11-2001

29th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

Senior Design Project

The 29th Conference on Senior Engineering Design Projects
You are invited to attend the twenty-ninth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 2 p.m. **Tuesday, November 27**, 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. Please park in metered spaces. There is a charge for parking. Meters accept quarters only.

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

Session locations, starting times for project descriptions:

Construction Engineering	213	9:00 to 9:30
Electrical and Computer Engineering	242	9:00 to 1:30
Industrial and Manufacturing Engineering A-1	210	9:00 to 11:00
Industrial and Manufacturing Engineering B-1	211	9:00 to 11:30
Materials Engineering	213	9:00 to 10:00
Mechanical Engineering and Aeronautical Engineering A-I	208	9:00 to 12:00
Mechanical Engineering and Aeronautical Engineering B-I	209	9:00 to 12:00
Paper Science and Engineering	212	9:00 to 10:00

Refreshments will be available in the lobby 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 Cathy Smith at (616) 387-4017.

The 29th Conference on Senior Engineering Design Projects

CE = Construction Engineering
ECE = Electrical and Computer Engineering
ID = Industrial Design
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering
PSE = Paper Science and Engineering
FL = Faculty Lounge

Time	Room	Dept.	Topic
9:00AM	213	CE	M-86 Bridge Construction Schedule and Cost Estimate
	242	ECE	Performance Motor Control for Electric Vehicles
	210	IME A-I	Implementation, Process Flow, and Layout of the Bearing Reclamation Tester
	211	IME B-I	A New Investment Casting Process
	208	MAE A-I	Spring Dampener for use in ABS Brake Systems
	209	MAE B-I	Notch Stress-Strain Analysis of Heavy Truck Axle Bracket Due to Local Yielding
	212	PSE	Development of A Solution Set for FTA 200 Surface Energy
9:30AM	242	ECE	TEC-BOT
	210	IME A-I	The Effect of Chrome Plating and Geometry on Tool Longevity
	211	IME B-I	Processing Parameters for Low-Pressure Die Casting Machine
	213	MSE	Optimization of Microfabricated Single-Sided Flexible Circuits
	208	MAE A-I	Finite Element Analysis of Thermodynamic Test Chamber
	209	MAE B-I	Fatigue Cycle Counting for Heavy Truck Axle Bracket using Rainflow Method
	212	PSE	Modified Clay Pigments in Paper
10:00AM	242	ECE	Variable DC-to-DC Voltage Regulator
	210	IME A-I	Material Handling Route Analysis
	211	IME B-I	ISO 9002 Quality System Upgrade
	208	MAE A-I	The Design of A Delta System Mini Water Bath
	209	MAE B-I	Design of New Latching System for Dryer Door

10:30AM	242	ECE	Wireless Firing System for Use in Pyrotechnic Displays
	210	IME A-I	Solid Modeling and Dynamic Simulations of Flexible Elements
	211	IME B-I	Design and Implementation of a Quick Mold Change Process
	208	MAE A-I	Redesign of 3600-Pound Vertical Boat Lift
	209	MAE B-I	Wing Behavior in Ground Effect
11:00AM	242	ECE	AquaAlert III
	211	IME B-I	Assigning Part-Time Employees to Irregular Shifts
	208	MAE A-I	Autoclave Automation Mechanism
	209	MAE B-I	Design of Quick Connect Drive Shaft for Engine Testing
11:30AM	242	ECE	Microcontrolled AC Power Source for GPIB-Controlled Instruments
	208	MAE A-I	Testing of an Alternative Method for Engine Coolant Flow Testing
	209	MAE B-I	Copper Heater for Boiling Test Vessels
1:00PM	242	ECE	Hybrid Electric Vehicle
1:30PM	242	ECE	Paging Auto Security System

The College of Engineering and Applied Sciences is grateful to these sponsors which have provided or cooperated in Senior Engineering Design Projects being presented in November 2001. If you have a project for our students or if you would like more information, please call Cathy Smith at (616) 387-4017.

