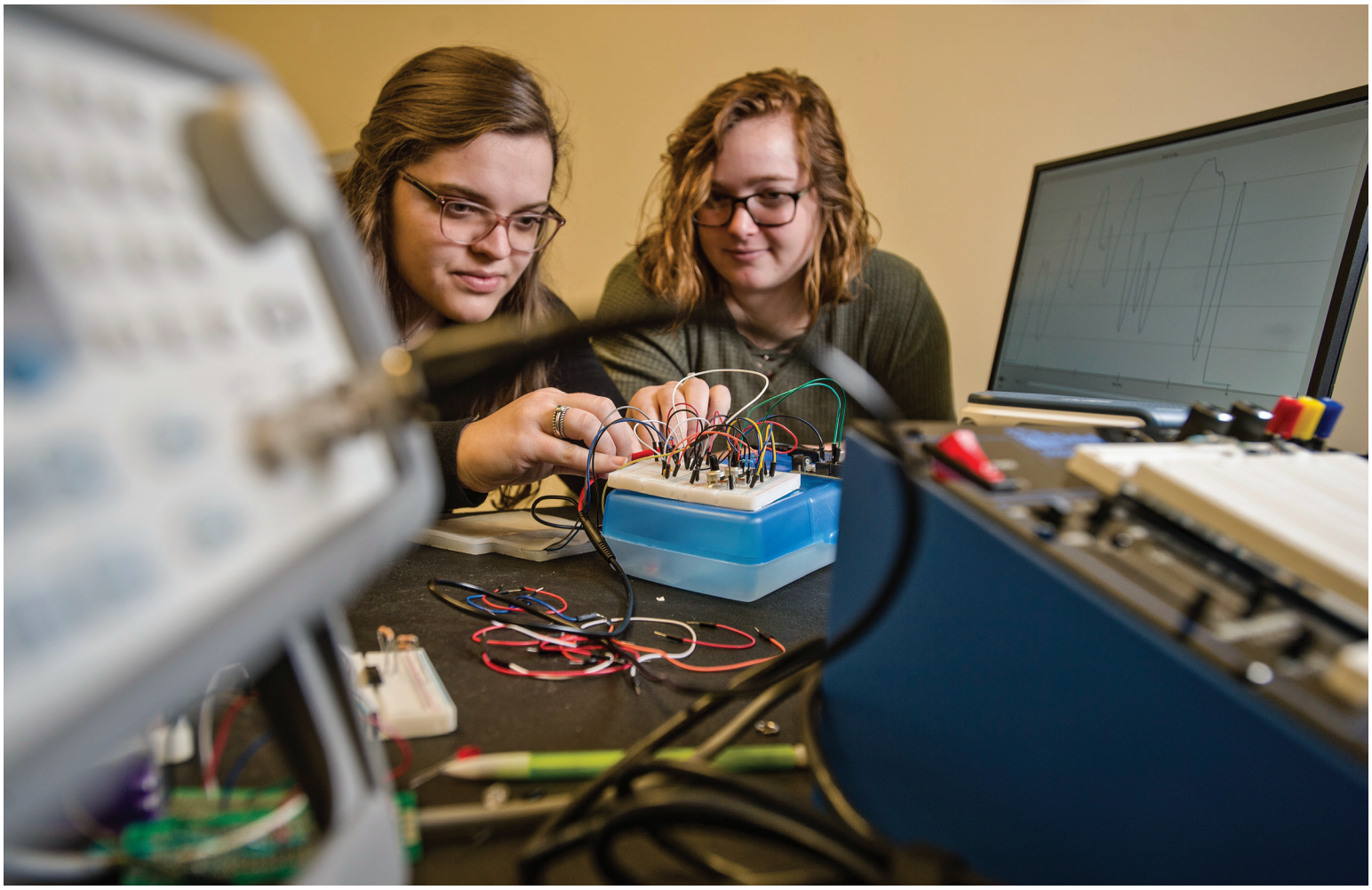
# TRINE UNIVERSITY

17TH ANNUAL

APRIL 26, 2019

# ENGINEERING DESIGN EXPO



BIOMEDICAL • CHEMICAL • CIVIL • COMPUTER
DESIGN ENGINEERING TECHNOLOGY • ELECTRICAL • MECHANICAL • SOFTWARE

# ALLEN SCHOOL OF ENGINEERING & TECHNOLOGY
# trine.edu/engineering

# ENGINEERING DESIGN EXPO 2019
## INDUSTRIAL PARTNERS - PROJECTS

**Biomedical Engineering**
- Blaire Biomedical
- Doctor of Physical Therapy Program
- Parkview Innovation Center

**Chemical Engineering**
- Satek Winery

**Civil Engineering**
- Citizens Energy Group
- Rise, Inc.
- Steuben County Highway Department
- Timothy L. Johnson Academy, Fort Wayne, IN

**Computer Science and Information Technology**
- Matt Viele – LCH Productions

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- Matt Viele – LCH Productions

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- Marathon Oil Company
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- Legends Running Shop
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# TABLE OF CONTENTS



# FROM THE DEAN

The Allen School of Engineering & Technology expresses its gratitude to the many individuals, companies and organizations who have contributed so much of their time, talent, materials and support to make the 2019 Engineering Design Expo an outstanding success.

Special gratitude goes to those individuals who served as industrial consultants. These busy people play an important part in the development of the projects by sharing their knowledge and experience. We also are grateful for the generosity of the many organizations that have sponsored or contributed materially and financially to the projects.

Although each student group has a faculty advisor, it is not uncommon for students to seek advice from other members of the Trine University family. Their interest and concern in helping students is also greatly appreciated.

We sincerely appreciate the area companies that are exhibiting their engineered products as part of today's activities. We are indebted to their support of Trine University academic programs throughout the year.

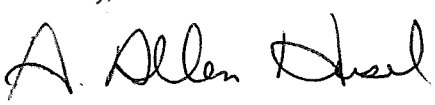
In addition to Deb Strong, who has been instrumental in assembling this booklet, I wish to personally thank the following members of the Trine administration, faculty and staff who have helped to make this year's expo a success:

Maria Gerschutz, Ph.D., Chair, Bock Department of Biomedical Engineering
Amanda Malefyt, Ph.D., Chair, McKetta Deptartment of Chemical & Bioprocess Engineering
Ryan Overton, Ph.D., Chair, Reiners Department of Civil & Environmental Engineering
Bill Barge, Ph.D., Chair, Department of Computer Science & Information Technology
Tom Trusty, Chair, Department of Design Engineering Technology
Sean Carroll, Ph.D., Chair, Department of Electrical & Computer Engineering
Darryl Webber, Ph.D., Chair, Wade Department of Mechanical & Aerospace Engineering
Jason Blume, Executive Director, Innovation One
Engineering staff: Karen Morthorst, Sue Radtke, Sheri Thomson, Jeff Raymond and Joe Thompson

And most importantly, the professors in charge of all of the design classes, whose work is on display today.

Finally, special thanks to all of the people in the offices of admission, university marketing and communications, and campus operations, as well as Bon Appetit Management Company, who helped to make this day a success.

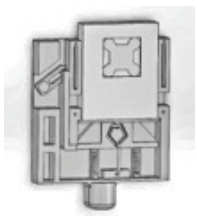
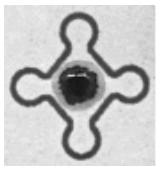
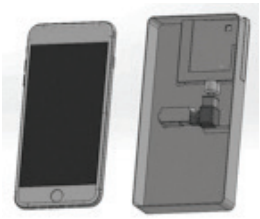
Sincerely,



Allen Hersel, Ph.D.
Dean, Allen School of Engineering & Technology

# JIM AND JOAN BOCK DEPARTMENT OF BIOMEDICAL ENGINEERING

## SmartMed Case Project

**Members:** **Jessa Crites (Team Leader, Biomedical Engineer)**
**Ryan Craig (Mechanical Engineer)**
**Jensyn Garrow (Biomedical Engineer)**
**Sarah Stewart (Biomedical Engineer)**
**Advisor:** **Melanie G. Watson, Ph.D.**
**Sponsor:** **Blaire Biomedical**

The goal of this project is to develop a point-of-care (POC) device for patients to easily perform at-home blood testing. Specifically, this project aims to extract plasma from one drop of whole blood for colorimetric quantification of blood potassium levels. Two other goals within the scope of this project include: optimizing an optical system for blood cell quantification and incorporating a micro stage with micro-motion controls for improved count accuracy.

Patients with chronic diseases run the risk of contracting hospital-acquired illnesses due to long-term, repetitive visits to a hospital laboratory for treatment and disease monitoring. The SmartMed Case has the potential to change current laboratory processes of blood testing by providing patients with a hand-held device capable of performing common laboratory blood tests. With the completion of the SmartMed Case, patients will be able to check their blood cell counts (white blood cells, red blood cells, and platelets) as well as other disease indicators, such as potassium or glucose, from the convenience of their own home. In addition, it will provide a POC system for physicians to easily transport to developing countries to help identify and control the spreading of diseases.

This year, our team has successfully demonstrated that a hypertonic NaCl solution used in conjunction with a paper-based microfluidic system can separate blood plasma from a single drop of whole blood. This system will be used along with a colorimetric detection algorithm to quantify potassium levels. Additionally, our team has incorporated a micro stage within the SmartMed Case to optimize sample imaging. Moreover, our team refined the previous test cartridge push-push mechanism and consolidated the optical analysis system into a single case design. Lastly, the optical system was improved by incorporating various glass lenses magnification levels of 100x and 350x, respectively.

