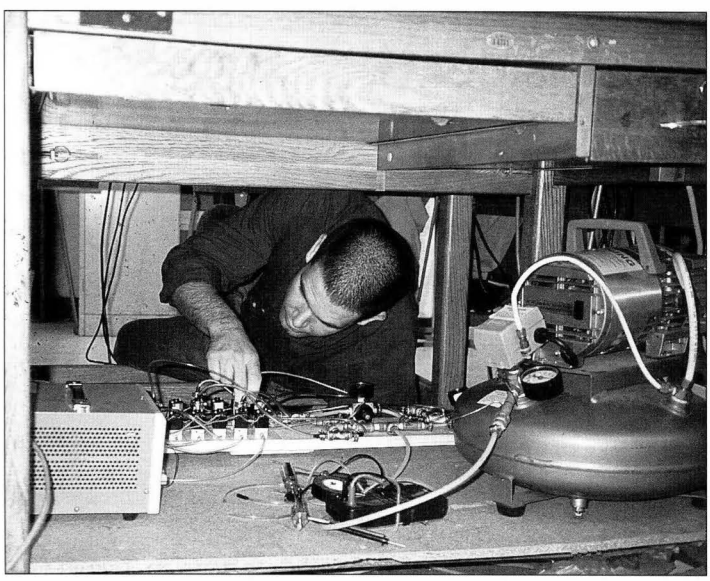
12-1997

21st Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences





21st Conference on Senior Engineering Design Projects

Tuesday, December 9, 1997

Bernhard Center

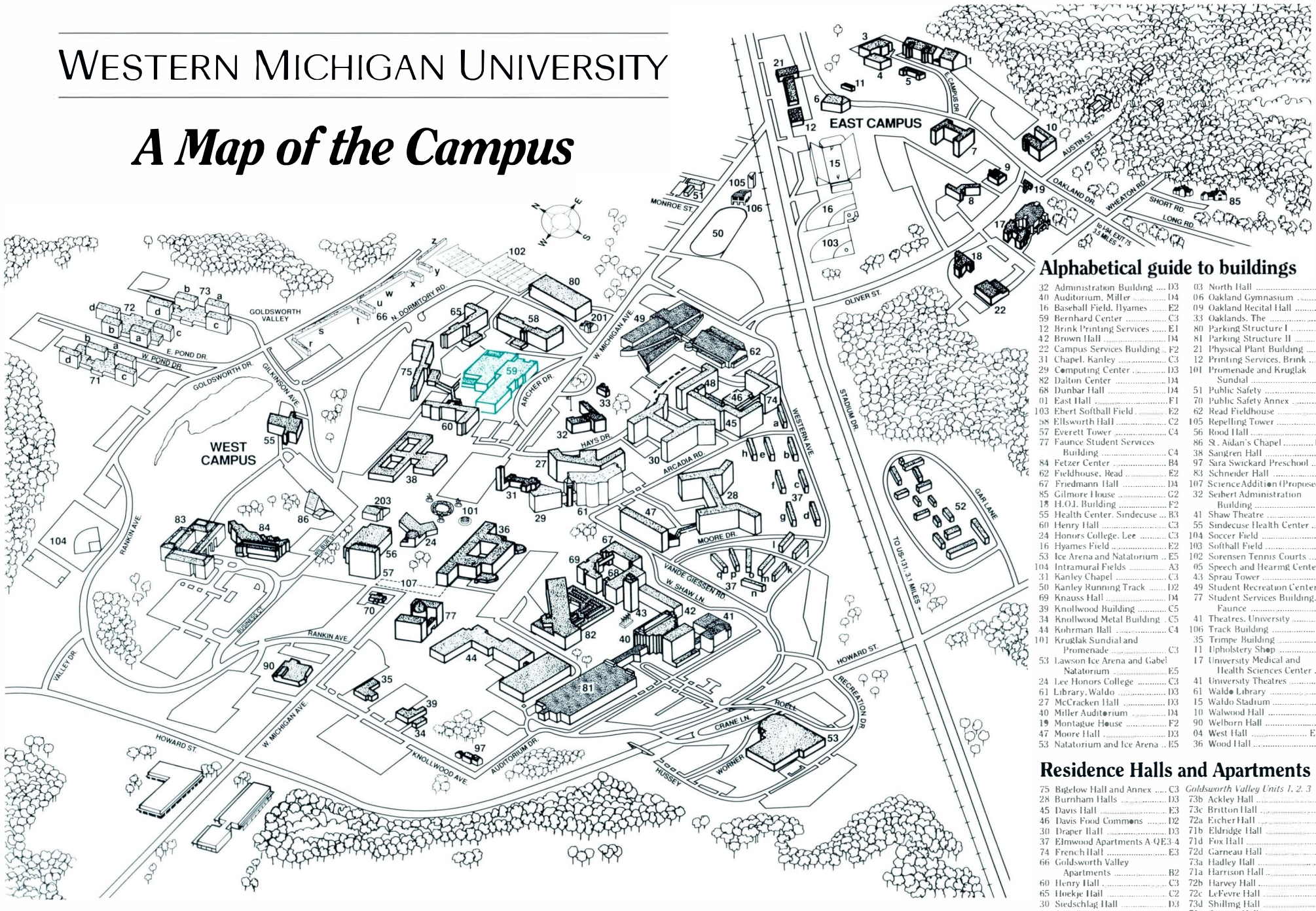
9 a.m. to 5 p.m.

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	
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	*Goldsworth Valley Units 1, 2, 3*
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	
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	Shillmg 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 tweny-first Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 5:00 p.m. **Tuesday, December 9**, at the Bernhard Center on the campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry.

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

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

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

Parking is available in the ramp near the Bernhard Center.

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

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

Construction Engineering and Management	242	9 to 10	p. 5
Electrical and Computer Engineering	210	9 to 3	p. 7
Industrial and Manufacturing Engineering - A-I	209	9 to 2	p. 11
Industrial and Manufacturing Engineering - B-I	204	9 to 1	p. 14
Industrial Design	242	10:30	p. 17
Mechanical and Aeronautical Engineering - A-I	208	9 to 4:30	p. 18
Mechanical and Aeronautical Engineering - B-I	213	9 to 11:30	p. 23
Paper and Printing Science and Engineering	211	9 to 2:30	p. 26

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

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

CEM = Construction Engineering and Management
ECE = Electrical and Computer Engineering
ID = Industrial Design
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering
PPSE = Paper and Printing Science and Engineering

