46th Conference on Senior Engineering Design

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46TH CONFERENCE ON
SENIOR ENGINEERING DESIGN

Tuesday, April 20, 2010, 8 a.m. to 4 p.m.
College of Engineering and Applied Sciences

WESTERN MICHIGAN UNIVERSITY
Conference on Senior Engineering Design Projects

You are invited to attend the forty-sixth Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., Tuesday, April 20th at the College of Engineering and Applied Sciences on the Parkview 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 College Circle in front of the building and then park in lot P-2. (See map)

Parking is available in the ramps behind the College of Engineering and Applied Sciences (See Map: Lots P3 and P4). There is no charge for parking for those attending the Conference.

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

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

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A lunch break is scheduled from 12 p.m. to 1 p.m. There is a café available on site.

For more information about the conference, call Tamara Bergman at (269) 276-3248.

Brochure available electronically at:
http://www.wmich.edu/engineer/senior-design-conference.htm
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THANK YOU

The College of Engineering and Applied Sciences is grateful to these sponsors that have provided or cooperated in Senior Engineering Design Projects being presented in April 2010. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

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USG OTSEGO PAPER, INC.
WADE TRIM ASSOCIATES
WIGHTMAN & ASSOCIATES, INC.
I-94 @ COUNTY ROAD 652: MATTAWAN INTERCHANGE, BRIDGE, AND ROUNDABOUT DESIGN
by Eric Jacobsma, Adam McKindles, Ryan Norton, and Nate Scheffers
Sponsor: Munawar Azam, Michigan Department of Transportation
Faculty Advisors: Jun-Seok Oh, Xiaoyn Shao, and Yufeng Hu
8:30 a.m. to 8:55 a.m., D-115

Excessive peak hour demand and congestion called for operational and safety improvements for the I-94 interchange at County Road 652 in the Village of Mattawan, Van Buren County, Michigan. A four-lane box beam bridge and two roundabouts were proposed and designed after evaluating feasible alternatives. A non-motorized path and pedestrian sidewalks were also added. In addition to the bridge and road design, the social, environmental, and economic impacts were also taken into consideration. The new, innovative design has improved mobility and safety.

THE RECONSTRUCTION OF BALCH STREET
by Scott Boyce, Melinda Kwok, Alexander Lehman, and Matthew Ruffing
Sponsor: Frederick J. Nagler, The City of Kalamazoo – Public Services Department
Faculty Advisor: Jun-Seok Oh
9:00 a.m. to 9:25 a.m., D-115

Balch Street was in severe disrepair. A set of plans were developed showing existing road conditions and locations of utility lines and pipes. New pavement was designed, using recycled concrete as part of the base, to promote environmentally-friendly practices. Driveway approaches, damaged sidewalk, and existing sidewalk ramps were replaced with ramps meeting ADA standards. The storm sewer was analyzed and redesigned to improve storm water collection and damaged water mains were replaced. An analysis at Balch Street and S. Burdick Street was done to see if a signal was warranted. Finally, a construction schedule, cost estimation, and a safety and mobility plan were created for the reconstruction of Balch Street.
MICHIGAN AVE. BRIDGE OVER CN RAILROAD
by Andrew Brooks, Andrew Kehn, Bret Sommers, and Douglas Stemler
Faculty Advisor: Upul Attanayake
9:30 a.m. to 9:55 a.m., D-115

Increased security at the St. Clair Tunnel International railroad crossing is causing severe delays for trains entering the United States. Train movements blocking Michigan Ave. frequently impact emergency personnel response times and regular traffic. Several alternatives were evaluated to facilitate the railway crossing and finally a pre-stressed concrete bridge was selected and designed using MDOT standards and specifications. Structural analysis was performed using an integrated structural analysis and design software. A project estimate and schedule was also included. The proposed bridge project will ease the difficulties faced by regular travelers and emergency response teams.

FOUR STORY CLASS A OFFICE BUILDING SITE DESIGN
by Allison Porrett, Britney Richmond, and Kimberly Warners
Sponsor: Todd Hurley, Hurley & Stewart
Faculty Advisor: Yufeng Hu
10:00 a.m. to 10:25 a.m., D-115

An expansion of the Trade Center commercial development included the addition of a third class A office building on the property, near Westnedge Avenue in Portage, MI. In preparation for the new structure, a site design and analysis was performed. Due to the location, many environmental and social factors were considered. Site design analysis and plans included geotechnical calculations, storm water design, wetland/floodplain mitigation, and foundation design. A traffic study was performed to demonstrate the impact of the future business in the surrounding area. With the completion of this site layout design, the proposed building is ready to be constructed.

VILLAGE OF AUGUSTA’S HISTORICAL BRIDGE
by Chad Girrbach, Mark Hedrick, Ryan Nowinski, and Nathan Wagenmaker
Sponsor: Jonathan Moxey, Fleis & Vandenbrink Engineering, Inc.
Faculty Advisor: Haluk Aktan
10:30 a.m. to 10:55 a.m., D-115

Built in 1909, in the Village of Augusta, the Van Buren Street Bridge is the last pony truss bridge in Kalamazoo County. The bridge is designated functionally obsolete and has been replaced. Based on its historical significance, the bridge was salvaged and relocated for pedestrian and park traffic. Through the use of engineering software, such as SAP 2000, a structural analysis was performed to ensure the structure was physically sound. Combined with a traffic analysis and design of new abutments, a basic set of construction plans and specifications were created.
PREPARATION OF CONSTRUCTION DOCUMENTS FOR THE ST. THOMAS MORE CATHOLIC STUDENT PARISH
by Michael Johnson, Paul Pagano, and Cheekian Teng
Sponsor: Karen Gruss, Miller-Davis Company
Faculty Advisor: Irfan Ahemd
11:00 a.m. to 11:25 a.m., D-115

Expansion and modernization projects are increasingly popular as viable solutions to increase and update facilities in an economical and eco-friendly manner. In order to save time and resources, detailed construction documents must be prepared and understood by all parties involved. The documents that a construction manager must prepare include the engineering estimate, project schedule, site layout, safety plan, and environmental conservation practices. The appropriate software, techniques, and standards were used in the creation of these documents; these tools included Primavera, Microsoft Project, AutoCAD, OSHA standards, and LEED principles. The resulting documentation meets all requirements, is easily updated, and can be understood and managed by client and all construction principals.

MAPLEWOOD INTERCOUNTRY DRAIN
by Tyler Blosser, Andrew Gebhard, Emma Luther, and Kendall Vasilnek
Sponsor: John Tenpas - Fishbeck, Thompson, Carr & Huber, Inc.
Faculty Advisors: Duane Hampton and Paul Romano
11:30 a.m. to 11:55 a.m., D-115

Due to industrial development, channelization, and other pressures, the Maplewood Intercounty Drain, located in Holland, MI, experiences frequent and severe flooding. Two phases were completed in an attempt to alleviate flooding: a study phase and a design phase. The study phase involved compiling background information, developing a hydraulic model of the drain, and using the model to analyze various improvement alternatives to mitigate flooding. The design phase involved detailed design of the recommended alternative, complete with engineering drawings.