## Low-Cost Manual Therapy Training Device

**Members:** **Allison McCrady (Project Leader)**
**Alexandra Kartje (Biomedical Engineer)**
**Erika Kasen (Biomedical Engineer)**
**Taylor Breidenbach (Mechanical Engineer)**
**Advisors:** **Melanie G. Watson, Ph.D. and Maria Gerschutz, Ph.D.**
**Sponsors:** **Trine University Bock Department of Biomedical Engineering and Doctor of Physical Therapy Program**

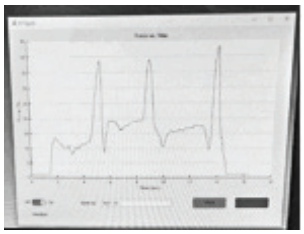
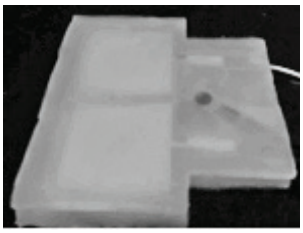



Figure 1(left): An outputted force versus time graph of applied forces to the sensing mat.
Figure 2 (right): Silicone mat encapsulating two force-sensing piezoelectric resistors with a vibration motor.

There is a major learning gap in physical therapist training programs involving spinal manipulation training techniques. The purpose of this project is to develop a low-cost device that would bridge this learning gap by improving the quality and consistency of physical therapy treatment patients receive from both novice and expert clinicians. In numerous research studies, augmented feedback implementation has shown improved student learning experiences by adding visual, auditory, and sensory feedback. Our team designed and developed a force-sensing mat controlled by an Arduino microcontroller and a MATLAB-generated interface based on customer needs and design specifications.

Our device incorporates two Tekscan Flexiforce sensors contained within a silicone-enclosing mat and wired to an Arduino microcontroller. A custom MATLAB script was developed to record and display sensed forces and assist in developing our user interface. A two-part Smooth-On EcoFlex silicone was poured into 3-D printed molds for the sensor enclosing mats. A vibration motor was added within the mat platform to provide haptic feedback along with the visual feedback from the live plot of force versus time. A MATLAB-based app was developed so users could easily interact with the mat platform device. The device was demonstrated to the Department of Physical Therapy (DPT) where user feedback was collected and assessed. After the project is completed, the mat platform will be given to the DPT program for future use in the classroom.

# Bioprinter Project

**Members:** **Rebecca Flora (Team Leader, Biomedical Engineer)**
**Joshua Carmichael (Mechanical Engineer)**
**Montana Hermann (Biomedical Engineer)**
**Advisors:** **Melanie G. Watson, Ph.D. and John Patton, Ph.D.**
**Sponsor:** **Trine University's Bock Department of Biomedical Engineering**

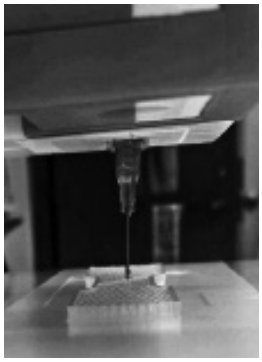


Figure 1 and 2: A dog bone shaped scaffold printed with 6 wt% Laponite nanoclay using the Se3d R3bel bioprinter.

The purpose of this project is to 3-D bioprint a cartilaginous tissue scaffold using collagen type II, hyaluronic acid, laponite nanoclay and other reagents. The printed scaffold is intended to be infused with chondrocyte cells. Different scaffold porosities and bioink materials were tested chemically and mechanically to determine the ideal scaffold design for cell and extracellular matrix (ECM) growth. All research was documented for continuity of information to future BME students utilizing the Se3d R3bel bioprinter.

Since the idea of bioprinting was first explored in 1986, 3-D bioprinting has made many advances, especially within the past decade. Bioprinting is widely used in fabricating living tissues for tissue engineering research and regenerative medicine. It has applications within organ transplantation, pharmaceuticals, specific molecule delivery, stem cells, and cancer research. There has been an increased demand for bioprinters as of late, due to rising interest within the medical community. Trine University obtained a Se3d bioprinter used by senior design students for research and medical therapy development purposes. Our group has successfully set up the bioprinter, installed software for its use, installed the dual print head, redesigned the dual print head, formulated an original scaffold bioink, printed porous scaffolds with desirable mechanical properties using original CAD designs, and recorded results for the benefit of future classes.

# Parkview Needleless Connector Advancement Project

**Members:** **Ashtyn Capen (Project Leader)**
**Nathan Kell (Project Recorder)**
**Michael Forthofer (Project Engineer)**
**Ashli Sanders (Project Engineer)**
**Advisor:** **Dr. Melanie G. Watson**
**Sponsor:** **Parkview Innovation Center**

Figure 1: Examples of needless connectors

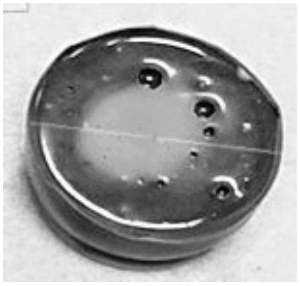


Figure 2: Thermochromic color change in silicone

Healthcare associated infections, specifically Intravenous Catheter Infections (IVCIs), are a reality for many hospitalized patients. When a patient contracts a Catheter Related Bloodstream Infection (CRBSI) during the hospital stay, it is the hospital's responsibility to resolve the infection, and pay for costs incurred due to the infection. Each infection can cost roughly $34,500-$56,000 per patient, totaling to billions of dollars each year. Not only are these infections costly for the hospital, but also result in increased morbidity and mortality rates from infections such as MRSA and Sepsis. Reducing the amount of IVCIs is not only in the best interest for patients' overall health, but also cost reduction for hospitals.

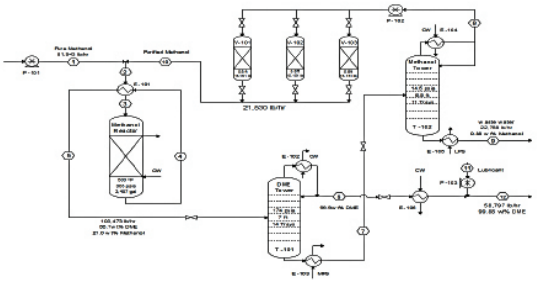
The purpose of the Parkview Needleless Connector Advancement Project was to decrease the overall amount of Intravenous Catheter Infections seen in hospital patients. The main goal of the Parkview team was increasing disinfection compliance while keeping the overall integrity of the original needleless connector design. This was accomplished by integrating a thermochromic dye (TD) into the outer material of the needleless connector (NC) and the internal silicone septum to provide healthcare professionals with a visual representation when NC has been properly disinfected. This is indicated by a color change, after 15 seconds of applied scrubbing. The Parkview team also integrated a nanoparticle coating onto the outer shell of the needleless connector and septum. The nanoparticle coating displays antimicrobial properties that kill common bacteria found in healthcare settings. Both the nanoparticle coating and thermochromic dye accomplish the overall purpose of the project by increasing disinfection protocol compliance and killing common bacteria that cause IVCIs.

# MCKETTA DEPARTMENT OF CHEMICAL & BIOPROCESS ENGINEERING

Each year the Chemical Engineering class participates in the AIChE National Student Design Contest. Unfortunately, contest rules prohibit publicly presenting the results until after June 1. In addition to this contest however, the seniors complete a minor design project. The AIChE Contest problem for the previous year is given below in addition to the Chemical Engineering Minor Design Projects.

## Chemical Engineering Major Design Project from 2018:

**Members:** **McKetta Department of Chemical & Bio-Process Engineering**
**AIChE 2018 National Student Contest – honorable mention – team category**
**Safety and Health Division Winner**
**Advisor:** **John Wagner, Ph.D.**



As part of the senior design course, students in the McKetta Department of Chemical & Bioprocess Engineering compete in the AIChE National Student Design Contest. Last year, the contest problems involved the design of a facility to produce Dimethyl Ether or DME for the Transportation Market.

The team of Anndi Wood, Daniel Barzycki, Megan Manes and Riley Johns won honorable mention from Trine University won both honorable mention in the national contest and a safety award.

The objectives of the contest were to produce 250,000 gallons per day of DME capable of operating with a 50% turndown while still meeting all of the ASTM standards for DME as a fuel. The process flow diagram for the plant that the team designed is shown below. The plant was estimated to cost nearly 13 million dollars and have a favorable rate of return.

## Satek Winery Crush Project

**Members:** **Colten Wimmer, Cameron Orr, and Madison Fain**
**Advisor:** **John Wagner, Ph.D.**
**Sponsor:** **Satek Winery**

The current method of unloading grapes during the crush (harvest) season at Satek Winery involves workers manually lifting the lugs (baskets) from the trailer and setting them on the loading dock by hand. They are then lifted from the loading dock and dumped into the de-stemmer. It is common for 5 tons of grapes to come in daily, and they must all be unloaded by a few workers. The current method of unloading is very strenuous and not ergonomic. This design project focused on relieving the strain from the workers by placing it on a mechanical transport system. Multiple designs were created by the team. These designs were evaluated for feasibility by managers at SATEK.

## Resource Guide for the FE Exam

**Members:** **Yahya Alsaeed, Connor Hoffman, Sarah Stroud, and Brandon Villanueva**
**Advisor:** **John Wagner, Ph.D.**

NCEES
advancing licensure for engineers and surveyors

This project created a Resource Guide for students taking the Fundamentals of Engineering Exam. This includes how to register, execution of exam day (calculator allowed, breaks, and other rules), and a compilation of study materials. The entire Resource Guide is a navigable as a resource with study materials separated into sections by topic with a review of each topic.
While originally created for the Chemical Engineering FE, this guide is a template that can be expanded to include sections of topics specific to other engineering disciplines.