Time	Room	Dept.	Topic
9	242	CEM	Advanced Estimating System for a Construction Management Firm
	210	ECE	Doppler-Based Ambulation Tracking System
	209	IME-A-I	Automatic Home Car Wash
	204	IME-B-I	A System for Automatic Steam Flow Control
	208	MAE-A-I	Semi-Truck Electric Shift Unit Design Improvement
	213	MAE-B-I	Modular Instrument Panel Component Design
	211	PPSE	An Evaluation of Never-Dried Pulp at Various Freeness Levels
9:30	242	CEM	An Integrated Construction Bid Preparation System
	210	ECE	Voice Task Prompter (VTP) for Cognitively Disabled Students
	209	IME-A-I	Thermal Distortion of Chemically Bonded Sand
	204	IME-B-I	Flag Assembly
	208	MAE-A-I	Rapid Prototyping Mold Design
	213	MAE-B-I	Adjustable Rising Rate Rear Shock Linkage
	211	PPSE	Optimization of Biocide Use to Control Microorganisms
10	242	CEM	A Computerized Project Planning System for the Interior Finishes Package
	210	ECE	ASIC Chip Design
	209	IME-A-I	E-Z Brake: New In-Line Skating Brake for Beginners
	204	IME-B-I	Development of a Tracking System to Reduce Changeover Time
	208	MAE-A-I	Reliability Improvements of Wire/Pin Collet Assemblies
	213	MAE-B-I	Aerodynamic Drag Reduction on Semi-Truck Trailers
	211	PPSE	The Effects of Recycling on Fiber Flexibility and Bonding Properties
10:30	210	ECE	Electronic Talking Compass
	242	ID	"Freelink" Interactive Furniture for the Office
	209	IME-A-I	Hydraulic Drag in Fly Fishing
	204	IME-B-I	Implementation of Lean Manufacturing
	208	MAE-A-I	Dual Flow Irrigation Pump for Surgical Instruments
	213	MAE-B-I	Annealing Machine for Long Heating Elements
	211	PPSE	The Effects of Clay Pigment Size on Coating Structure

11	210	ECE	Automation of an Abstract Reasoning Test
	209	IME-A-I	Enhanced Brake Light System
	204	IME-B-I	Improving Set-Up Procedures in a Plastics Plant
	208	MAE-A-I	First Model Dynamic Wheelchair Seating System
	213	MAE-B-I	Quick Connect Test Fixture for Hydraulic Valves
	211	PPSE	Cationic Microparticle Retention Systems for Fines Retention
11:30	210	ECE	Standard Testing Environment Automation (STEAM)
	209	IME-A-I	Wear of Copper Alloy Injection Mold Components
	204	IME-B-I	Eliminating Waste at a Cable Manufacturing Plant
	208	MAE-A-I	Test Facility for Innovative Heat Exchanger Design
	213	MAE-B-I	Universal Pump Drive Shaft Shear Fixture
	211	PPSE	Effect of Borax on Drying and Strength Properties of Paper

12 -1 LUNCH BREAK

1	210	ECE	Servo Motor Tester
	209	IME-A-I	The Coanda Register
	204	IME-B-I	Increasing Efficiency of the Customer Returns Process
	208	MAE-A-I	Programmable Test Fixture for Electrohydraulic Valves
	211	PPSE	MD Ribbing Instability of Air Knife Coating Application
1:30	210	ECE	Electronic Tether With Variable Distance Settings
	209	IME-A-I	Capturing Design Intent for Solid Modeling
	208	MAE-A-I	Quick Die-Change Clamping Mechanism
	211	PPSE	The Effect of Antioxidant Addition on Color Loss in Ink Jet Printing
2	210	ECE	Single-Phase Small Induction Motor Speed Controller
	209	IME-A-I	Finite Element Analysis Software Comparison
	208	MAE-A-I	Device for the Extraction of Aluminum Plug Welds From Prop-Shafts
	211	PPSE	Microparticles: A Comparison in Surface Area
2:30	210	ECE	Portable Hand-Held Small Object Manipulator
	208	MAE-A-I	Neutral Lock Mechanism for a Heavy Duty Transmission
	211	PPSE	PeakVue: An Enhancement to Vibration Analysis Within the Paper Industry

3	210	ECE	Tactile Form Recognition Board
	208	MAE-A-I	Redesign of a Chill Roll for a Web Offset Press
3:30	208	MAE-A-I	Variable Valvetrain in an Internal Combustion Engine
4	208	MAE-A-I	Force Adjustment Mechanism for a Chair
4:30	208	MAE-A-I	Increasing Steel Shelves Load Capacity by Using Finite Element Analysis

CONSTRUCTION ENGINEERING AND MANAGEMENT

Session Chair - Pnina Ari-Gur
Room 242

ADVANCED ESTIMATING SYSTEM FOR A CONSTRUCTION MANAGEMENT FIRM

by Damon R. Zvoch
Sponsor: Matt Wolf - Cornerstone Construction Management Inc.
Faculty Advisors: Osama Abudayyeh and Anil Sawhney
9:00 a.m. to 9:25 a.m., Room 242

Computer software is becoming widely used in the construction industry, particularly for estimation of project costs. The problem with the commercial software programs is that they are very generic and do not meet the specific needs of most construction companies. In this project, a construction estimating software was customized to fit the needs of a commercial construction company. A database of customized assemblies was developed to help the company quickly prepare an estimate of a project cost. The export function of the software was then used to export information needed to prepare the project schedule.

AN INTEGRATED CONSTRUCTION BID PREPARATION SYSTEM

by Andrew Cooper and Casandra Fields
Sponsor: Carl Wendell - The Austin Company
Faculty Advisors: Osama Abudayyeh and Anil Sawhney
9:30 a.m. to 9:55 a.m., Room 242

Estimators are faced with many challenges when preparing a bid for a commercial or industrial construction project. Fortunately, many mistakes in bidding can be avoided by carefully following proper guidelines each time a bid is prepared. This project provides guidelines for preparing a complete bid through the use of an integrated construction bid preparation system. This system includes a checklist which lists individual cost items. It provides an organized and thorough procedure to help construction companies minimize additional costs that may be incurred while working on a construction project.

A COMPUTERIZED PROJECT PLANNING SYSTEM FOR THE INTERIOR FINISHES PACKAGE

by Craig M. Alderink
Sponsor: Kenneth L. Sportel - Bouma-Betten Construction, Inc.
Faculty Advisors: Osama Abudayyeh and Anil Sawhney
10:00 a.m. to 10:25 a.m., Room 242

Interior finishes contractors need to be able to accurately and efficiently estimate labor and material costs of construction projects. Using WinEst®, a construction estimating software package, a more efficient estimating system was developed and implemented. This project involved collecting data regarding labor and material costs, man-hours, efficiency, and then using it to customize WinEst® and to develop assemblies to meet the company's needs. A test run of the program was performed using the revised software to formulate an estimate and schedule for a construction project.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair - John Gesink
Room 210

DOPPLER-BASED AMBULATION TRACKING SYSTEM

by Cary Brown, Christopher Chisek, Kenneth Horner and Marc Jansen
Faculty Advisor: John Gesink
9:00 a.m. to 9:25 a.m., Room 210

A Doppler-Based Ambulation Tracking System was developed to track the path of a moving object by using the Doppler shift of a radio frequency signal. This system consists of a pair of antenna arrays that detect a signal from a radio transmitter attached to the object being tracked. A microcontroller-based signal-processing unit designed specifically for this purpose then calculates the position of the object and stores it to memory. An interface was created to download the data to a personal computer. The computer then plots the data in an X-Y graph of the tracked object's trajectory.