DESIGN OF A WASTEWATER COLLECTION SYSTEM
by Nathan Herberg, Kevin Phillips, Matt Sinkovitz, and Jeff Terry
Faculty Advisors: Upul Attanayake and Iskender Sahin
1:00 p.m. to 1:25 p.m., D-115

The residents of Fish Lake in Marcellus Township, MI are currently using out-dated septic tanks for their wastewater disposal. Wastewater collection systems can replace these existing septic tanks and are more sanitary and convenient. A design using gravity was created from solid modeling software. The wastewater collection system design minimized costs through the use of easements, right-of-ways, and pump station locations. This new system was designed for the maximum daily flow of all current residents and is also suitable for potential growth. The final system design provides a cleaner and more sustainable wastewater collection solution for its users.
FORD YACHT CLUB SEAWALL REPLACEMENT
by Chris Arseneau, John Benson, Geoffrey Britton, and Tim VanBlarcum
Sponsor: Steve Gravlin, Wade Trim Associates and Ford Yacht Club
Faculty Advisor: Upul Attanayake
1:30 p.m. to 1:55 p.m., D-115

Seawalls are structures built to prevent the erosion of soil from waterfront properties. A failing seawall can have detrimental effects to the environment, property, and property owners including water pollution, code violations, and fines. The failure mode of the seawall was determined and a complete redesign, construction plan, and cost estimate for the replacement of the seawall was completed. Site and space constraints governed the design process and the construction methods. The proposed design and construction will protect shorelines and the environment, while preserving the aesthetics of the surrounding area.

COMPUTER SCIENCE
Session Chair – John Kapenga
Room – D-202

SUNSEEKER SOLAR CAR MODELING SOFTWARE
by Raymond Johnson, Alan Plotkowski, and Jesse Wick
Faculty Advisor: John Kapenga
9:00 a.m. to 9:25 a.m., D-202

An important solar car racing tool is an effective strategy. Race strategy considers energy generated by the solar array and factors related to the energy usage of the vehicle. These factors include aerodynamic drag, rolling resistance, sun position, weather conditions, road elevation, and efficiency of the motor/battery. A Java multi-platform simulation program was developed which models the vehicles remaining energy based on these factors. The program graphs simulated/real-time data for three variables: time, distance, and state of charge. The program allows the user to edit the current strategy and re-simulate which maximizes efficiency.

MONARCH: ARTIFICIAL NEURAL NETWORK API
by Jason Smith and Benjamin Welton
Faculty Advisors: Robert Trenary and John Kapenga
9:30 a.m. to 9:55 a.m., D-202

Neural Networks are on technique in an engineering “soft computing” toolbox. A neural network application is built from a reasonably large number of process elements connected in some architecture, where dynamics are used to solve a task. In 1998, a library of neural network routines was written in C++ as a master’s thesis named “Monarch”. A library re-architectures the original routines as a C library implemented within an object framework. This framework was then bound into Python and C# for creating high level applications. Demonstrations of well known examples have been implemented and the library has been used in a Computer Science course successfully.
MOBILE iyeCITATION: A HANDHELD E-CITATION SOLUTION
by Jordan Neidlinger
Sponsor: Salman Anwar, iyeTek
Faculty Advisor: John Kapenga
10:00 a.m. to 10:25 a.m., D-202

Safety, efficiency, and accuracy are of the upmost importance among Police Departments with regards to citation issuance. Adoption of electronic citation technology is increasingly common across the United States. An electronic citation solution was developed using Microsoft.NET technologies to run on handheld devices running Windows Mobile 5 or higher, coupled with traditional thermal Bluetooth printers. The solution allows for adoption of electronic citation procedures where a traditional laptop may be of less use. The system was designed to be complete, modular, scalable, and highly supportable amongst a vast variety of differing law enforcement agencies.

MUSIC PROMOTION AND DISSEMINATION SYSTEM
by Nathan Hartmann and Joseph Armstrong
Sponsor: M.D. Wood, Ascetic Aesthetics Records
Faculty Advisor: John Kapenga
10:30 a.m. to 10:55 a.m., D-202

Ascetic Aesthetics (AA), a local independent music label, had no web presence. AA’s only channels for distribution and promotion were through non digital means. Being a small organization with limited information technology resources, a free and open source software platform was chosen. Using Extreme Programming principles, a promotional website and an intuitive web based administration interface were created. With the need for rapid additions to the website, new artists and media can be added with limited technical knowledge. AA is now able to represent themselves on the web as their stable of artists and available music grows.

DATABASE MANAGEMENT SYSTEM FOR ELECTRONIC MANUFACTURING
by Jeremy Doornbos, Karan Thaker, and Joshua Williams
Sponsor: Jack Doornbos, Petra Electronic Manufacturing, Inc.
Faculty Advisors: Donna Kaminski and Li Yang
11:00 a.m. to 11:25 a.m., D-202

As database technology advances, many small businesses may find it difficult to stay current and must rely on outdated and inefficient software. An updated database management system for an electronics manufacturing company was created for controlling inventory, tracking production runs, calculating costs, and maintaining employee information. Existing data was transferred from an Access 97 database to a MySQL database, and user application for accessing it was developed using C#. This application will help streamline the daily functioning of the company and, as the needs of the business evolve, new features will be able to be added easily.
The property management business requires a systematic way to manage maintenance work orders. A work order web application has been created using CakePHP, a framework for PHP. The web application allows property owners, tenants, and company managers to request maintenance services for their properties. Work orders are assigned to maintenance workers and tracked throughout their life cycle. Time sheets for maintenance employees and billing invoices are just a couple of useful reports that can be generated using the work order data. By leveraging web technologies, the system allows property managers to easily manage maintenance work orders from any web-connected platform.

**ELECTRICAL AND COMPUTER ENGINEERING**  
Session Chair – John Gesink  
Room D-204/205

**BATTERY PROTECTION SYSTEM FOR ADVANCED LITHIUM POLYMER BATTERIES**  
by Meng Chun Cheah, Siok Yee Lim, and Kong Siew Yu  
Faculty Advisor: Bradley Bazuin  
9:00 a.m. to 9:25 a.m., D-204/205

Lithium polymer batteries have strictly defined operating ranges for voltage, current, and temperature. Failure to maintain the batteries within the appropriate range may result in catastrophic failure and fire. The battery protection system has been developed to monitor up to 12 series connected Li-polymer battery cells, detect out of range conditions, disconnect the battery from any load, and notify the operators of the range error. The protection system, during normal operation, continuously monitors battery cell voltage, temperature and total battery current, and voltage for display using either an RS-232 or Controller Area Network (CAN) interface.