# Modular Shell and Tube Heat Exchanger

**Members:** Vance Burnau and Blake Trusty
**Advisor:** John Wagner, Ph.D.

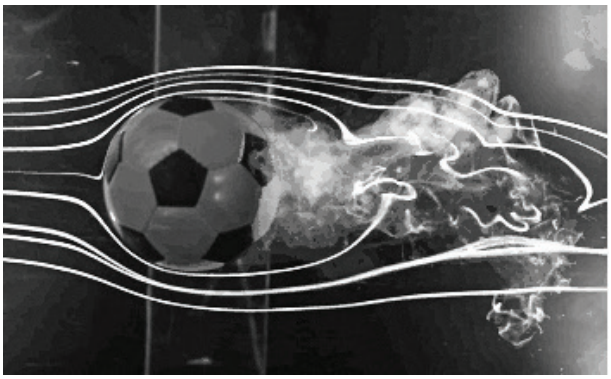
The goal of this project is to build a 3D printed tubular heat exchanger and use it as part of a demonstration or teaching unit. Large portions of the exchanger were made from modular 3D printed material and so can be easily replaced and reconfigured. The exchanger was built and connected to a hot / cold water source and existing measurement instrumentation. Data was compiled and the overall exchanger duty as well as overall and individual heat transfer coefficients were computed.

# Flash Pasteurization

**Members:** Ayasha Faria, Braden Thompson, and Roger Chase
**Advisor:** John Wagner, Ph.D.

A flash pasteurizer was designed and built from the ground up using readily available components. Pasteurization is the method of heat-treating liquid food products to reduce the number of microorganisms and provide a longer shelf life. Flash pasteurization achieves this by rapidly heating the product to 160-165°F for 15-30 seconds. This high temperature but short time treatment preserves flavor while still killing potentially harmful microorganisms. The flash pasteurization unit for this project contains two plate and frame heat exchangers for the product treatment. One exchanger is a recuperator that preheats the feed with the freshly pasteurized product. The second exchanger is steam heated and brings the product to the pasteurization temperature. A third exchanger is mounted to cool the steam condensate for safety purposes. After pasteurization the product is cooled in a large water bath. The temperature of the product in the steam heater is controlled by a control valve on the product outlet. To assess the effectiveness of this unit a bacteria solution was pasteurized to ensure the reduction of microbial concentration to acceptable levels.

# Visual Learning



**Members:** Shannon Padgett and Josh Bowman
**Advisor:** John Wagner, Ph.D.

Visual learning is a very effective teaching method to illustrate concepts. This method of learning can be applied to almost any curriculum from simple mathematics in primary school to the most complex thermodynamic phenomena seen in college courses. A subject encountered by almost all fields of engineering is Fluid Dynamics which mathematically represents the movement of fluids through different systems. By understanding this fluid movement, engineers can estimate proper operating conditions by anticipating how the fluid is going to wear on the system in various conditions. To allow for the application of visual learning to Fluid Dynamics, a dye injection fluid model has been constructed to illustrate how liquid flows through different types of systems and components. This model consists of a stationary pumping line with a dye injection port and a series of interchangeable modules. These modules can represent a variety of components expected to be encountered in processing systems such as bends, flow meters, valves, and more. The model is constructed from rubber tubing, PVC piping, and plywood with installed pump and valves, as well as fill and drain valves near the top and bottom respectively. The dye injection port is located near the inlet of the module system to allow for good representation of fluid flow. Two outlets are available for the modules, allowing for both horizontal and vertical flow modules. To maximize classroom usability, the model will be 2ft x 2ft for easy transport and be oriented vertically to maximize visibility to the classroom audience. The model can also be used for outreach programs, which Trine departments frequently participate in, to help teach younger students fluid dynamics principles in a fun and interactive way. The convenient design allows room for future improvements with the addition of more modules. This device is useful to supplement classroom learning and allow for a visual representation of complex physical phenomena and permits a more engaging experience than is currently available.

# QR Problems

**Member:** Kevin O'Malley, Travis Lores and Sebastian Ponicki
**Advisor:** John Wagner, Ph.D.

This project was conducted to contribute problems to an online repository that help students better understand key concepts in Chemical Engineering. The QR problem system allows for step by step problems where students can obtain immediate feedback each step of the way. Reflections sections were also built into the students experience so that students could reflect on their learning progress, connect it to the real world and explore different aspects of the problem. The system also allows for video clips and conceptual questions to further engage the student. Problems were created in the areas of material balances, fluid dynamics, heat transfer and mass transfer. These problems were distributed to senior students and these problems were rated by these students for effectiveness and difficulty.

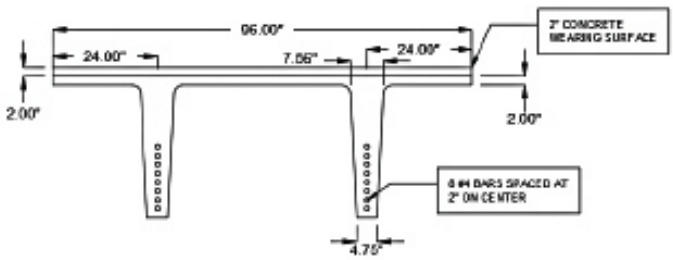
# Chemical Safety and Hazard Investigation

**Members:** Elijah Brandt, Ryan Kosek, and Joe Penrod
**Advisor:** John Wagner, Ph.D.

The Chemical Safety and Hazard Investigation Board (CSB) investigates many safety incidents and publishes videos that disseminate the underlying conditions that led to the incident. These investigations in turn were utilized by our team to develop several learning modules for use in collegiate chemical engineering courses. Several chemical engineering practice problems and learning modules related to olefins production were developed based on a CSB investigation and case study of an incident in 2013 at an olefins plant in Geismar, Louisiana.

# REINERS DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

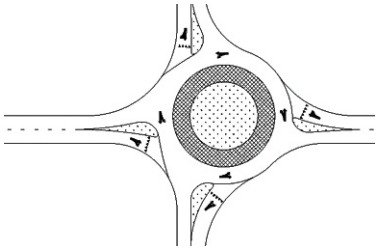
# Bridge 51 Replacement on Old State Road 1, Steuben County, Indiana




**Members:** Zach Shahan (Project Manager)
Nick Zak (Environmental Engineer)
Cameron Horan (Structural Engineer)
Trey Waagen (Hydraulic Engineer)
**Advisor:** Tim Tyler, Ph.D., PE
**Sponsor:** Steuben County Highway Department

Bridge 51 is located on Old State Rd 1, about 1.1 miles north of US 20 in Steuben County, Indiana. The single span concrete bridge spans a small legal drain. The bridge was evaluated by the Steuben County highway department and found to be in poor condition. Therefore, the county requested that a preliminary structure replacement design be performed. Astro Engineering designed three alternatives for the project: a new pipe culvert, a new box culvert, and a new bridge structure. The Indiana Design Manual along with any other appropriate codes and guidelines were used for this project. We determined that a 5' diameter pipe culvert with a square-edge headwall would be sufficient to prevent overtopping during a 500-year storm. Multiple sizes of box culverts were also considered which could carry the design storm flow. We recommend a 5 ft. x 12 ft. box culvert as an option for this project. The third option was to design a new single span bridge to replace the old bridge. A new concrete bridge consisting of pre-stressed double tee concrete beams with dimensions of 8 ft. x 32 ft. was designed for the project. The bridge will be supported by 14 inch diameter pipe piles. These three alternatives were presented to the Steuben County highway department, and the final design option was selected based on construction cost and the length of life of the structure.

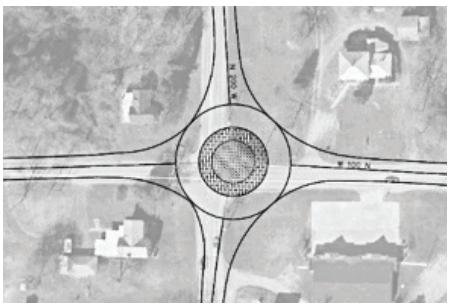
# County Road 100 N Improvements – Group 1



**Members:** Jeff McFerron (Project Manager)
Russel Reynolds (Hydraulic/Geotechnical Engineer)
Joe Burcroff (AutoCAD Technician/Design Engineer)
**Advisor:** Tim Tyler, Ph.D., PE
**Sponsor:** Steuben County Highway Department

County Road 100 North in Steuben County, Indiana is a local road that is a key corridor that connects the community to the surrounding lake area. Abrupt changes to the vertical alignment approaching the intersection at CR 200 W, narrow lanes, minimal to no shoulders, and limited roadside drainage creates potentially dangerous roadway conditions for the roadway's users. The purpose of this project was to evaluate and re-design the current intersection and to suggest improvements to the 1 mile long section of CR 100 North. Field working consisting of traffic counting, surveying and soil borings were performed. Following a review of the existing conditions and data, two options were considered for the intersection: a traditional 4-way stop with a by-pass lane and a roundabout. We concluded that a new roundabout will better meet the needs of the users. The Indiana Design Manual was used to design the roundabout. We also concluded that the existing CR 100 should not be widened due to limited right-of-way. Rather, the surface will be treated and a 1.5 inch asphalt overlay will be placed.