Application Engineering, Inc.
Copper Development Association, Inc.
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Eaton Corporation
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Michigan Department of Transportation
The Minute Maid Company
Roberts Sinto Corporation
Stryker Instruments
Stryker Leibinger
Thermotron Industries
Trident Pyrotechnic Displays
TRW Automotive
Whirlpool Corporation

The 29th Conference on Senior Engineering Design Projects

CONSTRUCTION ENGINEERING
Session Chair - Osama Abudayyeh
Room 213

M-86 BRIDGE CONSTRUCTION SCHEDULE AND COST ESTIMATE
by Edward Ashor, Michael Lehtonen, and Patrick Wackerle
Sponsor: Pete Pfeiffer - Michigan Department of Transportation
Faculty Advisor: Osama Abudayyeh
9:00 a.m. to 9:25 a.m., Room 213

The reconstruction of the bridge on M-86 over the St. Joseph River was a main focal point in the completion of our complex project. The M-86 Bridge was no longer up to state and highway building codes and needed to be demolished and reconstructed. We evaluated the bridge and came up with a cost estimate, work break down schedule, project management system, and a safety plan for the entire reconstruction of the bridge on M-86 over the St. Joseph River.

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ELECTRICAL AND COMPUTER ENGINEERING
Session Chair - Damon Miller
Room 242

PERFORMANCE MOTOR CONTROL FOR ELECTRIC VEHICLES
by Brey Hansford
Sponsor: Brey Hansford - Hansford Custom Vehicles
Faculty Advisor: John Mason
9:00 a.m. to 9:25 a.m., Room 242

The reconstruction of the bridge on M-86 over the St. Joseph River was a main focal point in the completion of our complex project. The M-86 Bridge was no longer up to state and highway building codes and needed to be demolished and reconstructed. We evaluated the bridge and came up with a cost estimate, work break down schedule, project management system, and a safety plan for the entire reconstruction of the bridge on M-86 over the St. Joseph River.

TEC-BOT
by Cathy Bush, Thomas Kracker, and Edward Mulimba
Faculty Advisor: Frank Severance
9:30 a.m. to 9:55 a.m., Room 242

In the TEC-BOT project, students designed and built several small, simple, micro-controlled, semi-autonomous walking robots. The robots are programmable, inexpensive, flexible, and battery powered. Robots receive macro command instructions emitted from a hand-held infrared device. The robots respond by following pre-programmed micro commands, such as moving forward or turning, then wait for the next command. Locomotion is accomplished by using nitinol wire, which contracts much like a muscle when current is applied. The performance of various robots was compared to determine the most effective design. The final product can be used as an inexpensive prototype for a freshman robotics course. top>

VARIABLE DC-TO-DC VOLTAGE REGULATOR
by Jian Yao Hong, Song Ching Koh, and Dinesh Kanagasingam
Sponsor: Yuh Jing Ho - Gentex Corporation
Faculty Advisor: Ralph Tanner
10:00 a.m. to 10:25 a.m., Room 242

A variable DC-to-DC voltage regulator was designed and built using micro-controller technology. The system is isolated and is designed to handle a voltage input of 24V DC and output a DC voltage from 0V to 24V with an accuracy of +0.1V. The system uses a keypad for input and a LCD screen to display a measurement of output voltage. If an overload of current or voltage occurs, the system will automatically cut off and will reset itself when conditions return to normal. top>

WIRELESS FIRING SYSTEM FOR USE IN PYROTECHNIC DISPLAYS
by Simon Baughman, Trevor Stutting, and Ben Wilson
Sponsor: Jack Stutting - Trident Pyrotechnic Displays
Faculty Advisor: Raghe Gejji
10:30 a.m. to 10:55 a.m., Room 242

A wireless firing system was designed and built to replace the existing hard-wired system used by the sponsor. This system uses 418MHz transceivers, programmable microcontrollers, and off-the-shelf digital electronics. This design consists of a central firing panel and up to eight remote pods, each capable of igniting 16 electric matches within 300 feet of the panel. An automatic repeat requestî and error catching algorithm was used to insure the reliability of data communications. top>