**ADVANCED BATTERY MONITORING AND PROTECTION SYSTEM**  
by Dan Heilman, Mohammed Islam, and James Truszkowski II  
Faculty Advisor: Bradley Bazuin  
9:30 a.m. to 9:55 a.m., D-204/205

Western Michigan University has been racing in the North American Solar Car Challenge since 1990. The solar car uses advanced Lithium Polymer batteries which must be closely monitored and then be disabled if out-of-range conditions occur. The Battery Monitoring and Protection System is a new implementation for the future 2012 car. The new design has fewer components, less weight, and is much smaller in size. This simplified the design, while reducing the number of components that could fail. The Battery Monitoring and Protection System has been redesigned, built, and tested and now meets all specifications.
PIEZOELECTRIC VALVE ACTUATOR TEST SYSTEM
by Hau Huynh, Phillip Gist, and Chester Wilson
Sponsor: Humphrey Products
Faculty Advisor: Massood Atashbar
10:00 a.m. to 10:25 a.m., D-204/205

In order to cater to clients with more precise actuator demands, a robust piezoelectric actuator testing system was developed. The actuator testing system is capable of an operating voltage range from 100V to 1000V. It tests various characteristics of an actuator in order to determine if the durability, reliability, and accuracy meet client specifications.

ELECTROPHYSIOLOGY MEASUREMENT AND STIMULATION SYSTEM
by Kyle Batzer, Richard Corsi, and Edward Crampton
Faculty Advisors: Damon Miller and Frank Severance
10:30 a.m. to 10:55 a.m., D-204/205

The WMU Neurobiology Engineering Laboratory is investigating the electrical activity of neural networks cultured on microelectrode arrays (MEAs). A low-cost system for measurement and stimulation of culture electrical activity capable of supporting four MEA electrodes has been developed based on previous work. The system enables low-noise acquisition of electrode voltages and generation of stimulation signals either defined by the user or based on a time history of culture behavior. The system is expandable to accommodate 60 electrodes as commonly available in commercial MEAs.

SOLAR CAR TELEMETRY MODULE
by David Landreth, Heather Scherer, and Jerry Taylor
Faculty Advisor: Bradley Bazuin
11:00 a.m. to 11:25 a.m., D-204/205

The WMU Sunseeker Rayce Team required new telemetry circuit board to enable transmission of solar car information to a chase vehicle. This information will be used to aid race planning, testing, and monitoring of the car’s systems including the electric motors, motor controllers, and drive controls. The circuit board was designed around a MSP430F5438 microcontroller utilizing multiple SPI, CAN bus, and UART interfaces to communicate with the chase vehicle with a USB memory stick and with the car’s systems. It uses high efficiency DC-DC power converters thus conserving the solar car’s battery energy. This new telemetry module has improved energy efficiency and a more robust feature set.
SMART VEHICLE: VEHICLE AD-HOC NETWORK
by Andrew Erdman, Andrew Walter, and Kevin Whyte
Sponsor: DENSO North America Foundation
Faculty Advisor: Liang Dong
11:30 a.m. to 11:55 a.m., D-204/205

The use of a vehicular ad-hoc network can improve the accuracy of a global positioning system (GPS) in dense urban areas by providing relative distance and speed measurements among vehicles. A printed circuit board (PCB) was developed using a microcontroller, GPS unit, and other distance measuring tools. Software was developed for the microcontroller to integrate various components on the PCB. This technique can effectively improve a framework for future transportation communication and safety.

WIRELESS FLEET MANAGEMENT SYSTEM
by Robert Hutchison, John Jacobs, and Kevin Key
Sponsor: Diagnostic Systems Associates
Faculty Advisor: Dean Johnson
1:00 p.m. to 1:25 p.m., D-204/205

A wireless fleet management system (FMS) has been designed, developed, and evaluated to simplify a commercial vehicle fleet’s ability to acquire information logged. Wireless FMS’s are vital to the efficient operation of a vehicle fleet. The wireless FMS is composed of a vehicle module and a terminal module. Each module is composed of a ColdFire microcontroller interfaced with a Texas Instrument CC1101 radio frequency transceiver. The performance of the wireless FMS is based on the ability to communicate data packets from the vehicle module to the terminal module.

VEHICLE DATA TRANSCEIVER
by Justin Andrews, Kasey Harden, and Jeffrey Ross
Sponsor: DENSO North America Foundation
Faculty Advisor: Liang Dong
1:30 p.m. to 1:55 p.m., D-204/205

Governing authorities are developing new standards for wireless vehicle communication to increase the safety and efficiency of transportation. A wireless transceiver was designed and a prototype was developed for data transmissions over the dedicated frequency band for vehicle communication. The device interfaces with analog sensors to collect and disperse safety related data.
SMART VEHICLE: GPS/INS VEHICULAR POSITIONING
by Chad Albert (CCE) and Jacob Dieter (MAE)
Sponsor: DENSO North America Foundation
Faculty Advisors: Jun-Seok Oh and Kapseong Ro
2:00 p.m. to 2:25 p.m., D-204/205

Intelligent vehicle Global Positioning Systems (GPS) are necessary for the improvement of roadway transportation efficiency and safety. Handheld GPS with differential correction capacity, Inertia Navigation System (INS), and integrated GPS/INS modules were evaluated to address positioning information loss in poor GPS signal conditions. A simulation benchmark of the test site was created for future study of the effects on large scale traffic models. Initiation of this project was to define a test site that will allow for advanced study into the process of data collection, integration, and application toward the automation of the roadways.

INDUSTRIAL AND MANUFACTURING ENGINEERING
Session Chairs – Betsy Aller and Bob White
Room D-201

FOOD BANK SUPPLY CHAIN ENDPOINT ORDERING
by Lawrence Claxton, Donald Frohriep, and Matt Scarbrough
Sponsor: Kalamazoo Loaves & Fishes
Faculty Advisor: Larry Mallak
8:00 a.m. to 8:25 a.m., D-201

In the current economic climate, more families in Kalamazoo are experiencing food insecurity. Local food pantries must match their capabilities to the demand for their services. Management tools using conventional methods and system techniques were created to help collect, monitor, and analyze inventory data. This will help food pantries and their suppliers better track inventories, begin to introduce lean methodologies into their supply chain network, and monitor trends. This should reduce order lead times, improve order accuracy, reduce stock-outs/overstocks, and ultimately increase network capacity.