# County Road 100 N Improvements – Group 2



**Members:** David Gaff (Project Manager)
Rebecca Goll (Environmental Engineer)
Morgan Sapara (Transportation Engineer)
Noah Spicer (Hydraulics Engineer)
**Advisor:** Tim Tyler, Ph.D., PE
**Sponsor:** Steuben County Highway Department

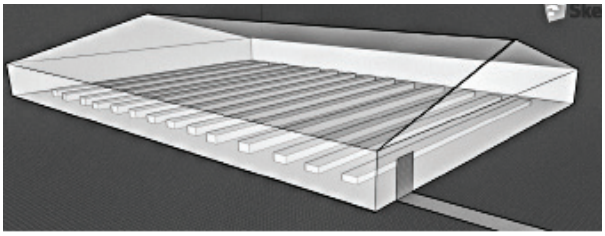
The purpose of this project was to analyze the existing intersection and roadway conditions for a 1 mile long section of County Road 100 N in Steuben County, Indiana. This road consists of two, 12-foot lanes with no shoulder. The intersection is a four way stop and queues 15 to 20 cars at peak hours of traffic. The current layout of the intersection does not provide adequate turning space for semi traffic. We were requested by the highway department to perform an evaluation of the existing conditions and make recommendations for road improvements and a new intersection at County Road 200 W. To begin the project, two of our group members, along with members of INDOT and the County's engineering department performed a safety audit. We then performed a traffic survey to evaluate turning movements at the intersection. We also performed a topographic survey and drilled soil borings. With this information, we determined the most beneficial intersection type would be a new roundabout to increase the traffic flow volume and decrease intersection collisions. The roundabout has a 13-foot truck apron to accommodate semi traffic, and the center of the roundabout is a low impact development spot with a rain garden. Improvements to CR 100 N includes resurfacing and restriping the current roadway from 12-foot lanes to 10-foot lanes with 2-foot shoulders. There is no need for widening the road, and the roadway will have a finishing overlay of Surface Type C, 1.5" hot mix asphalt. For drainage considerations, a culvert analysis of the legal drain that underlies CR 100 N was performed. The existing pipe will remain in place, but a CIPP liner will be put through to extend the existing culvert's design life. Curb and gutter will also be constructed at the intersection for drainage, and vegetative swales will be constructed to alleviate drainage issues.

# Geist Quarry Pump System Project

**Members:** Aaron Burns (Project Manager)
Ben Bellestri (Water Resources Engineer)
Taylor Eash (Water Resources Engineer)
**Advisor:** Tim Tyler, Ph.D., PE
**Sponsor:** Citizens Energy Group

The purpose of this project is to increase the raw water storage capacity of Geist Reservoir in Fishers, Indiana. To handle the growing population in the area and increased water usage in the summer months, a quarry adjacent to the reservoir which is at the end of its useful life will be flooded over time with water from the reservoir to store additional water. When full, the quarry will hold almost 3 billion gallons, which is half of the capacity of the current reservoir. The main task of this project was to design a system that will fill and empty the quarry efficiently and effectively. To accomplish this, we designed a concrete inlet structure with 3 PVC pipes to fill the reservoir by gavity, and a 4 pump system with a flow rate of 20 million gallons per day. Erosion control structures and environmental concerns were also addressed.

# Rise Inc. Greenhouse Design Project

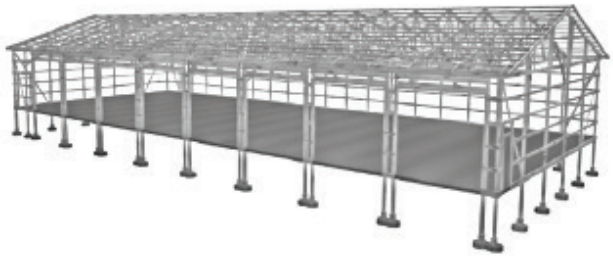


**Members:** Korrenn Broaddus (Project Manager)
Nick Gerber (Water Engineer)
Brian Roskowski (Environmental Engineer)
Erik Konermann (Foundations Engineer)
**Advisor:** Tim Tyler, Ph.D., PE
**Sponsor:** Rise, Inc.

The purpose of this project was to design a greenhouse for Rise Inc. that can be used as training in their adult classes and can also supply a small food counter service that they currently operate. Rise, Inc. is focused on improving the lives of adults with physical and mental disabilities. The greenhouse would help them teach classes on independent living as well as aid in running the food counter. To begin the project, we performed a topographic survey of the Rise, Inc. property, and we also drilled several soil borings. Using this information, we determined the best location of the new greenhouse on the site and determined runoff control methods that best suited the property.

Three different greenhouse structures were designed, all of which considered ADA standards and included additional considerations for the specific concerns presented by Rise, Inc. Three designs were developed in order to obtain, high, medium and low cost options for the purpose of securing a grant for the project. The greenhouses were all designed to have a floor space of 19,920 ft2. The floorplan consists of a smaller room set apart to specifically grow peppers in and store tools, and a larger room to grow the rest of the plants. The greenhouse will be built of plastic siding and a concrete floor with drains and special treatment to minimize slipping. The structure will be supported on shallow footings.

# Timothy L. Johnson Academy Master Site Plan Design



**Members:** Sarah Tiedemann (Project Manager)
Logan Amburgey (Environmental Engineer)
Matthew Brown (Project/CAD Engineer)
Daniel Head (Water Resource Engineer)
Catherine Webb (Environmental Engineer)
**Advisor:** Tim Tyler, Ph.D., PE
**Sponsor:** Timothy L. Johnson Academy, Fort Wayne, Indiana

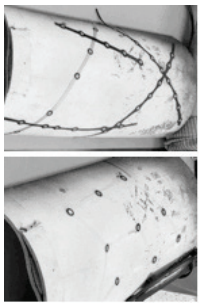
The Timothy L. Johnson Academy (TLJA) is an elementary and middle charter school in Fort Wayne, Indiana that wants to enhance their existing facilities. The academy requested us to assist in the design of these improvements, which includes a modified courtyard that will be used as an outdoor learning space, a new bus garage, a new pavilion for scholars and community members, improved playground areas, a new baseball, track and soccer field, and an additional enclosed educational area. A new high school building is also being considered in the future.

To begin the project, we performed a topographical survey of the TLJA facilities and grounds and also drilled soil borings around the property to obtain soil samples for lab testing and analyses. With this information, we developed a new layout to the existing courtyard by adding new planter boxes, a stage and movable benches, and a landscaped area. A timber-framed bus garage was designed to house 8 busses on the property in a 120 ft. x 50 ft. structure located close to the existing student drop-off area. A new 60 ft. x 30 ft. open walled timber pavilion was also designed, and will be located near the existing playground area in order to have classes outside and be available for use by the community. New baseball, track and soccer fields were sited on the property as well as an enclosed educational area.

# DEPARTMENT OF DESIGN ENGINEERING TECHNOLOGY

## Marathon's 3D Scan Overlay Project

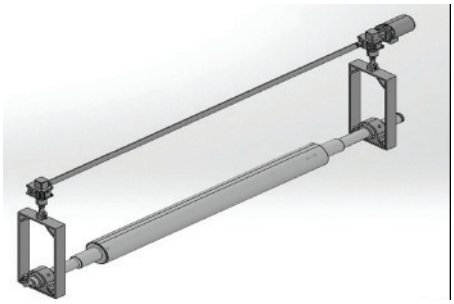
**Members:** **Benjamin Davage, Stephen Gierek, Breven Scroggins, and Hope Steyer**
**Advisor:** **Timothy Jenkins, Ph.D.**
**Sponsor:** **Marathon Oil Company**



Marathon Pipe Line, LLC currently owns and operates 13,300 miles of pipeline that moves and refines petroleum and natural gas products across the United States. One system requirement is to routinely inspect the pipelines for any defects using a 3D scanner once the defects have been found using inline robots. The current method that onsite surveyors use is to put small reflective dot targets spread across the pipe to complete a scan. The small target technique is time consuming and not reusable, while the new overlay concept that is was developed previously creates issues with the overlay material being picked up by the scanner, creating an inaccurate scan of the damaged section. The design team was tasked with redesigning the overlay system to commercialize the process and further aid the field surveying team with the 3D scanning of corrosion and defects found on oil pipes. A solution is desired that will save time, money, and allow for reuse of the overlay for the scanning process. The 3D overlay must meet rigorous scanner requirements while integrating reusability, repeatability, and ease of application. From interviews, concept production, testing and refinement the team has created an overlay that will adhere to all sizes of pipes. The team expects that this product will not only help Marathon with accurate scanning of the oil pipes but will also allow other oil companies to use the product to help ensure integrity of the pipelines across the United States and around the world.

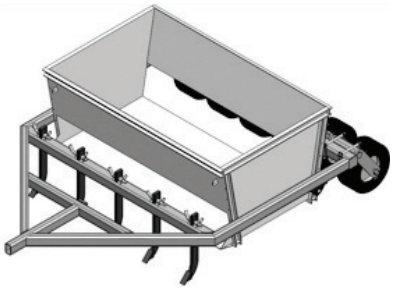
## Cooling Zone Lift Roller Project

**Members:** **Hollitte Greene, David Richards, John Rohr, and Kyle Sacco**
**Advisor:** **Les Grundman, Ph.D.**
**Sponsor:** **North American Stainless**



North American Stainless (NAS), located in Ghent, KY, is the nation's largest, fully integrated stainless-steel mill. NAS can produce many products that are made from stainless-steel, such as bar stock, angle stock, rebar, wire rod, or sheets. NAS runs operations 24 hours a day, 365 days a year with minimal down-time. On average, NAS loses $20,000 for every hour that the line is not producing product. The purpose of the Cooling Zone Lift Rolls project was to analyze a bearing failure within a North American Stainless-steel mill and provide a cost-effective solution to lower the time spent not producing products. The solution that was presented to NAS aimed at minimizing the corrosion of the bearings due to the high heat and water used in the cooling process of making steel sheets. By expanding the length of the rollers and shaft, the students were able to isolate the bearings from the chamber. However, because the length of the rollers was the only attribute to change, the students performed various stress calculations in addition to performing finite element analysis studies to ensure the system would not fail under load. The resulting redesigned bearing system is expected to last the entire lifetime of the rollers, as well as fit within the designated cooling zone.