VOICE TASK PROMPTER (VTP) FOR COGNITIVELY DISABLED STUDENTS

by Ragunathan Gopalakrishnan, Krishna M. Kannan, Sivakumar Muthu, and Vijay Tharma
Sponsor: Jim Yanna - The Learning Center - Van Buren Intermediate School District
Faculty Advisor: Raghvendra Gejji
9:30 a.m. to 9:55 a.m., Room 210

A human guide is often needed to prompt cognitively disabled students to perform certain daily tasks. The Voice Task Prompter was designed to facilitate the function of the guide. The compact device may be easily worn by the user. Record/playback integrated-circuit memory technology is used to store voice data, and a microphone and a speaker are used for recording and playback. Push buttons allow the disabled users to scroll back and forth through the tasks. Specially designed tamper-resistant keys allow the guide to record tasks. The system stores two minutes of voice data.

ASIC CHIP DESIGN

by John P. Belmonte, Tod R. Lanham Jr., and Joseph S. Melton Jr.
Faculty Advisor: Frank Severance
10:00 a.m. to 10:25 a.m., Room 210

An Application Specific Integrated Circuit (ASIC) chip containing both analog and digital components was designed and fabricated with the assistance of Mentor Graphics® software. The digital component of the ASIC chip consists of two AND gates and a J-K flip-flop. The analog component includes two op-amps, one having an isolated power supply, the other sharing its power supply with a digital component. Each component of the chip was compared against its commercial equivalent by computer simulation and by hardware analysis to reveal the accuracy of the ASIC procedure.

ELECTRONIC TALKING COMPASS

by Mohammad Alzawad, Troy Brown, and Matt Cardwell
Faculty Advisor: Frank Severance
10:30 a.m. to 10:55 a.m., Room 210

An Electronic Talking Compass was designed to aid in personal navigation, particularly for the visually impaired. It offers two resolution modes: 16-point, and a single degree mode for precision. A PIC14000 RISC processor converts magnetic sensor readings to control a speech chip, and an internally mounted speaker communicates voice recordings to the user. The compass is powered by four AA alkaline batteries for portability, and includes conveniently located buttons for easy use.

AUTOMATION OF AN ABSTRACT REASONING TEST

by Ezra Embaie, Donald Rankin, and Jason Trepins
Faculty Advisor: Sanjeev Baskiyar
11:00 a.m. - 11:25 a.m., Room 210

The Category Test, a thirty year old abstract reasoning test, was in need of modernization. The traditional administration of the Category Test involves a psychologist using a backlit projector, a tape recorder, and a mechanical lever device in a poorly lit room, resulting in some inaccuracy. This project modernized the test through the use of a multi-media computer fitted with a special button box made to replicate the original mechanical lever. The use of a computer not only automated the Category Test, it also increased accuracy and added new functionality such as easy patient data storage and a touch screen.

STANDARD TESTING ENVIRONMENT AUTOMATION (STEAM)

by Yit Hyen Liew and Aman Gopal Sureka
Faculty Advisor: Joseph Kelemen
11:30 a.m. to 11:55 a.m., Room 210

The current benchmark for psychological testing uses a standard testing device to measure human performance for a set of specific tasks. The subsequent test data is used to assess the subject's spatial organization facilities in response to tactile feedback. All the data was collected manually by an examiner, resulting in human errors and approximations. Project STEAM automated the testing environment to significantly reduce errors in the administration of the test, facilitating a more accurate analysis of the subjects' health. A prototype was designed, built, and tested to replace the current testing device without altering the environmental variables. This prototype uses microcontrollers and smart card technology to facilitate data collection and transport.

SERVO MOTOR TESTER

by Wei Han Chia, Poh Fong Chin, Kuan Kuei Chiou, and Kwok Ching Lee
Sponsor: William Jordan - Denso Manufacturing Michigan Inc.
Faculty Advisor: Johnson Asumadu
1:00 p.m. to 1:25 p.m., Room 210

A Servo Motor Tester was designed to verify automotive air conditioner damper positions. By adjusting internal damper positions, a servo motor routes air flow through several ports, such as vent, bi-level, and defrost. This tester provides the proper test sequence to verify the function of the servo motor. The Servo Motor Tester is battery powered, and offers a low cost and portable testing alternative for several styles of air conditioner units.

ELECTRONIC TETHER WITH VARIABLE DISTANCE SETTINGS

by Oscar E. Bolado, Jody Larson, and Khady Saip Sy
Sponsor: The Learning Center - Van Buren Intermediate School District
Faculty Advisor: John Mason
1:30 p.m. - 1:55 p.m., Room 210

The Electronic Tether with Variable Distance is intended to aid teachers in controlling special education students. The device consists of two units. The monitor unit is used to control the distance to the target unit. An electronic alarm on the monitor unit is activated by a radio frequency signal emitted by the target unit. The monitor unit provides an audiovisual signal, which indicates whether the target unit is inside or outside the preset distance. The user is able to choose among three settings for the maximum distance allowed between the two units.

SINGLE-PHASE SMALL INDUCTION MOTOR SPEED CONTROLLER

by Othman Almofeez
Faculty Advisor: Johnson Asumadu
2:00 p.m. - 2:25 p.m., Room 210

A speed controller for a single-phase fractional horsepower electric induction motor was designed, built, and tested. The speed controller is small in size and low in cost. It is a portable two-port device. One port is plugged into a 120V AC power outlet and the other port is a receptacle for the motor connection. A circular knob is turned to vary the speed from the rated motor speed to one-quarter of the rated speed.

PORTABLE HAND-HELD SMALL OBJECT MANIPULATOR

by Rodney L. Eggleston, Christopher D. Fisher, and Steven W. Spaeth
Sponsor: Geri Halloran - Disability Resource Center
Faculty Advisor: Raghvendra Gejji
2:30 p.m. - 2:55 p.m., Room 210

Some crippling diseases make it difficult for an individual to manipulate small, flat, or irregularly-shaped objects. The Portable Hand-Held Small Object Manipulator is designed to assist such an individual. A pneumatic suction system allows the user to maneuver lightweight, flat objects. To grasp irregularly shaped objects, an electromechanical gripper is incorporated into the device. Power is supplied by either a 120V AC outlet, or an electronically-controlled rechargeable battery system for increased portability.

TACTILE FORM RECOGNITION BOARD

by Christopher B. Comer, Kok Wee Tah, and Vincent E. Thaumanavar
Faculty Advisor: Janos Grantner
3:00 p.m. - 3:25 p.m., Room 210

The Tactile Form Recognition Board is a psychological testing apparatus used in neuropsychological assessment. The traditional method for using the Tactile Form Recognition Board involves an examiner placing a geometric object on a subject's hand and asking the subject to guess what the geometric object was by pointing to shapes on a console. The examiner then recorded the response time by using a stopwatch. This project made improvements to the existing data collection method because performing the whole process manually may cause the data collected to be inaccurate. A microcontroller-based device was designed to accurately record the subject's response time.