AQUAALERT III
by Abdul Aziz Al-Faraj, Khurram Javed, and Umer Sundal
Faculty Advisor: Ikhlas Abdel-Qader
11:00 a.m. to 11:25 a.m., Room 242

Presently no electronic device exists in the market that will allow visually impaired swimmers to compete in competitions with their sighted peers. The need for such a device is necessary to allow them to swim independently without any outside help. The AquaAlert III is a Sonar-based system that is intended to assist visually impaired swimmers by alerting them to turn back when they are within a specified distance from the pool wall. top>

MICROCONTROLLED AC POWER SOURCE FOR GPIB-CONTROLLED INSTRUMENTS
by Daniel Kruszka, Daniel Marlow, and David Nemshick
Sponsor: Gregory Rabick - Stryker Instruments
Faculty Advisor: Johnson Asumadu
11:30 a.m. to 11:55 a.m., Room 242

This project addressed the design of an AC power source for use with instruments that use the GPIB (General Purpose Interface Bus) communication protocol. Up to sixteen devices can be plugged into the system while the internal microcontroller monitors the communications between a computer and the devices, taking note of the activity of each. If a device is determined to be relatively inactive, then the power is cut to that device to save energy. top>

HYBRID ELECTRIC VEHICLE
By Matt Johnson, Micah Lillrose, and Sarah Morden
Sponsors: James Castellano - Ford Motor Company
Faculty Advisor: Joseph Kelemen
1:00 p.m. to 1:25 p.m.

A Hybrid Electric Vehicle (HEV) was designed and constructed to demonstrate that it is more efficient and exhibits lower emissions than standard fossil-fueled vehicles. The HEV uses a combination of gasoline and electric power. A gasoline engine is used to run an electric generator, which charges an array of onboard batteries. The electric energy stored in the batteries is then used to supply power to an electric motor, where it is converted into the mechanical energy that drives the vehicle. The speed, acceleration, fuel economy, efficiency, and range of travel of the HEV were evaluated. top>

PAGING AUTO SECURITY SYSTEM
by Alberto Araya, Suresh Manivasakam, and James Patrick
Faculty Advisor: Massood Zandi Atashbar
1:30 p.m. to 1:55 p.m., Room 242

Utilizing the immense power of today's paging and wireless networks, the team designed a smart pager using Motorola's Flex technology to disable a moving vehicle that has been stolen. The owner sends a message to the receiver, and this passes it to a microcontroller that runs a Flex decoding routine. The processor performs an action based upon the decoded message, which in our case, is to disable the car. top>

INDUSTRIAL AND MANUFACTURING ENGINEERING A-1
Session Chair - Colleen Phillips
Room 210

IMPLEMENTATION, PROCESS FLOW, AND LAYOUT OF THE BEARING RECLAMATION TESTER
by Dianthe Morgan, Mackenzie Williams, Rashanda Willis, and Melvina Wilson
Sponsor: Michael E. Meyers - Eaton Corporation
Faculty Advisor: Kailash Bafna
9:00a.m to 9:25 a.m., Room 210

Our sponsor refurbishes truck transmissions. The main focus for the project was to implement a test stand and material handling process that would salvage the output shaft bearings and A-5000 slave valves, enabling the company to reuse these parts. This, in turn, would generate additional cash flow for the company. We began by evaluating the current layout using value stream mapping to determine a continuous flow of work and parts. After the implementation of the test stand, we defined the workstations and created work instructions for operator use. In the final stages of the project, we participated in the monitoring of the test stand after implementation. For the A-5000 slave valve, we researched and consulted various companies to find a method to test the valve after it has been remanufactured. In our research, we found a system to test the slave valve's ability to circulate air.