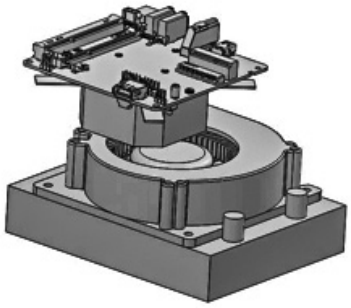
# Trail Maintenance Machine Project



**Members:** Bo Drerup, Cole Lorntz, Jimmy Starks, and Sam Trammell
**Advisors:** Timothy Jenkins, Ph.D.
**Sponsor:** Pokagon State Park

Pokagon State Park offers many trails for enthusiasts and novice hikers. Over time from use and also due to inclement weather, these trails can be damaged and need repair. In order to maintain these trails, the park relies on many hours of mostly volunteers using hand tools to replace gravel that has been washed off the trails after rain storms. This method is labor intensive and produces inconsistent results. The objective of this project is to build a device that has the capability to pick up and redistribute gravel or other trail material that has been washed off trails. Along with picking up and redistributing gravel the device will be required to dress the gravel trail surface. The intention of this machine is to reduce the number of workers and labor necessary to maintain trails. There are many devices currently in production for both the commercial and residential market that contain certain aspects of this device but not in a single machine. What makes this machine unique is the size and scope of its application. The device was designed to be pulled behind a small tractor, via the 3-point hitch system and onboard hydraulics. The unit is unique in its ability to pick up, redistribute, and dress material on the trail. The device consists of a central tub that can be lowered to pick up material and raised to dump material. Spikes were mounted fore of the tub to break up material before it is picked up and wheels with torsion units provide down force aft of the tub to dress the material after it is dumped. This machine should reduce labor hours and provide improved surfaces for users of the park trails.

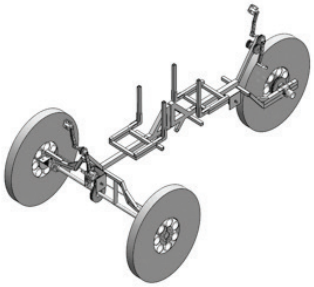
# Direct Digital Manufacturing Design Project



**Members:** Dakota Hucke, Nick Maykut, and Mitchell Westra
**Advisor:** Les Grundman, Ph.D.
**Sponsor:** Design Engineering Technology Department

The Digital Manufacturing team is a part of the SME design challenge competition. The challenge emphasizes the thermal management or temperature control of systems, process or devise that generate, convert, transfer or store energy. There are many different concerns that must be addressed when designing all the components in a computer system. One of the largest concerns that a design team must address is the cooling and thermal management inside of the case. In order to help manage the cooling efficiency of the system, the team has decided that a liquid cooling method for an Intel NUC would prove a simplistic, compact, yet efficient design that will increase the cooling capabilities over a standard case. The Intel NUC is a powerful mini PC that is capable of gaming, entertainment and a great amount of memory storage. The small device having such capabilities needs a cooling system and case redesign to have the NUC perform at maximum potential. The liquid cooling system the team has chosen is a Corsair H60. This system utilizes a 120mmx120mm radiator that will use a 120mm blower fan to pull air through the radiator cooling the liquid inside which in turn cools the heat sink/ pump combination that will be mounted to a CPU on the NUC.

# NASA Rover Challenge Project

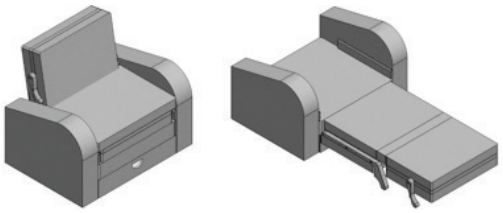


**Members:** Mohammed Alshaya, JJ Fierro, Dalen Fillenwarth, Kent Hollingsworth and Rachel Zink
**Advisor:** Timothy Jenkins, Ph.D.
**Sponsor:** Design Engineering Technology Department

The NASA Rover team competed in the NASA Human Exploration Rover Challenge in April 2019 (25th anniversary year). This design competition allows students to design a two-person vehicle capable of handling other-worldly terrains and powered by the riders. The course has 14 obstacles to traverse in 7 minutes or less due to the "oxygen levels" that NASA has set. There are hills, craters, sand, gravel, rocks, and cracks which the team must determine the best way to navigate in the shortest time possible. The rover must be at least 50% different or modified from a previous year's design to ensure teams are trying to think differently and come up with new ideas. NASA hosts this competition every year to engage students in the next phase of human space exploration. Many students design, build and test technologies that inspire the participants to become the next generation of engineers to design NASA's space program. There were three main designs the team considered and selected by using a design matrix. Options included: a three-wheel frame design, a four-wheel frame design, Ackerman steering, cardboard wheels with integrated suspension, traditional spoked wheels, aluminum stadium seating, carbon-fiber seating, timing belt drive and chain drive. The team decided on designing a three-wheeled rover with the suspension built into the wheels, used Ackerman steering lever arms and used a timing belt system for the drivetrain. The design is lightest and most innovative design Trine has developed thus far and was showcased in Huntsville, Alabama in April 2019.

# Recreational Vehicle Convertible Sofa Sleeper Project

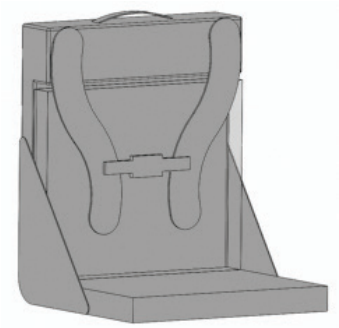
**Members:** Jacob Dewire, Katelyn Heckman, Zoe Koch, and Brady Stone
**Advisor:** Les Grundman, Ph.D.
**Sponsor:** Mastercraft Inc.



Mastercraft Inc., founded in Shipshewana, Indiana in 1971, is the world's largest maker of recreational vehicle furniture. Mastercraft has long produced innovative and high-quality products and is dedicated to providing improved products for their customers. Current convertible sofa sleeper designs are unique and innovative, but the company desired to make their product even safer and more innovative. This team was tasked with redesigning the current sofa sleeper concepts to improve ease of use. A design solution was desired that would protect users from harm when converting the sofa to a sleeper within the recreational vehicle. The newly conceptualized design allows the sofa sleeper to be lighter, have a smoother transition, and be aesthetically appealing. The sofa sleeper was designed to meet all criteria and specifications set forth by the sponsor, while incorporating new features. Through interviews, concept generation, testing and implementation, the design team created a sofa sleeper that would fully satisfy the needs of customers. The new design was created within the established budget. The final design has smooth motion and more importantly, safe operation when converting from a sofa to a sleeper and back. The new product design also incorporates new configurations and features that will differentiate this product from the competition. The team expects that this product will be implemented into recreational vehicles as well as other possible markets.

# Ultra-Portable Ground Seat Redesign Project

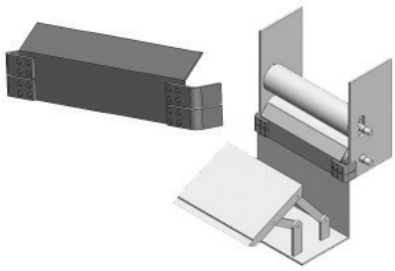
**Members:** Jackson Birkenbeul, Austin Clutinger, and Zach Nicholas
**Advisors:** Timothy Jenkins, Ph.D.
**Sponsor:** Salah Mubarak



The inspiration for this project stems from the sponsor's observations of Arabic culture. He observed in mosques that some people need to use chairs while praying and that these chairs can be noisy, large, and many times in the way of others. The sponsor envisioned a new portable chair product that can be used in this situation as well as in other activities like camping, sporting events or arena shows. Although the product stems from situations observed in Arabic culture, this product is intended for many uses; anywhere a person would want to sit on the ground and be comfortable. To accomplish this, the sponsor made mock-ups of potential designs of his idea and approached Trine University's Innovation One looking for help. Once the design team was matched with the sponsor, the development of a working solution began. Taking the original designs and ideas that were shared, the team created several new designs and features to better fit the customer needs and specifications such as a leg strap design for the feet and shoulder carry capability. Additional features include side straps, pouches, and a more ergonomic back shape. The final design shown here is beneficial because it does not limit what the customer can do with the ground chair and provides versatility to better meet individual needs as opposed to forcing the customer toward many single solutions.

# Pinch Roller Guard for a Stainless-Steel Mill Project

**Members:** Christian Barrow, Tristan Justice, Elias Kapsalis, and Ben Winsemius
**Advisor:** Les Grundman, Ph.D.
**Sponsor:** North American Stainless



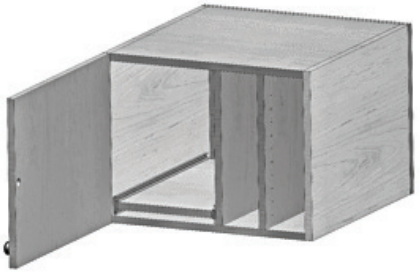
North American Stainless (NAS), founded in 1990, has undergone several phases of expansion to become the largest, fully integrated stainless-steel producer in the U.S. NAS currently wishes to improve the process of loading steel coils into one of the mills at their Ghent, Kentucky location. Due to impact issues during coil loading, the bottom pinch roller experiences excessive wear and the roller needs to be replaced more often than desired. The process of replacing the damaged roller is time-consuming and NAS loses about $20,000 per hour when the mill is down. The purpose of this project is to redesign how the coil is loaded into the pinch rollers so that both wear on the bottom roller and coil loading time are reduced. The senior design team has developed a solution for NAS that uses a moving roller guard that protects the bottom roller when a steel coil is loaded. The team has also designed a crimping method which will reduce steel coil memory when the steel enters the pinch rollers. The roller guard solution will fix the problem of the damaged pinch roller and the crimping method will help reduce coil loading time.