INDUSTRIAL AND MANUFACTURING ENGINEERING - A - I

Session Chair - Paul Engelmann
Room 209

AUTOMATIC HOME CAR WASH

by Jason Dendel, Eric Jackson, and James Radabaugh
Faculty Advisor: Jorge Rodriguez
9:00 a.m. - 9:25 a.m., Room 209

The project concept was developed to enhance the ease of washing an individual's car at home. The problem with current home car wash equipment is that most of the equipment requires the operator to be involved in the cleaning process. The Automatic Home Car Wash enables the individual to simply set up the device, turn on the water, and sit back and watch. This project not only came up with a working solution, but has dedicated many hours of research, designing, testing, and evaluating the Automatic Home Car Wash for consumers.

THERMAL DISTORTION OF CHEMICALLY BONDED SAND

by Lonnie L. Beckwith, Rodney R. Burkhardt, and Doug L. Busch
Faculty Advisors: Mitchel Keil, Sam Ramrattan, and Jorge Rodriguez
9:30 a.m. - 9:55 a.m., Room 209

The foundry engineer must make decisions that allow for the least amount of dimensional variation during molding, handling, and casting. A prototype thermal distortion tester that measures distortion in chemically bonded foundry sands has been developed. The goal of this project was to test various sand and binder combinations at room temperature and at elevated pouring temperatures. This data was then analyzed to determine the correlation between thermal distortion and mechanical properties. A sample matchplate pattern was used to determine actual distortion in a casted part with the different sand/binder combinations. This project is part of a larger project that focuses on developing process control tools to improve quality in the casting industry.

E-Z BRAKE: NEW IN-LINE SKATING BRAKE FOR BEGINNERS

by Brian Balloid, Kurt Pesch, Jason Reznar, and Joel Yuzon
Faculty Advisor: Jorge Rodriguez
10:00 a.m. - 10:25 a.m., Room 209

There is an increasing awareness of problems with the effectiveness of the braking systems that come with new in-line skates. These brakes are often difficult for beginners to use. A universal-fit braking system was designed. The new design is an aftermarket add-on. Blueprints were created based on actual dimensions and experience with existing in-line skates. Two prototypes were manufactured; both were field tested for safety, effectiveness, and usability. A comparison to existing systems was performed and a final design was proposed.

HYDRAULIC DRAG IN FLY FISHING

by Troy Aldrich and Shane M. Groner
Faculty Advisors: David Lyth and Jorge Rodriguez
10:30 a.m. - 10:55 a.m., Room 209

Currently, all of the motion control devices used on fly fishing reels have inherent problems with high start-up inertia, the need for manual compensation, and high heat formation during operation. A hydraulic motion control system has been designed, tested, manufactured, and applied to fly fishing reels. The theory behind the device is the use of an impeller enclosed in a fluid to produce resistance. This is the only motion control system of its type for fly fishing reels. The motion control system has very low start-up inertia, is self-compensating, and produces a minimal amount of heat during operations as compared to existing systems.

ENHANCED BRAKE LIGHT SYSTEM

by Gregg Hardman, Ryan Krolak, Joe Nagorka, and Tim Vladu
Faculty Advisor: Mitchel Keil
11:00 a.m. - 11:25 a.m., Room 209

The brake light systems that are currently found on vehicles can be misleading to tailing drivers. The enhanced brake light system informs the driver about the braking conditions of the vehicle in front of him/her. This is accomplished through the use of multiple brake lights that illuminate according to the amount of pressure applied to the brake pedal. When braking occurs, the required stop lamps will illuminate. As more braking force is applied to the pedal, the number of stop lamps that are illuminated increases, creating a clear picture of the stopping driver's intent.

WEAR OF COPPER ALLOY INJECTION MOLD COMPONENTS

by Kevin Andruszkiewicz, Eric Burgess, Erik Grant, and Carlene Harris
Sponsor: Dale T. Peters - Copper Development Association Inc.
Faculty Advisor: Paul Engelmann
11:30 a.m. - 11:55 a.m., Room 209

Industry has no comparable data on the wear characteristics of copper alloy molds. A study was conducted to collect data for establishing a wear index. This wear index compares the wear caused by abrasive plastics against the wearability of tool steels. Periodic inspection of the mold was taken and the resulting wear was recorded. These studies may allow for the production of copper alloy mold components with life expectancies comparable to steel.

THE COANDA REGISTER

by Drew Fouchea, Edmund Sutter, and Bobbie Warren
Sponsor: Warren Terry - Summit Polymers Inc.
Faculty Advisor: Mitchel Keil
1:00 p.m. - 1:25 p.m., Room 209

The Coanda Effect was used to increase control over the direction of air flowing out of an automobile air conditioning (AC) register. Finite element analysis (FEA) was used to determine possible designs. After evaluating the different designs, several models were constructed to verify the computer simulations. The models were tested to see if they met industry air direction control, air volume output, and air velocity requirements. After analyzing the test results from the models, a fully functional prototype AC register was fabricated. In order to validate the working prototype, it was tested to see if it conformed to industry specifications.

CAPTURING DESIGN INTENT FOR SOLID MODELING

by Amy Dickinson and Jim Ridge
Sponsors: Allen Tenhoor and Ronald Whitwam - Steelcase North America
Faculty Advisor: Jorge Rodriguez
1:30 p.m. - 1:55 p.m., Room 209

Parametric Technology Corporation's Pro/Engineer software empowers designers with the flexibility of parametric design. This border representation technology allows modification of the solid model by changing its dimensional parameters. Failures occur when modified dimensions cause a conflict within the geometry of the model. In answer to this problem, a tutorial package emphasizing proper design methodology has been developed. Pro/E enabled creation of tutorials through trail files. The trail files provided a record of each step in a Pro/E session. With the addition of text windows, the trail files then became training files. From this functionality, the tutorial package demonstrated the need for correct model construction and identified proven techniques for capturing the Design Intent of mechanical systems.

FINITE ELEMENT ANALYSIS SOFTWARE COMPARISON

by Tara Brouwer, Justin Holmes, and Jeremy Lambert
Faculty Advisors: Michael B. Atkins and Jorge Rodriguez
2:00 p.m. - 2:25 p.m., Room 209

Due to industry's need for software evaluation assistance, an objective methodology for comparison was developed. This methodology highlights software strengths and weaknesses using a series of criteria. Criteria were defined based on user preferences, published reports, and industry research. A company can weigh the criteria to their specific needs. This methodology was used to evaluate Finite Element Analysis (FEA) packages because they are widely used in industry to perform virtual testing on engineered components. ANSYS, Pro/Mechanica, and SDRC/I-DEAS were the FEA packages reviewed. Comparisons were performed and documented using the developed methodology.