THE EFFECT OF CHROME PLATING AND GEOMETRY ON TOOL LONGEVITY
By Dashia Bowens, Meghann Dickinson, Robert Smith, and Jason Worrall
Sponsor: Harold T. Michels - Copper Development Association, Inc.
Faculty Advisor: Paul Engelmann
9:30 a.m. to 9:55 a.m., Room 210

It is known that the erosive properties of glass filled resin reduces the life of injection molding tool components. Previous research has shown that the high thermal conductivity of copper alloys renders them excellent for mold components. Research has also revealed that chrome plating could increase the life of those copper alloy mold components. Utilizing production tooling in a designed experiment, this project aided in providing data to determine which substrate design factors contribute to chrome plating retention. The data generated was used to determine how the substrate design can affect chrome plating durability, thereby, prolonging the life of tool components top>

MATERIAL HANDLING ROUTE ANALYSIS
by Aric Carlisle, Jason Khodl, and Charlie Rupert
Sponsor: Mann+Hummel Automotive, Inc.
Faculty Advisor: Tarun Gupta
10:00 a.m. to 10:25 a.m., Room 210

The project team evaluated the current material handling system (MHS) in one department of a local automotive manufacturer. The primary objective of the project was to design standard routes with specific pick-up and drop points for in-process parts and sub-assemblies. Using simulation, the developed MHS was analyzed for its performance for problems that were anticipated under specific conditions. Meetings with department managers and the project advisor produced many possible solutions to the problems. The solutions were incorporated in alternate scenarios of the simulation model and were evaluated for feasibility. Results from the model showed gains could be made with standardization of material handling routes, improvement of workstation layouts, and implementation of the kanban system. The appropriate steps are now being taken to implement these changes on the factory floor. top>

SOLID MODELING AND DYNAMIC SIMULATION OF FLEXIBLE ELEMENTS
by Louis Davis, Scott Fulcher, Jeremy Gehoski, Benjamin Koenig, and Martin Swiecki
Sponsor: Marcus Hemmye - DaimlerChrysler
Faculty Advisor: Mitch Keil and Jorge Rodriguez
10:30 a.m. to 10:55 a.m., Room 210

Flexible elements have not been accurately represented in CAD models, thus resulting in longer product development cycles. Five aspects of the proposed solution have been addressed: data transfer, hose properties, simulation, validation, and graphical user interface (GUI). Effective data transfer was studied with CATIA and Adams. The transferred geometry was then simulated in Adams using the gathered hose properties. The simulated results where then compared to the physical measurements of the PT Cruiser to ensure accuracy. A GUI was created to help aid a user with data entry. The implementation of this methodology will greatly reduce the design time. top>

INDUSTRIAL AND MANUFACTURING ENGINEERING B-1
Session Chair - Fred Sitkins
Room 211

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A NEW INVESTMENT CASTING PROCESS
by Curtis Beene, Suet Fong Cheah, Terry Hochthanner, and Derek Reynolds

Faculty Advisor: Sam Ramrattan
9:00 a.m. to 9:25 a.m., Room 211

A new metal casting process is discussed. The investment casting process utilizes environmental friendly materials that are re-usable and offers other advantages such as a superior casting finish and dimensional stability. Processing parameters for pattern development and mold shell cure have been established.

PROCESSING PARAMETERS FOR A LOW-PRESSURE DIE CASTING MACHINE
by Frank J. Gitto, Jonathan F. Kendall, Jay M. Morrison, and Peter J. Nelson
Sponsor: Roberts Sinto Corporation
Faculty Advisor: Sam Ramrattan
9:30 a.m. to 9:55 a.m., Room 211

A decorative Western Michigan University aluminum plate was designed for production. A high level of detail and surface finish with minimal finishing operations was required for this product. Low Pressure Die Casting (LPDC) was selected as an optimal process for this application. The progression of this project required product design, solidification analysis, gating configuration, tooling fabrication, machine retrofitting, melting, cavity filling, and finishing operations. Processing parameters were established for this process that remains functional in the Metal Casting Laboratory at Western Michigan University. top>

ISO 9002 QUALITY SYSTEM UPGRADE
by Pingchia Chang, Jamin Kerby, and Shalon Ryan
Sponsor: The Minute Maid Company
Faculty Advisor: Fred Sitkins
10:00 a.m. to 10:25 a.m., Room 211

A quality system upgrade for a well known drink manufacturer was performed. The missing documents from the parent company's quality manual were identified following ISO 9002 standards. The local processors quality system was matched to the parent company's requirements. top>