# Polymer Extruder Cooling Line Project

**Members:** Logan Dorgelo, Levi Holdcroft, Zachary Richardson, and Phillip Staab
**Advisor:** Timothy Jenkins, Ph.D.
**Sponsor:** Design Engineering Technology Department

Trine University's School of Engineering and Technology offers a plastics minor with an assortment of machines for the students to gain experience using in a lab environment. One machine is a plastic extruder which mixes plastic pellets and fillers and extrudes the hot material through a die forming a 2D profile part. The current machine setup has no cooling unit at the die end, so when the hot plastic is extruded, it falls straight down into a five gallon plastic bucket where the material coils and sticks together while cooling. The time to cool fully is much longer than desired and makes achieving a standard sample difficult. The design team was tasked with creating a simple cooling system that catches the extruded plastic upon emerging from the die and cools it to a temperature which is safe to handle. A mechanism was designed to pull and guide the plastic and must match the speed of the extruder. With these requirements, the team came up with the overall design of a simple water trough system supported by a frame with a motorized mechanical puller device to guide the extruded plastic and provide sufficient cooling. The two main factors of the project were overall size and cost. Existing cooling lines are expensive and are designed more for manufacturing in a large environment with constant use, while the department only uses the extruder a few times a year for laboratory activities. The cooling device will allow students in the plastics minor to use the extruder and safety cool the plastic part and achieve more uniform samples as well as save the university money.

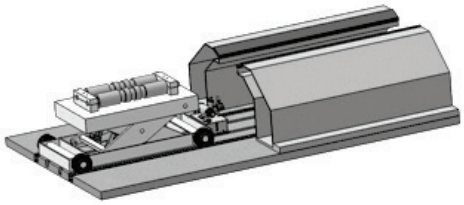
# Pill Cabinet for Utilizing Livi Systems in Group Homes Project



**Members:** Nicholaus Giese, Houston Lehman, Mikola Medich, and Austin Nault
**Advisor:** Les Grundman, Ph.D.
**Sponsor:** Benchmark/AWS

As a leader in providing residential services, Benchmark has been at the forefront of developing residential options for individuals with disabilities. Benchmark's Residential Services' primary goal is to apply the standards of health, safety, and respect to help people with disabilities so they can thrive at home and in the community. One of the major components of the residential homes is the storage and distribution of medications to occupants. The current method of storage includes organizing medications with plastic bins for each individual in the home, storing medication records in binders, and securing narcotics in double locking bank bags; all of which are stored in locking cabinets. The current method of distribution is done completely by hand. This technique does not allow for enough storage space, takes a long time to distribute medications, and allows for user error when giving medications. The design team was tasked with creating a storage system that helps organize and distribute medications in a group home setting. The storage system must meet standards and specifications set for the storage of medications and narcotics. Through research, discussions with Benchmark, and Innovation One, the design team found that the system must have a double locking mechanism for storing narcotics. The team designed the storage system to allow for increased efficiency and reduction of errors by utilizing a Livi automated pill dispenser. The team expects this product to greatly reduce the amount of time employees will need to take when managing and distributing medications.

# Exit Coil Car Project

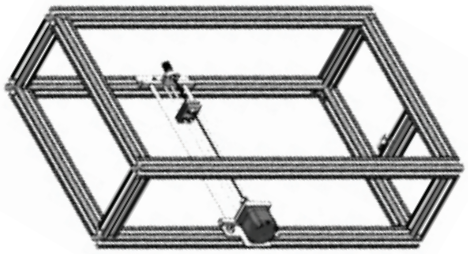


**Members:** Bo Reed, Devin Kershner, Hayden Runyan, and Caleb Schwalm
**Advisor:** Les Grundman, Ph.D.
**Sponsor:** North American Stainless

North American Stainless is the largest, fully integrated stainless steel producer in the U.S. The purpose of this project is to provide North American Stainless, located in Ghent, Kentucky, with a new exit coil car design to transfer steel coils from the annealing line to a holding fixture. The current exit coil car cannot handle more than 40,000 lbs. The team set out to design a car that would handle a larger 70,000 lb. coil plus an extra 5,000 lbs. for a total of 75,000 lbs. The team based the design on the current car and made improvements in the structure and hydraulic system to be able to successfully meet these requirements. The car is designed to be able to raise and lower the increased weight coils as well as fit into the existing coil support structures.

# Laser Test Stand for Electrical Engineering Assessment Project

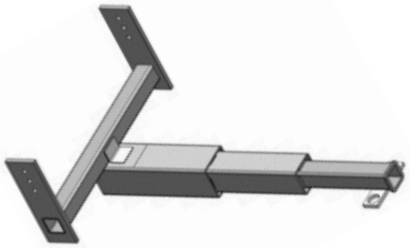
**Members:** Colin Mohr, Joseph Stasiak, and Garett Stimac
**Advisors:** Timothy Jenkins, Ph.D.
**Sponsor:** Electrical and Computer Engineering Department



Electrical engineering students investigate and demonstrate transverse light waves with a laser, lens, and fiber optic cable as part of a class exercise. One of the crucial aspects of this demonstration is the ability to have finite movement with the laser. The current method includes placing the laser on blocks and trying to line up the laser, lens and fiber by hand without precision tools. This technique is time consuming, inefficient, and it makes it difficult to repeat the same results. The design team was tasked with creating a simple and yet efficient system that can produce repeatable results while still meeting the accuracy specifications. The team created multiple designs that provided different solutions to the test stand including different laser and lens holders, two outer cover designs, and three methods to move the laser in the X and Y directions. These were presented to the sponsor and a final design with both manual and motorized capability was chosen. This design will be inside a box like frame structure and will be able to achieve movement in the X, Y and Z direction with motion in the Y path adjustable in microns. This final solution will save time and allow for an easier demonstration that can be easily done in multiple classes. This laser test stand design will significantly improve the learning outcomes for students in the EE curriculum.

# Extendable Hitch Receiver Project

**Members:** Zane Baxter, Kayla Davis, Ryan Haarer, and Chris Shuster
**Advisor:** Timothy Jenkins, Ph.D.
**Sponsors:** Dave Glass and Matt Viele



Founded in 2001, LHP Engineering Solutions is a company with the goal of creating a safer, smarter, and more connected world. One project the company has undertaken is the creation of an extendable trailer hitch receiver to increase the mobility between a tow vehicle and trailer. With a traditional hitch receiver, the angle of mobility is very limited as the back bumper of the tow vehicle and the front end of the trailer may collide when making sharp maneuvers. The design team was given the task of designing and fabricating an extending hitch receiver mechanism to expand the angle at which the trailer can turn without contacting the back bumper of the tow vehicle. The team was asked to design a product that was safe, relatively low cost, and will not create a counterweight issue while meeting all trailer and automotive safety standards. The hitch system must also be able to withstand minor collisions and weather extremes. This product will bolt to the frame of a tow vehicle and can extend past the back bumper with the help of hydraulics and an electronic app. This functionality will create the possibility of a 90° turn angle between the trailer and vehicle when needed and also be able to retract to a safe distance when the vehicle is traveling at higher speeds. This hitch receiver was designed and built in such manner that LHP can incorporate the receiver into an existing autonomous vehicle chassis. The team hopes to see LHP partner with a vehicle manufacturing company which will allow this product to be commercialized on a larger scale and be implemented into the lives of trailer owners across the world.

# Tennis Racket Vibration Damping Case Design Project

**Members:** Seth Anderson, Lily Dietz, Jacob Heller, and Theresa Magenheimer
**Advisor:** Les Grundman, Ph.D.
**Sponsor:** Jerry Allen

Tennis is a sport practiced at many levels across the United States and globally. One problem with tennis rackets is that vibration may occur in the racket when contact is made with the tennis ball. Another problem is that racket durability may be compromised when the racquet hits the ground. The design team was tasked with creating a flexible case that could wrap around the tennis racquet head and reduce both vibration and impact damage. The design team developed several concept designs for the project. These designs included a worm design, a four damper design, a tight case design that touched the strings, an exoskeleton design, and a tight case design that did not touch the strings. These designs were evaluated by considering customer needs and design requirements. The tight case final design was selected based on ease of use, protection of the racket, lighter weight, and higher frame damping, while also minimizing prototyping and manufacturing cost. The case prototype was manufactured using polymer extrusion die and formed into a hoop and secured together with epoxy resin. A cut out was made to allow for placement of the racket head.

# Aquaponics Monitoring System

**Members:** Adam Griswold, Travis Peterson, Nick Lucas, and Shiqi Wu
**Advisor:** Kevin Woolverton, Ph.D.
**Sponsor:** Trine University ECE Department

The intended goal of this project is to create an automated system to replace the general manual testing commonly used in an aquaponics system. The revised system will continuously monitor the current state of multiple variables of the system. For testing purposes these variables have been reduced to electro conductivity, pH and temperature which would be easily expanded upon for the final release. A webhosted API will bridge the gaps between our database, UI, and physical system. Whenever a described threshold for these variables is reached and the tank seems to be at risk, an alert will be sent out to any available technician who will correct the issue. Maximizing efficiency within an aquaponics farm is the primary goal of the project.

A typical aquaponics system would require several tests of the water per day. These tests can span several hours, and additional time would be needed to correct for any imbalances or errors within the system. Logically, improvements to this field should be made through reducing the overall time needed for testing and monitoring the aquaponics system environment. Doing so would increase efficiency of tests and would allow for any aquaponics team to devote more of their time to other important areas of the system.

# Autonomous Control System for a Mars Rover

**Members:** Robert Cooley, Ben Goenner, Olivia Miller, Lucas Westjohn, and Matthew Westjohn
**Advisor:** Kevin Woolverton, Ph.D.
**Sponsor:** NASA

Humans cannot yet live on Mars to study it, so we must rely on rovers sent to the red planet to acquire any information regarding it. NASA has sent rovers there in the past and continues to do so. NASA is planning to send another rover and has thus reached out to two universities to design and develop a prototype Mars rover. Our job is to design the autonomous control system for this rover so it can travel on Mars without any outside assistance.