THERMAL MECHANICAL ANALYSIS OF SHELL SAND
by Matt Kunesh, Chris Reniger, and Tim Gaston
Faculty Advisor: Sam Ramrattan
8:30 a.m. to 8:55 a.m., D-201

Resin coated sand systems offer higher quality castings with reduced cycle times and improved dimensional tolerances and surface finish. Shell sand systems are widely used in the foundry industry without sufficient knowledge of their thermo-mechanical properties. Optimization of shell sand processing parameters with proper testing could help to improve the reliability and consistency of shell cores and molds. New testing techniques were designed, equipment developed, specimens fabricated, and tests implemented. The new methods should help the foundry industry to standardize and improve testing.
THREE-WHEELED URBAN ELECTRIC VEHICLE DESIGN
by Brad Horvath, Marcus Marzetti, and Dustin Walter
Faculty Advisors: David Middleton and Pavel Ikonomov
9:00 a.m. to 9:25 a.m., D-201

To perform the function of urban transportation, a three-wheeled, electric-powered vehicle required an enclosed cabin for protection from the elements and for passenger safety. The exterior shell was created using the CAD programs Pro/ENGINEER and 3D Studio Max. A 1/5 scale model was shaped out of foam to depict real-life attributes. A test version was tailored specifically to the E-car dimensions. The final product displays the viability and achievability of a new generation commuter vehicle.

AUTONOMOUS RENEWABLE ENERGY SYSTEM
by Mosaab Alburih and James Morley
Faculty Advisors: Pavel Ikonomov and Betsy Aller
9:30 a.m. to 9:55 a.m., D-201

As fossil fuels continue to diminish and the earth’s population increases, the price of energy grows in response. Developing and researching opportunities for alternative energy is becoming vital. The feasibility of an independent, green, and renewable power system that involves wind energy and hydrogen was researched and a system was designed and tested using an electrical car. The suggested system is clean, renewable, and comparable to the current power system.

DESIGN OF A LOW IMPACT COLLISION BUMPER
by Simon Caron and Jonathan McDonald
Faculty Advisor: Fred Sitkins
10:00 a.m. to 10:25 a.m., D-201

A 1949 Chevrolet project truck required a collision feature to protect it from impact damage. A period bumper system was developed to absorb and redirect an impact without sustaining vehicle body damage and to assure occupant safety. Research into current and authentic bumpers helped determine the best way to absorb impact. The engineering tool Pro-Engineer was used to design a model of the bumper system, and finite element analysis (FEA) tested and analyzed the stresses imparted by a 5 mph impact. The final design incorporates both safety and aesthetics into the bumper system.
SEGMENTATION AND PARAMETRIC MODELING OF THE HUMAN SPINE
by Brian Dragone and Brian Wojciechowski
Faculty Advisors: Jorge Rodriguez
10:30 a.m. to 10:55 a.m., D-201

In order to better understand the biomechanics of the human spine, three-dimensional representations of a patient’s spine were created by segmenting MRI data. This was done utilizing 3D-Slicer, an open-source software used for biomedical imaging. Additionally, computer models of the spine were parameterized, using PRO/Engineer, in order to create features relevant to various spinal conditions. Through the parameterization of these visualizations, various conditions can be simulated and analyzed for improving or worsening symptoms.

PRODUCT CONCEPTS FOR FALL AND INJURY PREVENTION IN HOSPITALS
by Joseph Adams, Brandon Carlson, and Daniel Flora
Sponsor: Richard Derenne, Stryker Medical
Faculty Advisor: Jorge Rodriguez
11:00 a.m. to 11:25 a.m., D-201

There is a need to keep patients in a hospital safe from preventable injuries. These injuries can be caused by many factors, the two most important being pressure sores and falls. Starting from concepts and continuing with feasibility studies, several solutions were generated and evaluated, resulting in three options that focus on preventing injuries to hospital patients. Conceptual engineering design process, Pugh matrices, and the group normative technique were used to select the proposed solutions. Basic engineering was developed for these products and an implementation plan was presented to the sponsor.

EXPANDING EMPLOYMENT ACCESS FOR PEOPLE WITH DISABILITIES
by James Burns, Napoleón Pérez, and Alix Phillips
Sponsor: Yonathan Shibru and Karl Kingsley, ADEC Industries
Faculty Advisor: Tycho Fredericks
11:30 a.m. to 11:55 a.m., D-201

Non-profit organizations that employ people with disabilities often have difficulty expanding operations because of workforce limitations and financial constraints. However, with the Green Movement, recycling of electronic equipment has shown economic promise. Tools and processes needed to assist workers with disabilities in breaking down electronic components for recycling were developed. These tools and processes provide an effective alternative to current market options that are safe and effective. An economic analysis of the system was performed to determine the feasibility of expanding this business segment in the future.
CLUTCH TOOL: AN AUTOMATED DESIGN TOOL FOR SLIDING CLUTCH COMPONENTS
by Scott Horton, Josh Utt, and David Cooper
Sponsor: James Ridge, Eaton Corporation
Faculty Advisor: Jorge Rodriguez
1:00 p.m. to 1:25 p.m., D-201

The modern role of engineering is not only to solve problems but to solve them efficiently. A software tool, ClutchTool, was developed to help a designer document sliding clutch components more efficiently than the standard method. This design tool includes a Graphical User Interface (GUI) that serves as a platform where input data are collected from a specifications database, and checks and potential modifications are performed. This tool was developed using Visual Basic and documentation was performed in Pro/Engineer. Using pre-established parameters, Clutchtool interacts with a solid modeling software to build a part model and drawing of chosen sliding clutch components.

CONSOLIDATING MULTIPLE PRODUCTION LINES INCREASES SPACE FOR COMPANY EXPANSION
by Prachi Chandrana, Jayaram Ganesan Krishna, Mariam Ouazar, and Nicholas Maes
Sponsor: Susan Shah, Stryker Medical
Faculty Advisors: Azim Houshyar, Tarun Gupta, Bob White, Steven Butt, and Tycho Fredericks
1:30 p.m. to 1:55 p.m., D-201

Due to the growth of the medical industry, the need for innovative medical equipment has been increasing. To survive, a company must produce as efficiently as possible. Consolidating production lines of different products into a single line is one way to reduce space to allow future expansion within the available production area. Challenges included different machinery and equipment, different lead times, and line balancing. Engineering tools used included facility layout planning, time studies, and simulation. Results allow the company to free up space within the current production area for future production lines to be introduced.

MECHANICAL AND AERONAUTICAL ENGINEERING A
Session Chair – William Liou
Room D-109

AERODYNAMICS OF THE AIAA RC AIRCRAFT
by Matthew Aven, Nicholas McDermott, and Alex Satonik
Faculty Advisor: Kapseong Ro
9:00 a.m. to 9:25 a.m., D-109

A remote controlled aircraft was designed and built to compete in an international competition. During the design process, computational fluid dynamics was used to compute the aircraft’s aerodynamic coefficients.
Wind tunnel testing was done to verify the results of the computational fluid dynamics. Flight testing was performed to verify appropriate control surface sizing and stability of the aircraft.