DESIGN AND IMPLEMENTATION OF A QUICK MOLD CHANGE PROCESS
by Clifton C. Cheek Jr., Victor O. Krievs, Sarah G. O'Leary, Jason L. Roberts, and Eric L. Taylor
Sponsor: Shawn Wendt and Kevin Bell - Lear Corporation - Mendon
Faculty Advisor: Fred Sitkins
10:30 a.m. to 10:55 a.m., Room 211

The team applied their engineering skills to improve the company's productivity by reducing mold changeover times while simultaneously decreasing the operational expenses. Capital investments and workplace organization were used to reduce the changeover time from an average of 50 minutes to 20 minutes or less. By applying various engineering techniques such as time studies, statistical analysis, and lean manufacturing philosophies, alternatives were developed. top>

ASSIGNING PART-TIME EMPLOYEES TO IRREGULAR SHIFTS
by Yee Ying Chong, Todd Choura, and Sheau Yee Wong Michelle
Faculty Advisor: Steven Butt

11:00 a.m. to 11:25 a.m., Room 211

In this project a scheduling program was developed for part-time employees working irregular shifts. Weekly employee schedules are constructed based on projected customer demand; employee availability; and corporate, state and federal regulations. This management tool was developed for use by managers with minimal computer background using Visual Basic for Applications (VBA). top>

MATERIALS ENGINEERING
Session Chair - Ahalapitiya Jayatissa
Room 213

OPTIMIZATION OF MICROFABRICATED SINGLE-SIDED FLEXIBLE CIRCUITS
by Joel C. Nettleman
Faculty Advisor: Ahalapitiya Jayatissa
9:30 a.m. to 9:55 a.m. Room 213

A conductor is bonded to a thin polymer substrate to create a flexible single-sided printed circuit component. Typical processes used to create flexible circuits are photolithography, etching, and metallization. Microfabrication of flexible circuits is essential for further miniaturization, and applications in interconnect and packaging of microelectronics, and future micro-electro-mechanical systems (MEMS). In this project, single-sided printed circuit components were made using the microfabrication facility at WMU. The fabricated devices were tested by measuring the surface and electrical properties. The project studied the understanding of MEMS and application of miniaturized flexible circuits for packaging of MEMS.

MECHANICAL AND AERONAUTICAL ENGINEERING A-1
Session Chair - Jerry Hamelink
Room 208

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SPRING DAMPENER FOR USE IN ABS BRAKE SYSTEMS
by Daniel Hustyi and Eric Miller
Sponsor: Joe Starr - TRW Automotive
Faculty Advisor: Jerry Hamelink
9:00 a.m. to 9:25 a.m., Room 208

Current anti-lock brake systems (ABS) create hydraulic pressure pulsations during wheel slip events. These pulsations can be felt through the pedal and heard throughout the passenger compartment. An attenuation system to reduce these pulsations was explored utilizing rubber type materials as compressible springs. Optimal results were achieved through the study of compression tests, displacement under load, and material properties.

FINITE ELEMENT ANALYSIS OF A THERMODYNAMIC TEST CHAMBER
by Timothy Post and Jason Rigterink
Sponsor: Darin Immink - Thermotron Industries
Faculty Advisor: Jerry Hamelink

9:30 a.m. to 9:55 a.m., Room 208

Environmental test chambers produce a wide variety of temperature and climate conditions. With the expansion and contraction of the test chamber due to the drastic changes in temperature, the corners of the faceplate on these structures often buckle and crack. By working closely with representatives from an industry that creates testing chambers, a method was developed to minimize cracking and buckling. Tests were run on many different solutions using the Finite Element Analysis program, Algor. top>

THE DESIGN OF A DELTA SYSTEM MINI WATER BATH
by Jeffrey B. Edinger and Douglas D. Miller
Sponsor: Ronald Lancaster and Bruce Henniges - Stryker Leibinger
Faculty Advisor: Jerry Hamelink
10:00 a.m. to 10:25 a.m., Room 208