The rover needs to be able to detect obstacles in its path. This allows it to avoid rocks, craters, and cliffs in order to explore on its own. This will be accomplished using two types of sensors: LiDAR and ultrasonic. These will identify any obstacle in its path and allow the rover enough time to maneuver and locate a new path. We will either use the LiDAR sensor as a way to locate objects such as rocks or mountains. The ultrasonic sensor will be used to detect craters and cliffs or any object that gets too close to the rover. These sensors will need to be tested strenuously to make sure that functionality is achievable over a wide range of scenarios. Also, the data being sent and received needs to be tested for accuracy. Datasheets for each sensor will provide input for testing and usage.

The final product will be a fully functional autonomous rover that will be able to navigate Mars without running into any obstacles. It will be able to detect obstacles, cliffs, and slopes and adjust its course accordingly.

# Autonomous Soldering Robot

**Members:** Samuel Tallo, Travis Riddle, Samantha Stensland, Brandon White, and Andrew Halverson
**Advisor:** Kevin Woolverton, Ph.D.

This purpose of this project is to develop an autonomous soldering robot that will specifically solder header pins onto circuit boards of varying sizes. The Department of Electrical and Computer Engineering at Trine University uses many of these boards in classes and labs, and as senior students in this department, we are aware of the need for circuit boards with soldered header pins. However, the process of soldering the header pins onto these boards by hand can be tedious and time intensive. This autonomous soldering robot will be able to solder up to two rows of 40 header pins each, spaced 0.1" apart, and it will have an intuitive graphical user interface.

To complete this task, the design utilizes a three-axis gantry system, which allows for consistent and precise interaction and positioning between the mounted soldering iron and the circuit board. This gantry system has been physically constructed and integrated into a control system, which takes user input through a graphical user interface. The control system translates the user input from a string of pin names, as they are represented on our mounted breadboard, to gcode coordinates and determines the order in which the selected pins will be soldered.

# Brakeless Electric Motor Loading System

**Members:** **Christian Koehl, Bradly King, Mohamed Alsomali, Mohammed Al Warthan, and Jacob Brutcher**
**Advisor:** **Stephen Carr, Ph.D.**

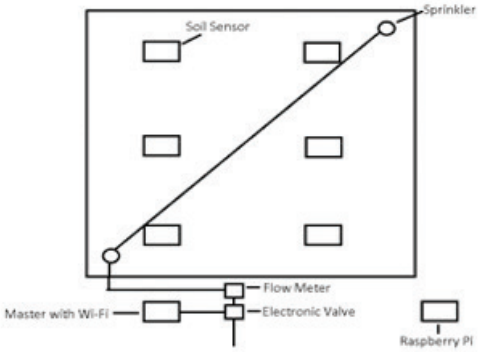
This design project aims to create a simple dynamometer-like system to replace the mechanical brake used in the measurement of motor torque in the electrical engineering laboratories.
With the removal of the mechanical brake, the process of applying torque and measuring power will be accomplished without a mechanical interface and instead will rely on the counter torque of a generator.

The system relies on the use of a DC motor being utilized as a DC generator to replace the mechanical brake. The generator will produce a voltage across a variable resistive load. The load current will flow in the armature of the generator and it is related to the torque applied on the motor, as verified by calibrations with the previous mechanical system. The voltage produced by the generator will be kept constant in order to control the torque being applied. This will be accomplished by a feedback controlled DC power supply connected to the field circuit of the generator.

The system will take advantage of microcontrollers programmed in the C language to process information received from sensors. The sensors consist of a tacho-generator, which will send a signal proportional to the speed of the motor, and a current sensor, which will send a signal proportional to the motor torque. These measurements are displayed on the control panel.

# Smart Sprinkle System

**Members:** **Zachary C Gering, Logan M Brinker, Alexander R Lewis, Ziyad A Al-Dobaian**
**Advisor:** **Sameer Sharma, Ph.D.**



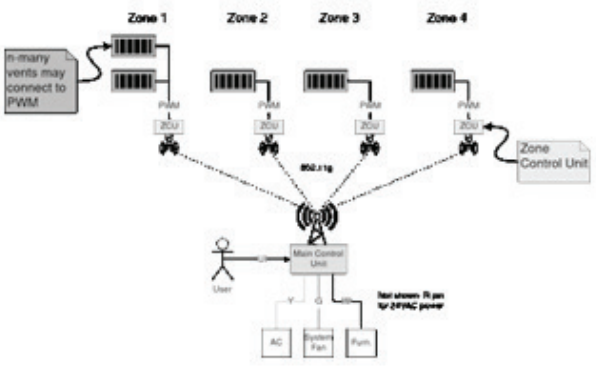

Anyone who owns a garden or takes care of their lawn knows that it is critical to gauge how much water is being delivered to their plants and grass. It is almost impossible to send out just the right amount of water every day that will keep your landscape happy and healthy. On top of this issue, there is never a good way to automate the sprinkling of your water with the weather patterns of where you live. As much experience as meteorologists might have, they are only right a small percentage of the time, making it very hard to discern when the sprinkler system should activate.

These issues stated above are the reasons for which this smart sprinkler system is being developed. To combat not knowing how much water is needed for your lawn or garden, the design will include six individual moisture sensors attached to Arduinos distributed over 400 square feet of soil. The six sensors will take real time data from the soil to decide how truly dry the user's lawn is, giving a real-time view of the ground. Via Bluetooth, the soil sensors will transmit data to the master Arduino, which controls the electronic valve and reads from the flow meter. Once the master Arduino has collected the average moisture of the lawn, and the gallons of water distributed, it communicates this value to a Wi-Fi module. The Wi-Fi module then updates our online server with these two values. Our Raspberry Pi display then reads the data from the server and displays it to the user. This information is also inputted into an algorithm which accounts for the current weather, and the weather later on in the day, to decide if the sprinkler should turn on or not. When a decision is made, the Raspberry Pi sends a value to the server which is then read by the Wi-Fi module. Once the Wi-Fi module has the value, it communicates it to the Arduino which then interprets it as an on or off command for the sprinkler. Because of the way this system is set up, we will be able to accurately choose times of the day to activate the sprinklers, saving water for the customer and keeping their lawn healthy.

# Smart Thermostat System

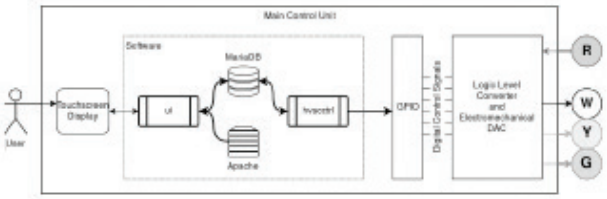
**Members:** Joshua Jennings, Kyle Kern, Ricardo Lopez, and Serena Zhang
**Advisor:** Sameer Sharma, Ph.D.

Heating, ventilation and air conditioning (HVAC) systems account for a large portion of residential energy consumption. Considering the high monetary and electrical cost of operating these HVAC systems, some homeowners may be interested in a solution for reducing the run time of their systems while maintaining or improving upon the perceived heating and cooling effectiveness. The purpose of this smart thermostat system design is to allow the user to take greater control over their home's climate control system, providing increased comfort in the rooms they occupy most, while saving energy by not directing air to room that are used the least. Similarly to commercially-available thermostat systems, this design includes a thermostat unit which interfaces directly with a house's conventional appliance control wires in order to control power to the furnace, air conditioner, and fan. This unit will provide a means for the user to establish a temperature schedule, which changes the desired temperature setting throughout the day. What differentiates this system from other currently-available models is its implementation of independently-programmable zones.




The user may define up to four zones in the system, corresponding to rooms or groups of rooms in the house. Each zone contains a control unit which senses temperature and sends data back to the main control unit. The zone control unit is also capable of operating a motorized vent; the vent is driven open when the room is in the process of reaching its desired temperature, and driven closed once the target is reached, thereby diverting the air to other rooms where it is still needed. By allowing the user to schedule their desired temperature in each room, this system allows them to maximize their comfort. By automatically closing the vents in rooms that no longer need air flow from the HVAC appliances, this system achieves its goal as efficiently as possible.

**Architecture:** The main control unit (MCU) serves as the central hub of the smart thermostat system. Its control programs send commands to both the HVAC system to turn appliances on and off, and to the zone control units (ZCU) which operate the temperature sensor and custom vent hardware. The MCU connects to the HVAC appliances via the house's wiring, and it communicates with the ZCUs via a wireless network. Up to four ZCUs may be connected to the thermostat system at a given time; each is intended to monitor the temperature for a single user-defined area of the building, which may be a single room or a collection of rooms.

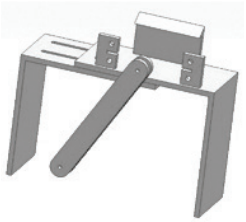



**Main Control Unit (MCU):** The system's MCU is based on a Raspberry Pi 3 and other supporting components. The MCU's custom HVAC control circuitry is designed to accept standard conventional HVAC control wires, including an input for 24 VAC power (R pin) and outputs for the heat call (W), cool call (Y) and fan call (G). A MariaDB server runs on the Pi to provide both storage and inter-process communications. The user interface and HVAC control programs both connect to the database to share temperature data and system statuses and configurations. One benefit of providing these communications via a MariaDB database is that all changes are automatically saved to disk, allowing seamless recovery from failure after a system reboot.

In order to communicate with the ZCU, an Apache2 server will be running on the Pi. This will serve as a gateway to send and receive data from the MCU to the ZCU, and vice versa. Both the MCU and ZCU will need to be in the same network, the data received from the ZCU will be stored on our MariaDB database as soon as it's received. The MCU will also be able to send a signal whether the vents need to be open or closed. The User Interface, written in C#, will display the current readings from all the zones and will allow the user to talk to the HVAC control system via the database.