**STATIC EXTENDED TRAILING EDGE APPLIED TO A DELTA WING PLATFORM**

by Adam Goulet, Nicole Obriecht, Tim Welch, and Jonathan Zolp

Faculty Advisors: Tianshu Liu and William Liou

9:30 a.m. to 9:55 a.m., D-109

In today’s world of escalating fuel costs, the aerospace industry finds itself researching new methods of enhancing aerodynamic efficiencies. A scaled model of a delta wing platform with a static extended trailing edge (SETE) was designed using solid-modeling design software. The delta wing was then subjected to a series of computational fluid dynamic (CFD) tests which involved using multiple angles of attack and SETE angles via CFD software. A three-dimensional prototype was constructed and the lift-to-drag ratio was analyzed from experimental data collected during wind-tunnel testing.

**FEASIBILITY OF DRAG REDUCTION WITH THE ADDITION OF A SPLITTING TAB**

by Jorge O’Neil, Rodney Pickett, Ryne Radermacher, and Daniel Stremersch

Faculty Advisor: Tianshu Liu

10:00 a.m. to 10:25 a.m., D-109

Drag reduction devices are used in airplanes to increase fuel efficiency and reduce fuel cost. Testing was performed on a NACA 0012 airfoil to study the reduction in drag when applying a relatively thin static extended trailing edge commonly known as a tab. Several tab variations were designed and tested. Analysis was performed using wind tunnel testing and computational fluid dynamics simulation programs. The final design demonstrated a reduction in drag over the baseline configuration. Reducing a significant amount of drag with the slight modification of adding a splitting tab could increase fuel efficiency in industry.

**STRUCTURAL DESIGN OF A PROTOTYPE BLENDED WING BODY CONCEPT AIRCRAFT**

by Adam Peruski-Smith and Melissa Wagner

Sponsor: Craig Evans, DynaComp Corporation

Faculty Advisor: Peter Gustafson

10:30 a.m. to 10:55 a.m., D-109

Fuel consumption concerns have created a demand for more efficient, greener aircraft. Blended Wing Body designs offer this efficiency increase, by way of a unique construction and layout. This unique layout requires special techniques and materials. A half-span model was designed and constructed using composite materials and stressed-skin structure, with the goal of maximizing internal space by minimizing internal structure. The model was designed using three-dimensional parametric modeling software and it was evaluated against design parameters with a finite elements analysis package. Physical testing of the model was performed to verify the analysis results and presented in the final report.
STRUCTURAL DESIGN OF A MULTI-ELEMENT WING
by Matthew Shellen
Faculty Advisor: Judah Ari-Gur
11:00 a.m. to 11:25 a.m., D-109

Structural design and analysis of a race car wing was performed for use on a new aerodynamic design. The structural design was created by studying previous aircraft wing structures and applying the same features. Structural analysis was performed on the wing with the use of Finite Element Analysis software. The final design resulted in a structurally sound, lightweight wing that utilized the new aerodynamic design.

WIND TURBINE DESIGN FOR HOME USE
by Maureen Chepkoech, Timothy Ho, Jarel Jackson, and Sir Ling Low
Faculty Advisor: Bade Shrestha
11:30 a.m. to 11:55 a.m., D-109

With today’s interest in clean, efficient alternative energy, capturing energy from the wind is increasing in demand. This is due to its economic, environmental, and social benefits. For this, a cost efficient wind turbine which can potentially power a single family home was designed. The focus was on efficient blade design and structural components that were designed using solid modeling software and analyzed using finite element analysis.

CONSTRUCTION AND TESTING OF A VERTICAL AXIS WIND TURBINE
by Gregory Farrer and Aaron Williams
Faculty Advisor: Judah Ari-Gur
1:00 p.m. to 1:25 p.m., D-109

Wind power is a clean form of energy and, in many locations, a reliable source. Vertical axis wind turbines are practical for converting wind power to electricity without the need to orient the blades toward the incoming wind. The vertical axis wind turbine was designed to affordably generate one kilowatt of electricity. This was done through analysis of the forces that would be applied to airfoil. Solid modeling and Finite Element Analysis was also performed to optimize the turbine’s structure. Prototype testing verified the mathematical and solid model results.
DESIGN OF WIND TURBINE BLADE LOADING APPARATUS PROTOTYPE
by Hannah Cooley, Andrew Koehler, Letitia Mwangi, and Alex Quinlan
Faculty Advisor: Peter Gustafson
1:30 p.m. to 1:55 p.m., D-109

A load transferring apparatus was designed and built so as to conduct fatigue and failure testing on a wind turbine blade. The purpose of this prototype is to be able to develop a resource that would advance the university’s renewable energy program. This was done by designing, simulating, and building an apparatus capable of transferring variable loads and displacements from an axial-torsional load-frame to the wind turbine blade.

WIND TURBINE MAIN BEARING AND SHAFT REDESIGN
by Dan Cook, Thomas Stilson, and Brent Timmerman
Faculty Advisor: Judah Ari-Gur
2:00 p.m. to 2:25 p.m., D-109

A large, 1.5 mega watt wind turbine’s main shaft and bearing system was redesigned to increase the reliability and durability of the bearing and gearbox system. Different innovative ideas were used and integrated into one dynamic system geared towards saving money by reducing replacement costs and maintenance, and decreasing down time. The team used solid modeling software, mathematical modeling software, and simulation software to produce the new design.

OPTIMIZATION OF A GEARLESS WIND TURBINE
by Ross Mischnick, Frank Owsiany, and Ryan Wilkins
Sponsor: Dan Confer, Conatus Inc.
Faculty Advisor: Iskender Sahin
2:30 p.m. to 2:55 p.m., D-109

A gearless wind turbine was developed and tested for use in a residential setting. The main purpose was to increase the power per square meter of turbine area over that of the benchmark design. The efficiency of the system was increased through material selection of key components, improved bearing design and positioning, and tighter tolerances. Ease of assembly and maintenance were addressed as part of the design process to reduce the operational costs. Fluid flow simulations were performed to assure efficient energy conversion and finite element analysis was used to assure the system would be structurally sound.
PRESSURE REDISTRIBUTE OF WHEELCHAIR SEATS
by Nathan Brussee and Joel Herder
Faculty Advisor: James Kamman
9:00 a.m. to 9:25 a.m., D-210

A seat cushion and control unit for a wheelchair has been designed to redistribute pressure points on the user. Designing a seat cushion with alternating pressure chambers is an effective way to reduce pressure ulcers or bed sores with those who remain seated for extended periods of time. With this type of system, the cushion redistributes the user’s pressure points automatically. This will eliminate the need for assistance to adjust the user’s weight distribution in the seat.

SIMULATION AND DESIGN OF A HYDRAULIC POWERTRAIN
by Peter Bombara, Levi Scheenstra, and Brad Thomas
Faculty Advisor: James Kamman
9:30 a.m. to 9:55 a.m., D-210

Since 2005, Western Michigan University has participated in a national competition focused on human-powered vehicles that utilize hydraulic powertrains designed by students. Although hydraulic drive systems are less efficient and heavier than conventional chain and sprocket gearing, they offer unique design options. Performance tests were done to compare the existing hydraulic bicycles with chain and sprocket bicycles. Software was used to construct a simulation model to maximize the effectiveness of the hydraulic design options. The information obtained from the simulations was then used to complete the final design recommendation.