INDUSTRIAL AND MANUFACTURING ENGINEERING - B - I

Session Chair - Larry Mallak
Room 204

A SYSTEM FOR AUTOMATIC STEAM FLOW CONTROL

by Chunwei Hu, Joe Jankord, and Robert Miller
Sponsors: Tim Krueger, Michael Monfore, and Brian Stannard - Ralston Foods
Faculty Advisor: Larry Mallak
9:00 a.m. - 9:25 a.m., Room 204

Excessive product variation was found to exist between and within the corn flake steam cookers, resulting in an inconsistent final product quality. The variation is associated with a variation in steam pressure and flow rate. This study identified and tested a method for controlling steam-related variance. An automated system to control steam flow was tested and evaluated to improve the consistency of the final product. The results of this study will be implemented for use throughout the plant.

FLAG ASSEMBLY

by Tara Gibbs, Elizabeth Holmes, and Jason Tedrow
Sponsor: Basil Karlow - Bissell, Inc.
Faculty Advisor: Larry Mallak
9:30 a.m. - 9:55 a.m., Room 204

A manufacturer of flags and flag components required an analysis of its various assembly lines for the purpose of redesign and improvement. Time studies, cost analysis, and ergonomic research were performed for this analysis. The assembly lines were redesigned to accommodate the assembly of 25 different products and to incorporate potential operation by physically handicapped individuals. Results and suggestions were presented to the management team.

DEVELOPMENT OF A TRACKING SYSTEM TO REDUCE CHANGEOVER TIME

by Earl Adams, Erica Rodgers and Kant Suwansathit
Sponsor: Andy J. Seiser - L. Perrigo Company
Faculty Advisor: Larry Mallak
10:00 a.m. - 10:25 a.m., Room 204

Slats used for determining the count size of a bottled product were organized into a system to reduce changeover time. A tracking system was introduced to facilitate faster changeovers from one product to another and to allow employees to track where the slats were within the system. This system also helped the marketing department determine whether an alternate count size could be offered for promotional purposes. The system provided the company with a reliable, flexible, and predictable process for administering a changeover.

IMPLEMENTATION OF LEAN MANUFACTURING

by Damon Brown, Nirari Oda, and Bart Wellisley
Faculty Advisor: Larry Mallak
10:30 a.m. - 10:55 a.m., Room 204

This project implemented lean manufacturing techniques into an existing production system. To accomplish this, the process was modeled using computer simulation. Eliminating work-in-process inventory after the first operation allowed for an easier transition into the next operation and thus eliminated two transportation steps. This simulation of the new production cycle improved the performance of the system while increasing efficiency and removing the bottleneck between the first two operations. As a result, the manufacturing lead-time was reduced, the production system had smoother transitions, and work-in-process inventories were reduced from the system.

IMPROVING SET-UP PROCEDURES IN A PLASTICS PLANT

by Denae Culberson, Adam New, and Shiree Rosemond
Sponsors: Ricardo Ramirez, Dave Smith, and Todd Soles - Engineered Plastic Components
Faculty Advisor: Larry Mallak
11:00 a.m. - 11:25 a.m., Room 204

A southwest Michigan supplier of plastic components for the automotive industry sought to improve documentation of set-up procedures and efficiency of assembly workcenters. The plant had previously depended upon the knowledge of experienced employees for set-up procedures and assembly processes. The previous method resulted in inconsistent and inefficient assembly line set-ups. Development of a new documentation system provided complete work instructions for the set-up process, assembly process, and referenced all necessary gauging. A time study of the previous assembly process revealed areas of improvement that were documented in the new system. Implementation of documented procedures significantly decreased manufacturing lead-time and cycle time.

ELIMINATING WASTE AT A CABLE MANUFACTURING PLANT

by Kristen M. Everly, Wei Chuet Leong, and Marco A. McGrinson
Sponsor: Mark L. Wallace - Hi-Lex Corporation
Faculty Advisor: Larry Mallak
11:30 a.m. - 11:55 a.m., Room 204

This project eliminated waste by balancing specified cable system manufacturing lines, by analyzing the line flow, single minute exchange of dies (SMED), capacity, ergonomics, and safety issues. This project concentrated on eight areas of waste, including waste due to production, wait times, transportation, processes, inventory, motion, defects, and not fully utilizing employees' talents and ideas. Recommendations were proposed to optimize production of the assigned manufacturing lines. These recommendations were made within the context of the Toyota Production System (TPS) and Kaizen.

INCREASING EFFICIENCY OF THE CUSTOMER RETURNS PROCESS

by Jonathan Butts, Mark Rutkowski, and Trassie Williams
Sponsors: Basil Karlow and Mari Rios - Bissel Homecare Division
Faculty Advisor: Larry Mallak
1:00 p.m. - 1:25 p.m., Room 204

A local homecare division manufactures vacuum cleaners, sweepers, deep cleaning machines, and cleaning formulas. Approximately 5% of these products are returned. The returns were received at a rate greater than they could be processed, creating high inventory cost. The largest bottlenecks existed in the documenting and disassembly line, known as the triage line. Several triage line simulations models were set up. Cost, floor space, and variations in volume were considered. Improvements were made in reducing time spent logging in products, handling, and disassembling the products. Without increasing operating and inventory costs, throughput increased and processing of returns was made more efficient.

INDUSTRIAL DESIGN

Session Chair - Dmitry Azrikan
Room 242

"FREELINK" INTERACTIVE FURNITURE FOR THE OFFICE

by Winston Jin Beng Tan
Sponsors: Clark Thorp and Jeff Reuschel - Haworth Inc.
Faculty Advisor: Dmitry Azrikan
10:30 a.m. to 10:55 a.m., Room 242

Freelink is a set of mobile furniture that has a different ergonomic environment which caters to both personal and group work. It is designed to get what is not absolutely necessary out of the personal workspace, freeing up the employee so as to control and focus on the task at hand. It merges furniture and technology to enable a person to connect to the online world. Ultimately, it is simple and integrated enough to be used by everyone.

MECHANICAL AND AERONAUTICAL ENGINEERING - A - I

Session Chair - Iskender Sahin
Room 208

SEMI-TRUCK ELECTRIC SHIFT UNIT DESIGN IMPROVEMENT

by Tracy Conklin and Sara Mickle
Sponsor: Leo Wenstrup - The Eaton Corporation - Truck Components of the Americas
Faculty Advisor: Daniel Kujawski
9:00 a.m. - 9:25 a.m., Room 208

The electric shift unit had a field life shorter than predicted in the initial design phase. Warranty return analysis revealed the main causes of failure to be in the circuit board, shift fork seal, and the motor mounting. Leakage in the shift unit led to corrosion of the internal components and more importantly, the circuit board. An alternative set of designs was investigated to reduce leakage and eliminate binding in the motor. These design alternatives included a redesigned motor mount and a repositioned shift fork seal.