A team of engineers redesigned the DeltaSystem Bathî as a result of the demand for a smaller water bath. The water bath is used to heat resorbable plates to a desired temperature within approximately fifteen seconds. The new mini water bathî was designed to specifications decided on by a team of engineers, marketing representatives, and manufacturing personnel, along with the design team. The design team researched the problem, brainstormed, and analyzed possible solutions. A prototype system was developed, built, and tested. top>

REDESIGN OF 3600-POUND VERTICAL BOAT LIFT
by Matthew S. Beach and Daniel C. Demski
Sponsor: Jennifer Burke and Bob Puckit - Lakeshore Products
Faculty Advisor: Koorosh Naghshineh
10:30 a.m. to 10:55 a.m., Room 208

The 3600-pound vertical boat lift was found to exhibit insufficient structural stability and be difficult to assemble and maintain. Structural modifications were made to increase load carrying capacity. Design changes were incorporated to ease assembly by reducing the number of components and manufacturing operations. These changes resulted in a stronger lift with fewer parts, which results in lower maintenance. These modifications decreased the cost of manufacturing and increased the company's profit margin. top>

AUTOCLAVE AUTOMATION MECHANISM
by Daniel Steven Butts and Joshua Paul Wickey
Sponsor: Aaron Blades - Stryker Instruments
Faculty Advisors: James Kamman
11:00 a.m. to 11:25 a.m., Room 208

Possibly one of the most important aspects of engineering is testing. This, however, can be a very time consuming process when a great number of parts are being tested repeatedly. This is the case most often encountered when dealing with autoclave testing. The autoclave is a pressurized steam bath that is used to sterilize medical devices. For companies that make medical instruments, it is absolutely necessary to test all relevant parts to their respective limits. To make this testing process efficient and cost effective, the team designed and constructed a mechanism that would be capable of automating the process. top>

TESTING OF AN ALTERNATIVE METHOD FOR ENGINE COOLANT FLOW TESTING

by Thomas Adler, Douglas Clark, and Kurt Hoadley
Sponsor: Tom Flynn - DaimlerChrysler
Faculty Advisor: Christopher Cho
11:30 a.m. to 11:55 a.m., Room 208

Turbine flowmeters are the most common device used to test engine coolant flow. Although turbine flowmeters perform well in a lab environment, use in an automotive engine to test coolant flow can often times be problematic. Impurities present in the cooling system can reduce the accuracy of the flowmeter. A few alternative flowmeters were researched, and it was determined that an ultrasonic flowmeter was the best alternative. Testing was performed to determine if it would be practical for use in an automotive environment. top>

MECHANICAL AND AERONAUTICAL ENGINEERING B-1

Session Chair - Daniel Kujawski

Room 209

NOTCH STRESS-STRAIN ANALYSIS OF HEAVY TRUCK AXLE BRACKET DUE TO LOCAL YIELDING

by Chin Wei Lau and Michael Laupp

Sponsor: Prasad Mangalaramanan - Dana Corporation

Faculty Advisor: Daniel Kujawski

9:00 a.m. to 9:25 a.m., Room 209

Premature fatigue failure in heavy truck brackets required a complete fatigue analysis to obtain the desired service life. Research for this project consisted of background investigation into previous and recent engineering methods of stress analysis in notched segments. Algor, a finite element software, was utilized to determine the elastic stresses of the brackets. These stresses were then used with Neuber, Glinka, and GLOSS methods to determine the actual stresses. From these actual stresses, the life of the brackets were predicted and finally compared to the life found in the lab. Based on the analysis, one fatigue method was chosen for fatigue service life prediction.

FATIGUE CYCLE COUNTING FOR HEAVY TRUCK AXLE BRACKET USING RAINFLOW METHOD

by Andrew Kwan and Daniel VanPeenen

Sponsor: Prasad Mangalaramanan - Dana Corporation

Faculty Advisor: Daniel Kujawski

9:30 a.m. to 9:55 a.m., Room 209

Real life loading in automotive components is seldom static. Dynamic loads are capable of causing sudden catastrophic failures due to accumulated damage over a period of time. The focus of this project was to apply existing fatigue life prediction techniques to estimate the life of the brackets used in heavy truck axels. The random nature of service loads were categorized analyzable simple load cycles using the rainflow cycle counting method and the Palmgren-Miner's rule, to estimate the cumulative damage factor. Finite element stress data were used as the input for the program. The output of the program was then compared with the data obtained from lab tests. top>