ELECTRIC RACING VEHICLE
by Scott Kennedy, John Lipasek, and Brian Silovich
Faculty Advisors: Richard Hathaway and Abraham Poot
10:00 a.m. to 10:25 a.m., D-210

An electric powered vehicle for a high school competition was designed. Components were modeled and analyzed using solid modeling and finite element analysis software. The vehicle was designed to weigh a minimum of 100 pounds minus the batteries, with a 50/50 weight distribution. The vehicle was designed to reach closed course speeds up to 55 miles per hour. The performance of the vehicle was optimized through physical testing and the use of simulation software.
KINEMATICS AND COMPLIANCE TEST SYSTEM
by Nickolas Bailey, Ryan Kristoff, Chancellor Parker, and Matthew Roobol
Faculty Advisor: Richard Hathaway
10:30 a.m. to 10:55 a.m., D-210

A kinematics and compliance test system was designed and constructed to evaluate vehicle structural properties and suspension characteristics. Currently, commercial test systems are expensive and otherwise unavailable for educational use. This system provides an inexpensive alternative to outsourcing testing and can be used for preliminary measurements while designing a vehicle’s frame and suspension. The system applies forces and measures displacements of the discrete compliance behavior. The system has proven to be effective for measuring the suspension compliance and torsional stiffness of the frame. The machine was designed utilizing solid modeling software and structurally evaluated with finite element analysis.

EXHAUST DRIVEN TURBINE GENERATOR FOR GASOLINE ENGINES
by Devin Hein and Joseph Kilcoyne
Faculty Advisor: Bade Shrestha
11:00 a.m. to 11:25 a.m., D-210

In order to increase the efficiency of a vehicle with a gasoline internal combustion engine, a turbine generator system was designed to recover wasted exhaust gas energy. The prototype turbine generator was designed for implementation in passenger vehicles with small displacement engines operating under highway cruise conditions. The design features a gas turbine directly coupled to a synchronous high-speed permanent magnet generator with an exhaust gas bypass system. Experimental data was taken from a 1.6 liter gasoline engine in order to determine the system’s operating parameters. The physical design was developed using solid modeling and simulation software. Experimental testing of the turbine was done to verify the simulated data.

DESIGN OF A RACE CAR MUFFLER
by Sarah Gerbig and Brett Lovell
Faculty Advisor: Claudia Fajardo
11:30 a.m. to 11:55 a.m., D-210

A lightweight, low cost muffler was designed and manufactured for a 600 cc, 4-cylinder engine-powered formula-style racing vehicle to reduce noise during engine operation. High priority was placed on reducing high-performance vehicle noise to comply with the racing rules, prevent hearing damage of drivers, passengers, spectators, and to reduce noise in areas of the racing events. Design iterations were analyzed through solid modeling, simulation software, and physical testing. The muffler was manufactured and tested to prove the validity of the design using customer specified regulations and parameters.
DESIGN OF FUEL CELL MEMBRANE TEST STAND FOR ADVANCED MEMBRANE RESEARCH
by Rebekah Achtenberg, Brandon Darr, and Luke Roobo
Faculty Advisors: Bade Shrestha, Muralidhar Ghantasala, and Valery Bliznyuk
1:00 p.m. to 1:25 p.m., D-210

Fuel cells hold the potential for being an alternative energy source for many applications, from transportation to stationary power units. A fuel cell membrane test stand was designed and fabricated to evaluate solid polymer electrolytes. The test stand allows for the measurement of temperature, pressure, humidity, and oxygen concentration at the reactant-catalyst-electrolyte interface. Performance of the fuel cell was evaluated through electrochemical impedance spectroscopy. Material characterizations were made to analyze electrochemical and mechanical properties of the materials. The data collected will compliment future research to develop more durable and efficient membranes.

DESIGN OF A GEOTHERMAL HEAT PUMP FOR WMU WALWOOD HALL
by Aaron Prough and James Watson
Sponsor: Trent DeBoer, David Bell, and Steve Hamstra, GMB Architecture and Engineering
Faculty Advisor: Ho Sung Lee
1:30 p.m. to 1:55 p.m., D-210

Recently, there has been increased demand for cheaper and higher efficiency heating and cooling. Geothermal heat pumps offer safe, reliable energy efficient heating and cooling by harnessing the ground’s natural energy. A study was conducted for Western Michigan University’s Walwood Hall to adapt the current HVAC system to a geothermal system. Sizing and layout of the ground loop, as well as design of the heat pumps, was done analytically and through the use of computational fluid dynamics software. Once the design was completed, a cost analysis was conducted to evaluate whether it would be financially viable for the university to adapt the new geothermal system at Walwood Hall.

FLOW TRAINER DESIGN
by Nathan Chamberlin, David Kelly, and Ji Wey Lee
Sponsors: Lake Michigan Community College, American Electric Power - Cook Nuclear, Entergy-Palisades
Faculty Advisor: Christopher Cho
2:00 p.m. to 2:25 p.m., D-210

With the majority of workers in nuclear energy production reaching retirement age, a highly trained workforce is needed to fill future openings. To provide hands on training a full size flow trainer was designed. The flow trainer layout was created using computer aided design software and includes tanks, pumps, valves, instrumentation, piping, and a heat exchanger. Component selection was analyzed using thermal design calculations that were then verified using numerical engineering software. Validation of total system flow and system dynamics was accomplished using flow simulation software. The completed flow trainer provides hands on training specifically aimed at future nuclear energy production employees.
DESIGN OF VIRTUAL MATERIAL SCIENCE EXPERIMENT  
by Noor Aishah Ahmad Fuad and Ahmad Ashraf Ahmad Mahir  
Faculty Advisor: Pnina Ari-Gur  
9:00 a.m. to 9:25 a.m., D-212

The virtual lab is designed to transform teaching and improve classroom learning with innovative uses of technology. The virtual materials science laboratory is made of simulated experiments, animated videos, and electronic interactions. Users of this virtual lab will benefit from a lab experience without the time, equipment, safety, and personal costs of a real lab.

DESIGN OF A MAGNETIC SHAPE MEMORY SMART MATERIAL  
by Brendan Hill and Jonathan Wiley  
Faculty Advisor: Pnina Ari-Gur  
9:30 a.m. to 9:55 a.m., D-212

The composition of Nickel-Manganese-Gallium (Ni-Mn-Ga) magnetic shape memory alloy was designed to accommodate the largest magnetic field-induced strain which occurred in off-stoichiometric crystalline structures. This was achieved by modifying the composition and observing the Curie temperature, martensitic, and premartensitic transition temperatures. Through these observations it was determined that the martensitic temperature was the most sensitive to a change in composition. Casting of the designed compositions, electron microscopy, synchrotron, X-ray, and neutron diffraction were conducted to determine the phases present and their transformations.