RAPID PROTOTYPING MOLD DESIGN

by Jason Carpenter and Chris Wisniewski
Sponsor: Marty Flatland - Richard-Allen Medical
Faculty Advisor: Daniel Kujawski
9:30 a.m. - 9:55 a.m., Room 208

Prototype plastic molding currently is a time consuming and costly process due to the need to machine current mold dies made of machined steel. Alumilite, a compound consisting of a resin and catalyst, can be used to decrease the lead time and cost of the mold die. Alumilite has relatively low strength and will not sustain its dimensional accuracy at working pressures of common thermoplastics. By designing a stainless steel mold case to secure the mold halves, and by determining the amount of carbon fibers or carbon particles needed to strengthen the Alumilite, this project determined whether an Alumilite mold with carbon fibers could withstand the working stresses caused by injection molding of thermoplastics.

RELIABILITY IMPROVEMENTS OF WIRE/PIN COLLET ASSEMBLIES

by Jason S. Allen and Karen L. Smit
Sponsors: Eric Johnson and Kurt Lentner - Stryker Instruments
Faculty Advisor: James Kamman
10:00 a.m. to 10:25 a.m., Room 208

A local manufacturer of surgical instruments produces various wire driving instruments used to set different sized pins and wires into bones of patients during orthopedic surgery. The instruments grip the wire through a collet attachment, and then spin the wire using power supplied through a handpiece. The reliability of these attachments was lower than acceptable for current product lines. This project uncovered the failure modes that caused the decrease in reliability, and implemented measures to reduce the effect of these failure modes.

DUAL FLOW IRRIGATION PUMP FOR SURGICAL INSTRUMENTS

by Benjamin B. Edinger and Brent S. Lalomia
Sponsors: Milton Barnes, Mark Salzberger, and Greg Rabick - Stryker Instruments
Faculty Advisor: Iskender Sahin
10:30 a.m. to 10:55 a.m., Room 208

A manufacturer of surgical instruments desired to create an irrigation system that would provide fluid to one of two different instruments based upon a specified input signal. Both instruments were controlled by a single console. The fluid would be delivered by a peristaltic pump on the console. A network of specialized valves was developed for use in the tubing assembly. With this developed valve system, the fluid destination is controlled by changing the rotational direction of the pump motor. The design project was concluded with the successful construction of a functioning prototype.

FIRST MODEL DYNAMIC WHEELCHAIR SEATING SYSTEM

by Scott Ballinger
Sponsors: Jim Tappel - MicroPulse
Faculty Advisors: Tycho Fredericks and John Jellies
11:00 a.m. to 11:25 a.m., Room 208

Static seating pressure over a prolonged time period compromises blood flow to the affected area. By providing alternating pressure points on the supporting seat, blood flow can resume its normal circulatory process unabated, thus providing relief from pressure sores. Through research, the biological aspects of the problem were realized, current solutions in medical practice considered, and alternative possibilities for the first model of a dynamic interface system entertained. The completed first model is the initial step towards a marketable dynamic wheelchair seating system that will provide pressure sore relief to chronic wheelchair users.

TEST FACILITY FOR INNOVATIVE HEAT EXCHANGER DESIGN

by William Dowling and Mark VanderVeen
Faculty Advisor: Srinivas Garimella
11:30 a.m. to 11:55 a.m., Room 208

This project developed a test facility to experimentally determine heat transfer coefficients in enhanced-tube heat exchangers. A single-phase heat transfer test facility was fabricated to enable heat transfer between a hot process fluid and cold city water. The test loop incorporated features that facilitated the rapid change of test sections of different geometries. The project included the development of test section and test facility design, careful experimentation procedures, and analysis techniques to deduce heat transfer coefficients from measured data. The results of this project can be used to develop more efficient heat exchangers for automotive and air-conditioning applications.

PROGRAMMABLE TEST FIXTURE FOR ELECTROHYDRAULIC VALVES

by Erik Cooley and Don Johnson
Sponsor: Mark Oerther - FEMA Corporation
Faculty Advisor: Richard Hathaway
1:00 p.m. to 1:25 p.m., Room 208

A programmable test fixture was developed to test the spring rate of certain electrical components of electrohydraulic valves by relaying data from a low voltage displacement transducer (LVDT) and a load cell to a plotter. A programmable logic controller was incorporated for control, repeatability, and to allow the test fixture to be used for a wide range of applications. The programmable logic controller uses feedback from a load cell and LVDT to operate a step motor. The step motor rotates a power screw that applies force. The fixture was rigidly designed to minimize error and assure repeatability.

QUICK DIE-CHANGE CLAMPING MECHANISM

by Bob Gedert and Dennis Peterson
Sponsor: Thomas M. Wessel - Parker Hannifin Corporation
Faculty Advisor: Judah Ari-Gur
1:30 p.m. to 1:55 p.m., Room 208

A quick die-change clamping mechanism for a trim die press was designed for improving the changeover process. A clamping mechanism was selected for use in the trim press and the fixtures for attachment were designed for stress and fatigue with the aid of finite element analysis. Universal guides and clamping plates were designed to allow the clamping mechanism to accept the varying sizes of trim dies. The mechanism decreased the changeover time considerably and increased safety for the changeover personnel.

DEVICE FOR THE EXTRACTION OF ALUMINUM PLUG WELDS FROM PROP-SHAFTS

by Daniel Carpenter and Douglas Gilbert
Sponsors: Mike Bommarito, Kevin Szeszulski, and Darrell Telgenhoff - American Axle and Manufacturing
Faculty Advisor: Koorosh Naghshineh
2:00 p.m. to 2:25 p.m., Room 208

A quality control device was required to assure that a counterbalancing weight welding machine was consistent with a local company's manufacturing standards. Counterbalance weights were plug-welded to aluminum prop-shafts (automotive drive shafts) as part of the manufacturing process to properly balance the shaft. After completing the prop-shaft, three to five shafts a day were randomly selected and the counterbalance weight was removed. To check the strength of the weld, a device was designed to pull the counterbalance weight perpendicularly from the prop-shaft. This allowed for the inspection of the amount of parent material which was included in the weld.

NEUTRAL LOCK MECHANISM FOR A HEAVY DUTY TRANSMISSION

by Greg A. Andres and Eric W. Rothermal
Sponsor: Thomas N. Riley - Eaton Corporation
Faculty Advisor: James Kamman
2:30 p.m. to 2:55 p.m., Room 208

Diesel powered vehicles perform tasks and operate in environments that require a neutral drive train condition. For safe vehicle operation, a positive lock in the neutral position must be achieved. A neutral lock mechanism, which is integral to the vehicle transmission, was proposed. This device locks the transmission shift controls in a neutral position and provides verification when this lock is achieved. The verification of this lock may then be required to allow engine starting and power take-off (PTO) operation. Mechanical analysis of the mechanism for safety and performance was conducted.

REDESIGN OF A CHILL ROLL FOR A WEB OFFSET PRESS

by Elias Detto and Rodrigo Sosa
Faculty Advisors: Srinivas Garimella and John Serafano
3:00 p.m. to 3:25 p.m., Room 208

The demand for more printing services has increased the speed in which printing presses operate. Consequently, the inking rollers overheat. In this project, the internal structure of the inking chill roll was redesigned for increased heat removal without modifying the external dimensions. The purpose of the design was to maintain the temperature of the roller at a desired constant value. Drawings of the redesigned chill roll and performance prediction were presented.