DESIGN OF NEW LATCHING SYSTEM FOR DRYER DOOR

by Harvey Darrell Fluellen and Bon Cheong Koo

Sponsor: Whirlpool Corporation

Faculty Advisor: Daniel Kujawski

10:00 a.m. to 10:25 a.m., Room 209

Research was conducted to investigate latching systems used on dryer doors. The problem with the current latching system is that only one of the dual latching clips makes the proper connection in the door closing process. A new single latch system was designed that eliminates the simultaneous latching problem. Statistical techniques were used to investigate the product requirements and specifications. Multiple tests confirmed that the new design passed all required specifications. The new design will be implemented in new production. top>

WING BEHAVIOR IN GROUND EFFECT

by James Arraut and Nathan Block

Faculty Advisor: Richard Hathaway

10:30 a.m. to 10:55 a.m., Room 209

A model of the front wing of a super modified racecar was built and tested in a wind tunnel. Wing behavior at various test conditions and wind tunnel data were summarized in a series of lift coefficient

vs. ground height plots. Utilizing these plots, the manufacturer of a super modified racecar can now optimize the height and angle for maximum racecar performance. top>

DESIGN OF A QUICK CONNECT DRIVE SHAFT FOR ENGINE TESTING

by Damian Dockery and Timothy Ratliff

Sponsor: Pete Mosher - Application Engineering, Inc.

Faculty Advisor: Richard Hathaway

11:00 a.m. to 11:25 a.m., Room 209

A quick connecting drive shaft was needed to improve setup time for engine testing because attaching the engine to the dynamometer was a very time consuming and expensive process. Alternative designs were desired to increase profitability and a universal drive shaft for each engine class was designed and analyzed. Different concepts were considered to determine the most efficient proposal. The final design was selected based on manufacturability and expected set up time. top>

COPPER HEATER FOR BOILING TEST VESSELS

by Matt Bol and Andrew O'Neill

Faculty Advisor: Ho Sung Lee

11:30 a.m. to 11:55 a.m., Room 209

A copper element heater for use in boiling test vessels was desired. A uniform temperature across the heater surface and a means to measure surface temperature and power were requirements of the heater. In order to maximize performance, a prototype was constructed and tested. The data acquired from the prototype was used to create a model using commercially available computational fluid dynamics (CFD) software, FluentÔ. The CFD model was then used to predict the performance of other heater element designs. The heater design with the highest predicted performance was then constructed and tested to confirm performance characteristics. top>

PAPER AND PRINTING SCIENCE AND ENGINEERING
Session Chair - Peter Parker
Room 212

DEVELOPMENT OF A SOLUTION SET FOR FTA 200 SURFACE ENERGY CALCULATIONS
by Jamieson Doll
Faculty Advisor: Margaret Joyce
9:00 a.m. to 9:25 a.m., Room 212

Surface energy calculation using the FTA 200 contact angle measuring device was the focus for this research project. Currently there are no standardized solutions or established testing procedures for determining the surface energy of different substrates. This experimental plan was conducted to test, analyze, and report the development of a standardized solution set for use with the FTA 200 to determine the surface energy of any unknown substrate. top>

MODIFIED CLAY PIGMENTS IN PAPER
by Kelly Schafer
Faculty Advisor: Margaret Joyce
9:30 a.m. to 9:55 a.m., Room 212

The purpose of this project was to incorporate a modified clay pigment into a coating for the production of a matte finished rotogravure coating and to determine if the use of the modified clay pigment in these coatings improves the water-based print quality. Three different coating formulations were developed and evaluated. Each of the formulations contain different percentages of the modified clay. A lightweight substrate was coated with all three coating formulations, using a draw down method. The optical properties and smoothness of the coated substrate was tested. When the draw down testing was complete, the coating formulation with the best optical and smoothness properties was duplicated on a CLC coater. top>