EVALUATION OF SLEEVE OVERLAY AND SURFACE FINISH OF A MECHANICAL SEAL SHAFT SLEEVE  
by Jay Gronbach and Yalin Liu  
Sponsor: Chris McCowey, Flowserve Corporation  
Faculty Advisor: Pnina Ari-Gur  
10:00 a.m. to 10:25 a.m., D-212

A mechanical seal shaft sleeve rotates with a compressor shaft and comes into contact with a stationary circumferential carbon ring. Material testing was done to compare different surface finishes and hard coatings on the outer diameter of the shaft sleeve to determine their wear and corrosion resistance. The elimination of the hard coating overlay on the outer diameter, a 410 Stainless steel alloy shaft sleeve used in the mechanical seal, was evaluated. Analysis of the test results led to the redesign of the sleeve coating and surface finish for optimum cost and manufacturing time, without compromising the seals performance.
DIAMOND ANVIL CELL WITH INDUCED SHEAR
by Andrew Bringley and Thomas Kremenski
Faculty Advisors: John Patten and Muralidhar Ghantasala
10:30 a.m. to 10:55 a.m., D-212

Intense stresses are exerted on silicon carbide (SiC) during the micro-laser assisted machining process. In order to perform material experimentation on SiC, diamond anvil cells (DAC) are necessary to simulate similarly intense forces to samples. If shear forces are introduced, together with intense pressure and heat, then closer-to-actual machining simulations can be performed which provide material characteristics information that can be used to devise more efficient machining processes. 3-D modeling software of the rotational DAC prototype is provided to visually represent its function.

REDESIGN OF AN ELECTRO-HYDRAULIC VALVE
by James Rucker and Brian Vennix
Faculty Advisor: Daniel Kujawski
11:00 a.m. to 11:25 a.m., D-212

An existing electro-hydraulic valve design exhibited performance shifts that caused customer returns and contributed to production line scrap. The components causing this shift were identified and analyzed using hand calculations backed by finite element analysis. A new design was created to eliminate the root causes of the performance shift by integrating several components into one. Experiments were conducted which verified that the redesigned valve met current specifications while reducing performance shifts.

DESIGN OF A RADIATOR P-TANK COOLING MACHINE
by David Crow, Nicholas Crow, Kevin Mikishko, and Nathaniel O’Brien
Sponsor: Denso Manufacturing Michigan, Inc.
Faculty Advisor: Iskender Sahin
11:30 a.m. to 11:55 a.m., D-212

A machine was redesigned to cool a plastic radiator end tank more efficiently, reducing the operating time and cost for manufacture. Computational fluid dynamics (CFD) software was used to determine the optimum cooling method while finite element analysis (FEA) was utilized to improve the structural integrity. The machine was designed around the parameters determined by the CFD and FEA software. A prototype test fixture was designed and built to verify CFD results. The final machine design is scheduled to be built at a later date.
DESIGN OF A SIDE SWINGING OVEN DOOR
by Eric Gassman and Kyle Mills
Faculty Advisor: Koorosh Naghshineh
1:00 p.m. to 1:25 p.m., D-212

When a traditional oven door is opened, the door limits the reach of the user into the oven. A local appliance manufacturer is looking to solve this issue and to accommodate for the increasing size of ovens. A solution to this problem would be a side swinging oven door instead of the traditional pull down door. The new design is completely and easily side-to-side reversible and meets the same requirements and functionality as a traditional oven door. The new side swinging oven door design was modeled using solid modeling software and tested with finite element analysis. A full scale working prototype was then manufactured to demonstrate its functionality.

PIPE LEAK DETECTION SYSTEM
by Thomas Reiff and Suan Loong Tan
Faculty Advisor: Javier Montefort
1:30 p.m. to 1:55 p.m., D-212

Burst or leaking pipes in homes and businesses costs insurance companies and consumers hundreds of millions of dollars every year in clean up and restoration. With a new concept in leak detection, a system has been developed that can offer nearly 100% leak detection coverage by monitoring the entire plumbing system. The system detects any leak and offers automatic supply shut off and leak location detection. The system cost is less than most insurance deductibles and offers peace of mind.

PAPER ENGINEERING, CHEMICAL ENGINEERING, AND IMAGING
Session Chair – Peter Parker
Room D-208

A “GREEN” SOLUTION FOR INCOMING WATER TREATMENT
by Brittany Albin, Mark Fournier, and Cole Rogers
Sponsor: Edward Winegar, The Kellogg Company
Faculty Advisor: Andrew Kline
9:00 a.m. to 9:25 a.m., D-208

An increase in demand for an industrial water softener has created a need to investigate either replacing or upgrading the current system. A water filtration and softening process was developed to meet the increased demand for critical utilities such as the cooling tower and reverse osmosis units. The water composition from the softening process was analyzed to examine corrosion on the pipes. Preliminary economic estimations and returns on investment calculations were performed. The chosen technology achieved the goals of reduced consumption of natural resources, a lower cost, and long-term viability.
BAKING OVEN THROUGHPUT INCREASE
by Kristin Busch, Ileana Irizarry, Ben Ruffolo, and Derek Yelinek
Sponsors: John Guy and Danielle Habitz, The Kellogg Company
Faculty Advisor: Andrew Kline
9:30 a.m. to 9:55 a.m., D-208

Kellogg’s operates many tunnel ovens to bake various products. In many situations these ovens are at maximum capacity and are the bottleneck operation in the production process. There is a need to identify and evaluate new technologies that could be added before or after the oven that would enable increased oven throughput. An analysis and economic comparison of these different technologies was completed allowing for a recommendation to be made on which process to use. If implemented, this process should allow for increased throughput within the baking ovens.

RICE COOKING PROCESS ANALYSIS
by David Hills, Whitney McCue, and Emily Tomes
Sponsor: Visnu Sookhai, Post Foods, LLC
Faculty Advisor: Andrew Kline
10:00 a.m. to 10:25 a.m., D-208

When new equipment for the rice cooking process in cereal making is installed, there is a need to determine if the process and its current operation can be used to update or replace other similar cooking systems. Material loss is a major issue and can be quite costly for companies. Through analysis of economics, material flow, and equipment performance, recommendations were made to reduce the yield loss of rice from cereal production. The new process is operationally and economically suitable for transferability to similar cooking systems and other production sites.