VARIABLE VALVETRAIN IN AN INTERNAL COMBUSTION ENGINE

by David R. Czarnecki Jr. and David M. Woodard
Sponsor: Kynan Church - Eaton Corporation
Faculty Advisor: Richard Hathaway
3:30 p.m. to 3:55 p.m., Room 208

A variable valvetrain for an internal combustion engine was designed to improve performance, fuel economy, and emissions. Variable valve control was achieved through manipulation of timing, lift, and duration. Electrical control was utilized to activate the mechanics of the valvetrain. The challenge of the project was to design a system with enough improved benefits in power, fuel economy, and reliability to overcome the added complexity and cost of the system.

FORCE ADJUSTMENT MECHANISM FOR A CHAIR

by Tod Bennett and Jim Holman
Sponsor: Jon Schiff - Premise Group, L.L.C.
Faculty Advisor: Koorosh Naghshineh
4:00 p.m. to 4:25 p.m., Room 208

An adjustable force mechanism was designed for a chair. Varying body weights of different people using a chair require different reaction forces on the back of the chair when a person is reclining. This mechanism provides the reaction forces to the back of a chair as it changes position in relation to the person's weight. The reaction force increases at specific rates with respect to position. The mechanism includes ten different force rate adjustment levels.

INCREASING STEEL SHELVES LOAD CAPACITY BY USING FINITE ELEMENT ANALYSIS

by Chong Hou Loh and Steve Rizor
Sponsor: Doug Howard - Borroughs Corporation
Faculty Advisor: Daniel Kujawski
4:30 p.m. to 4:55 p.m., 208

Steel shelves for general storage purposes could only support a maximum load of 1200 lbs. with a safety factor of 1.65 (1980 lbs.). The maximum allowable deflection on the shelves was 0.17143 inches. To get a higher loading capacity without exceeding the maximum deflection and yield stress of the material, the geometry at the end of the shelves was redesigned. Stiffeners were incorporated into the steel shelves. These new designs were analyzed using ALGOR® Finite Element Analysis software.

MECHANICAL AND AERONAUTICAL ENGINEERING - B - I

Session Chair - Jerry Hamelink
Room - 213

MODULAR INSTRUMENT PANEL COMPONENT DESIGN

by Stephen Crandall and Shawn Wood
Sponsor: Warren Terry - Summit Polymers Inc.
Faculty Advisor: Chris Cho
9:00 a.m. to 9:25 a.m., Room 213

Modular units were designed for the auto industry to allow the option for customers to select from various individual modular units including cup holders, ash trays, power centers, computer access ports, global positioning systems, etc. These designs were completed with the intent to lower production and assembly costs. Repair and replacement costs were subsequently lowered, while interchangeability and customer selection were greatly increased. The modular design concept has greatly increased customer interaction with the layout of their vehicles while allowing the flexibility of an ergonomic design.

ADJUSTABLE RISING RATE REAR SHOCK LINKAGE

by Richard Hyvarinen and John P. McClure
Sponsor: Paul Thede - Race Tech Incorporated
Faculty Advisor: James Kamman
9:30 a.m. to 9:55 a.m., Room 213

The current 1997 Honda CR250 rear suspension linkage is a fixed design. This design limits suspension flexibility. The rear linkage is a four bar mechanism that produces an increase in shock velocity as the wheel reaches its maximum travel. An adjustable link was designed to replace the OEM drive link. The centerline distance between the three connection points of the new link are adjustable to alter the velocity curve. This allows the rider to tune the rear suspension to meet the track conditions or rider style. Dynamic and stress analysis of the new suspension were evaluated using Working Model and Cosmos. A working prototype was manufactured for testing.

AERODYNAMIC DRAG REDUCTION ON SEMI-TRUCK TRAILERS

by Akira Ito and Adil M. Mahmood
Faculty Advisor: William Liou
10:00 a.m. to 10:25 a.m., Room 213

The need for greater fuel saving and increasing maneuverability of commercial trucks led the truck industry to look for new designs of drag reduction devices on semi-truck trailers, especially for the drag of the trailing edge of trailers and on the trailer underside. Improving the shape of the trailers and adding new devices made the goal of better aerodynamic shape possible. This project conducted a wind tunnel experiment using a prototype of a semi-truck trailer. In addition, Computational Fluid Dynamics (CFD) analysis and flow visualization were used for verification. Drag reductions of more than 50% were achieved.

ANNEALING MACHINE FOR LONG HEATING ELEMENTS

by Pawan Gurung and Arnold Rapa
Sponsor: Rainer Ponzel - Electro-Heat, Inc.
Faculty Advisor: Srinivas Garimella
10:30 a.m. to 10:55 a.m., Room 213

Electrical heating elements sometimes need to be shaped for certain applications. In order to shape or bend these elements, they must be heated to a high temperature. This process changes the material properties (anneals), so the heating elements can be bent without breaking. Currently, long heating elements are annealed by hand using a gas torch, which is a slow and imprecise process. This project designed an annealing machine to anneal several long heating elements. The new machine was designed to optimize both the production time and the cost of the machine.

QUICK CONNECT TEST FIXTURE FOR HYDRAULIC VALVES

by Jason Ferris and Rick Seymour
Faculty Advisor: Jerry Hamelink
11:00 a.m. to 11:25 a.m., Room 213

By exploiting the similarities between valve models, a fixture was designed for a local manufacturer of hydraulic valves to eliminate the need to re-plumb a test stand between model changeovers. Incorporating adapter devices also eliminated the need for screwing fittings together when changing between valves of the same model. The valves come in different sizes and with different plumbing connectors. The testing and adjustment of the different models of valves required changing the plumbing on the test stand. The new fixture increases the efficiency of the testing and adjustment process.

UNIVERSAL PUMP DRIVE SHAFT SHEAR FIXTURE

by Benjamin Baldwin
Sponsor: Ted MacNeill - Parker Abex NWL, Inc.
Faculty Advisor: Daniel Kujawski
11:30 a.m. to 11:55 a.m., Room 213

A universal test fixture that provides accurate and precise measurements of both angle of twist and shear torque of hydraulic pump drive shafts was required for quality testing. The fixture was designed using traditional mechanical engineering methodology. The designed fixture holds the shafts securely while they are individually torqued using a hydraulic rotary actuator. Torque is measured using a load cell on the end of a torque arm.

PAPER AND PRINTING SCIENCE AND ENGINEERING

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

AN EVALUATION OF NEVER-DRIED PULP AT VARIOUS FREENESS LEVELS

by Timothy C. Liverance and Heath Smith
Faculty Advisor: David Peterson
9:00 a.m. to 9:25 a.m., Room 211

This project comparatively examined the fiber recycling characteristics of the two largest contributors of recycled paper fiber: mixed office waste and newsprint. Starting with never-dried pulps, sheets of paper were formed under controlled conditions. While some sheets were tested, the remainder were recycled. In order to reduce damage to the fiber during recycling the sheets were pulped with minimum agitation. This recycled pulp was used to make additional test sheets. The evaluation of the physical and optical properties of these sheets yielded a comparison study of the recyclable characteristics of these fiber sources, which accentuates the nuances of the pulp composition and fiber structure.