BOILER STEAM BLANKET DESIGN
by Chase Bouman and John McCauslin
Sponsor: James Goodwin, Post Foods, LLC
Faculty Advisor: Andrew Kline
10:30 a.m. to 10:55 a.m., D-208

Steam blankets are critical to maintain boiler quality and operating efficiency. They prevent rust and scale on the boiler drum and tubes, prevent thermal shock to an offline boiler, and make for easier boiler startups. Operation of an industrial boiler was analyzed and a steam blanket system designed. Use of a steam blanket reduces natural gas to fuel boilers and saves time when starting boilers to meet load demands. Technical and economic analyses were performed to recommend an optimal steam blanket design. The design is transferable to similar boilers at the current production site or other company site locations.
FERMENTATION TANK DESIGN
by Josh Cederna, Luke Harding, and Kelly Kucharcyzk
Sponsors: Irene Kokkinos and Alex Mantakounis, Tempo Vino Winery
Faculty Advisor: Andrew Kline
11:00 a.m. to 11:25 a.m., D-208

Freshly squeezed local grape juice requires increased consistency and quality control when compared to commercially stored grape juice. Local wineries were surveyed to determine a solution that would work under the design constraints of space, capital investment, and ease of use. The project scope included design and possible installation of fermentation tanks, a cooling system, an agitation system, and a testing lab. Stainless steel, oak alternatives, and Flex Tanks were evaluated for optimum qualities. The recommended design resulting from the design constraints and an economic analysis incorporates larger production capacity, user friendliness, and increased quality control.

THERMAL SOLAR ASSIST FOR WATER HEATING SYSTEMS
by Todd Christie and Andrew Schaefer
Sponsors: Cory Hoffman and Jon Singer, Armstrong Hot Water Incorporated
Faculty Advisor: Peter Parker
11:30 a.m. to 11:55 a.m., D-208

High efficiency water heaters operate with the peak efficiency when there is a large temperature differential between the water inlet and the set point. Standard industrial and commercial settings are to have hot water recirculation minimizing the lag of hot water reaching the fixture upon demand. Solar energy can be collected, stored, and used in the system in a manner that requires the burner to fire only when there is a fixture demand maintaining high efficiency. Solar water heating systems were developed using an economic analysis for different regions and user patterns so a specific system can be recommended for a particular need throughout the USA.

THE EFFECT OF CHIPPING METHOD ON THE PULPING REACTION
by Robert Rouse
Faculty Advisor: John Cameron
1:00 p.m. to 1:25 p.m., D-208

There is no mechanical chipping device available in the paper department and in its place for studying chipping and pulping a hand chipping method is used instead. This is being done without knowing the effects each method has on the pulping reaction. Chips from each type are going to be pulped and then use the digester and compare the resulting pulps from each one. Paper will also be made to compare the final end results from the two chipping methods. The analyzed results will provide background for using the hand chipping method in the department as a solid way to look at the pulping reaction.
YIELD LOSS REDUCTION
by Laura Beacham, Bo Hatfield, and William McCabe
Sponsor: Chris Knollman, Graphic Packaging
Faculty Advisor: Andrew Kline
1:30 p.m. to 1:55 p.m., D-208

In the papermaking process, some fiber is sent out through the water filtration plant and disposed of with other solids to form sludge. In order to reduce the amount of usable recycle fiber disposed of in the sludge waste, multiple options for fiber removal were compared. Filters, cleaners, and equipment efficiency improvements were considered as fiber recover options. Reducing fiber loss means lower annual landfill costs and raw material cost savings. Based on technical and economic analyses, recommendations were made on the best methods to reduce fiber loss as sludge in the papermaking process.

PAPER PLANT WASTE REDUCTION
by Lewis Osei, Andrew Smith, and Phillip Scramlin
Sponsors: Larry Hill and Henry Krell, USG Otsego Paper, Inc.
Faculty Advisor: Andrew Kline
2:00 p.m. to 2:25 p.m., D-208

Paper mills generate large amounts of waste, especially when using recycled waste paper as the raw material. This waste is expensive to move as well as dispose of. Mass and energy balances were used to analyze the consistency of the waste, as well as identify quantities being sent to a landfill. Dewatering agents were evaluated as a means of lowering the weight of the waste. Uses for the waste were also found and evaluated in a defender challenger economic analysis. Recommendations were provided for future methods of dealing with waste streams.

MANUFACTURING HEATING AND COOLING CAPACITY STUDY
by Andrew Brown, Tyler Dennison, and Bailey Wandyg
Sponsors: Darren Morozuki and Jeff Terpstra, Pfizer Global Manufacturing
Faculty Advisor: Andrew Kline
2:30 p.m. to 2:55 p.m., D-208

Pharmaceutical manufacturing contains many reaction processes that require a centralized heating and cooling system. Manufacturing capabilities have been increased over the years and current load specifications for the system are unknown. A thermal and hydraulic study of a manufacturing building was conducted to determine the current operating capacity. A dynamic model using Aspen Simulation Software was generated to allow for changing operation parameters and used to inform performance and/or expansion recommendations with respective cost estimates. The completed model provides tools that will aid the future manufacturing decisions.
SITE VENT COLLECTION SYSTEM CAPACITY STUDY
by Andrew Conrad, Heather Galbreath, Nathan Metcalf, and Michael Penninger
Sponsors: Jeff Terpstra, Pfizer Global Mfg., Steve Maynard and Andrew Baner, Pfizer Inc.
Faculty Advisor: Andrew Kline
3:00 p.m. to 3:25 p.m., D-208

Pharmaceutical production processes vent volatile organic compounds which are routed to thermal oxidizers for destruction. The current thermal oxidizers were originally installed to accommodate significantly different stream compositions than are currently being destructed and thermal oxidizer replacement requires an updated production site load analysis of its feed streams. A capacity study of streams entering the oxidizers was conducted and models for pharmaceutical production were established based on collected thermal oxidizer feed stream capacity and composition data. Results from the production models and an economic analysis were used to make design recommendations for the implementation of new oxidizers.

B149 BRINE SYSTEM STUDY
by Andrew Lanting, Matthew Maycroft, and Jully Senteu
Sponsors: Gordon Grove and Gregory DiGennaro, Pfizer Inc.
Faculty Advisor: Andrew Kline
3:30 p.m. to 3:55 p.m., D-208

Cooling chemical reactions with brine is a common practice in the pharmaceutical industry. Additional products and production runs cause added load on the brine system, which may not be adequate to meet cooling demand. A working model of the Brine System was developed to determine if the system cooling capacity was adequate when different production schedules were used. Results from the model and an economic analysis were used to test future production schedules which use Brine System cooling and to explore design opportunities for the Brine System.
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Information about the College of Engineering and Applied Sciences at Western Michigan University

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To educate our learning community for life-long excellence in responsible professional leadership. To increase knowledge through collaborative discovery, integration, application, and teaching. To serve as a resource and partner to our constituents. To prepare job-ready graduates for the global market.

CEAS Vision
A scholarly community dedicated to excellence through student-centered education and research emphasizing professional practices in engineering and applied sciences.

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- Engagement: Produce job ready graduates with the ability to grow in their profession and are life long learners
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CEAS Data (Fall 2009)
- Bachelor’s Enrollment: 2185
- Master’s Enrollment: 293
- Ph.D. Enrollment: 78
- Number of Faculty: 94
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