OPTIMIZATION OF BIOCIDE USE TO CONTROL MICROORGANISMS

by Joshua P. Taube
Faculty Advisor: David Peterson
9:30 a.m. to 9:55 a.m., Room 211

Biocides can be very helpful agents in the control of microorganisms during the papermaking process. By optimizing the application of the biocide, the amount of microorganisms can be decreased, leading to fewer paper breaks, a cleaner machine, less slime, and reduced downtime. Maximization of a new biocide was attempted on a paper machine by using a biocide with a different active ingredient, changing the application amounts, and using new feed methods. This method introduced large amounts of biocide in a short amount of time instead of a slow trickle over time. This was done to achieve a high rate of kill instantly. Then microorganisms were allowed to build back up somewhat before killing them again. The testing included plate counts in colony forming units per milliliter at various chemical addition rates. A final analysis of the various methods of addition was done to discover which was the best method.

THE EFFECTS OF RECYCLING ON FIBER FLEXIBILITY AND BONDING PROPERTIES

by Diana Burger
Faculty Advisor: Dewei Qi
10:00 a.m. to 10:30 a.m., Room 211

The recycling process can involve various enzymes, chemicals, and other conditions, such as repeated drying, that affect fiber characteristics. These characteristics may include the fiber's ability to swell, the relative bonding area, and its flexibility. These characteristics are related to fiber bonding, which is an important property to examine when studying recycled fibers. This experiment enabled us to determine how sodium hydroxide (NaOH) and drying temperature affect fiber flexibility and bonding properties during recycling.

THE EFFECTS OF CLAY PIGMENT SIZE ON COATING STRUCTURE

by Steven L. Cochran
Faculty Advisor: Dewei Qi
10:30 a.m. to 10:55 a.m., Room 211

The main focus of this project was to use different sizes of engineered clay particles to optimize the secondary coat on a paperboard medium. The white top liner of the paperboard medium was replaced with a layer similar to the brown back liner layer of a 100% recycled paperboard. The new engineered clay pigments were designed to pack closer together, improving the optical properties of the coating. The effects of the size of the pigments on the coating structure were investigated.

CATIONIC MICROPARTICLE RETENTION SYSTEMS FOR FINES RETENTION

by Derek Maddox
Faculty Advisor: Dewei Qi
11:00 a.m. to 11:25 a.m., Room 211

Fines retention is known to be a significant factor in the papermaking process. Cationic polymeric microparticles (CPMP) used in conjunction with an anionic polyacrylamide (APAM) is a new technology that will significantly aid in fines retention. This study shows the retention mechanism with the CPMP-APAM system and quantifies the ability to retain fines.

EFFECT OF BORAX ON DRYING AND STRENGTH PROPERTIES OF PAPER

by Melanie Robydek
Faculty Advisor: Raja Aravamuthan
11:30 a.m. to 11:55 a.m., Room 211

Sodium tetraborate, the most common of the borate minerals, is a salt believed to promote crosslinkage among the cellulose and hemicellulose fibers. Samples of bleached hardwood pulp (45% maple, 25% birch, 15% beech, 15% poplar) were treated with borax at three different levels, based on earlier experiments done with softwood. The pulp was pre-soaked with borax at 10% consistency, for one hour, prior to refining in a PFI mill. The drying and strength properties of the paper produced from the control and treated pulps were tested according to Standard TAPPI procedures and analyzed statistically. In addition, the recyclability of the filtrates from borax treated pulps, obtained during sheet formation, was assessed to determine the amount of borax required as a make-up chemical.

MD RIBBING INSTABILITY OF AIR KNIFE COATING APPLICATION

by Brad Fadden
Faculty Advisor: John Cameron
1:00 p.m. to 1:25 p.m., Room 211

Mills that produce coated board are searching for ways to optimize coating coverage to improve printability and overall aesthetics. During the roll application of the coating onto the sheet, the coating may not transfer smoothly, but instead it may split from the applicator roll. These splits cause faint machine direction streaks in the coating. To understand the relationship, the coating was characterized and a trial was proposed to increase the frequency of the film split to reduce the machine direction streaks. It was discovered that the surface tension, along with the high and low shear rate viscosity of the coating, were the most important parameters to be altered.

THE EFFECT OF ANTIOXIDANT ADDITION ON COLOR LOSS IN INK JET PRINTING

by Jennifer M. Siuda
Faculty Advisor: John Cameron
1:30 p.m. to 1:55 p.m., Room 211

Ink jet printing is a non-impact means of printing. It produces a quality product at a low cost to the end user. The archival properties of ink jet printing are challenged when the sample is exposed to environmental conditions, i.e., sunlight and ultraviolet light. The light source reacts with the dye on paper and oxidizes it. When the ink is oxidized, it begins to lose its color and fade. This project investigated a means to reduce fading by adding an antioxidant which enabled the paper to retain its vibrant color for extended periods of time.

MICROPARTICLES: A COMPARISON IN SURFACE AREA

by Scott Vermullen
Faculty Advisor: John Cameron
2:00 p.m. to 2:25 p.m., Room 211

This study investigated and compared the impact of microparticle surface area on retention within a paper making system. This was accomplished by using microparticles, specifically silica gel, exhibiting two different surface areas. To compare these separate microparticles, they were imparted to the system on a mass basis. Analysis of their performance was accomplished through fines retention as well as ash recovery retention. All of this was done to form a better correlation between microparticle surface area and performance within a paper making system.

PEAKVUE: AN ENHANCEMENT TO VIBRATION ANALYSIS WITHIN THE PAPER INDUSTRY

by Matt Vander Roest
Sponsor: Thomas Spettel - Predictive Maintenance Services Incorporated
Faculty Advisor: John Cameron
2:30 p.m. to 2:55 p.m., Room 211

A new technique for processing the signal from typical accelerometers in the vibration industry was evaluated. This technology, called PeakVue, increased the ability of the analyst to detect bearing failures on slow speed rotating equipment. In addition, PeakVue detected gearbox problems when conventional methods did not show signs of failure. Due to the vast use of vibration analysis within the paper industry and the difficulties encountered when monitoring slow speed rotating equipment, there is a need for accurately diagnosing problems that propagate low levels of energy and contain high levels of background noise. PeakVue is expected to aide in the analysis of slow speed rotating equipment in the paper industry and in diagnosing gearbox failures. It should not be expected to replace normal vibration monitoring due to its insensitivity to running speed problems such as imbalance, misalignment, and electrical problems.

THANK YOU

The College of Engineering and Applied Sciences is grateful to these firms which have provided or cooperated in Senior Engineering Design Projects being presented in December 1997. If you have a project for our students or if you would like more information, please call Yvonne Steffler at (616) 387-4017.

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