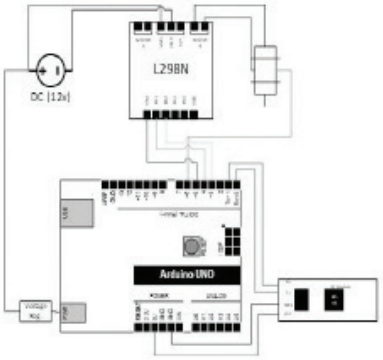
**Zone Control Unit:** The zone control unit consists of a microcontroller, WIFI shield, a thermistor and a motor. The ZCU is designed to work with the main control unit by sending and receiving data via WI-FI. The ZCU will also receive a signal from the MCU to determine whether the vents need to be open or closed. The ZCU will then send a PWM signal to a motor placed on the vents. The PWM signal will only be sent if the position of the motor is opposite of the desired, otherwise no PWM signal will be sent.

**Vent Bracket:** The vent bracket is designed to work with existing household vents with heights ranging from 4 inches to 6 inches. It uses a feedback servo motor to open/close vent to adjust air circulation in order to control the temperature of the zone. The motor gets a PWM signal from the microcontroller in the ZCU.



# COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

## Telescopic Hitch Control System




**Members:** **Hunter Crispen, Drew Waltermann, Mohammed Alotaibi, and Zachary Brown**
**Advisor:** **Prof. Dan Matthews**
**Sponsor:** **Matt Viele – LCH Productions**

The purpose of this project is to supply the DET group that is working on the telescopic hitch with a functioning electrical control system. With that control system, our group will be supplying an Android application that will interface with the system via Bluetooth.

To begin the project, our group procured an Arduino board, a Bluetooth receiver breakout board, and an H-bridge motor controller. With the basic functionality of the control system established, we took to making our first test application to test the functionality of the Bluetooth module and to verify that our mobile application was transmitting the correct data to the Arduino board. Once the system was working properly, we began adding several safety features to the control system – a voltage regulator to protect the Arduino from overvoltage, an emergency stop button in the application and on the vehicle, and an encoder and current reader to ensure that the motor will not burn up when hitting the end stops and to tell the encoder where the motor is after a system power cycle.

# DEPARTMENT OF INFORMATICS

## Thunder Tech Consultants Projects

**Members:** **Brice Cooper (Software Engineer), Austin Zachrich (Project Manager), Eric Peal (Project Developer) Julian Ridgway (Project Developer)**
**Advisor:** **Prof. Dan Matthews**
**Sponsor:** **Franks School of Education**

The purpose of this project will be designing a website for Trine's new CS/IT club. This is a new club at Trine with the goal of helping computer science and information technology students be the best they can be. We plan on adding a staff directory that will include classes by those professors. The site will also contain a 4-year plan for CS/IT students.

We will also be developing a phone application aimed for freshmen students as our second project. We will be teaming up with the living-learning community of the Franks School of Education to provide information about locations and opening times of all food places on campus, activities around campus, and discounts for Trine Students around the area.

As our third project, we got the opportunity to acquire a CrowPi computer to help develop lessons for future students. The CrowPi is a portable Raspberry Pi project kit. It consists of a small hinged case, a 7-inch touch screen and an extensive set of buttons, displays, and sensors. Connectors are provided to allow servos and stepper motors to be attached. The product has been designed to allow experimentation with software and hardware without the associated mess of wires.

# WADE DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING

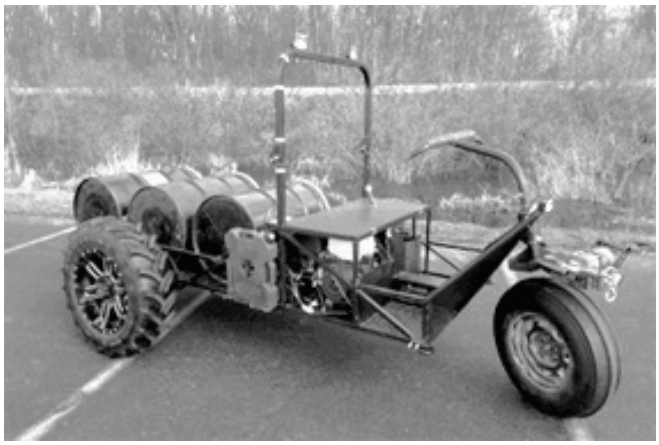
## Mini Baja Electrical Conversion

**Members:** Jason Brand, Spencer Graf, Devin Royal, and Justin Stewart
**Advisor:** Jon Koch, Ph.D.
**Sponsor:** ME Department – Trine University

The purpose of the project is to convert a Mini Baja vehicle from gas- to electric-powered; this is the first step towards creating a vehicle for the evGrandPrix go kart competition hosted by Purdue University. There were two goals. The first was to build a drivetrain with components that were compatible with the evGrandPrix rules. This allows future teams to use the same drivetrain and focus on the design of a new frame. The second goal was to install the drivetrain on the existing Mini Baja frame and demonstrate a vehicle acceleration that meets or beats 0 – 30mph in 10 seconds.

The drivetrain that was designed is chain driven from a 10.1 hp motor to a differential. The gear ratio for the chain drive is 1.5:1. The calculated max speed of the vehicle is 42mph. The vehicle is being powered from four 12V batteries wired in series for a 48V system with a total energy charge of 88 Ah. The team designed and built a custom faceplate for the motor from a block of aluminum using the lathe and mill in the SDC. The battery box was designed and manufactured using the CNC plasma table in the Bock Foundry and welded onto the frame with a divider manufactured to be bolted into the battery box to keep the batteries from moving around while driving the vehicle.

## Basic Utility Vehicle (BUV)



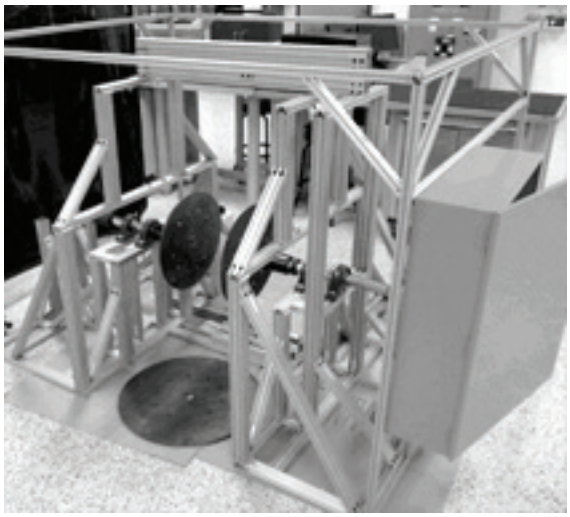
Current BUV. The curb weight is approximately 1600 lbs., which is 400 lbs. less than last year's vehicle. It is designed to carry up to 1300 lbs of water.

**Members:** Austin Snyder, Erin Boles, Damon Prifogle, and Nathan Lane
**Advisor:** Jon Koch, Ph.D.
**Sponsor:** Trine University

The goal of this project is to create a utility vehicle that is capable of pumping water from a body of water into barrels and transporting them to a different location. Similar vehicles are used in rural third world countries to help deliver a wide variety of hygienic and agricultural items. Our vehicle is to be tested at a closed course provided by the University of Cincinnati to determine the functionality and reliability in a realistic situation.

Our group started with an existing vehicle from last year. This year the goal was to take that vehicle and make it more efficient and robust. The old frame has been scrapped and a new, lighter frame consisting of thin angle iron was developed. Replacing the frame has reduced the weight of the vehicle by more than 20% (400 lbs.). Along with the frame renovation, a new drive linkage and a detachable winch has been added to the vehicle. These improvements ensure the vehicle is even more reliable and robust in the harsh conditions of rural areas.

# Goodyear Tire Tread Displacement

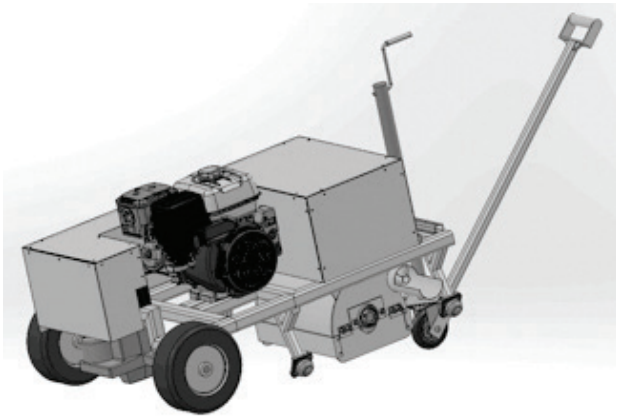


**Members:** **Lalaina B. McCue, Tyler M. Neuman, Jarrod M. Chaney, and Aaron A. Titkemeier**
**Advisor:** **Jon Koch, Ph.D.**
**Sponsor:** **Goodyear**

Sponsored by Goodyear, the goal is to design a process and a machine that can make tiny holes on the tread of a tire. Hundreds of precisely located, repeatable markings are required to measure tire performance in a laboratory setting. Experimental results help Goodyear predict, among other things, how a tire will perform on the road and wear over time. Currently, the tire-marking process requires approximately 4 man-hours to create about one hundred marks on a tire, and the location and size can be inconsistent because they are done manually. A repeatable, precise, fast alternative method is desired. Preliminary results indicate that a CNC-style laser is the best process to meet the requirements. The machine will allow a tire to be mounted to a shaft so that a stepper motor can rotate it to any desired angle. Two other stepper motors will control the vertical and horizontal position of a mirror and lens system above the tire and thus control where the marks are applied. Software is being designed and hardware is being specified to control the motors and the firing of the laser to quickly make tiny, precise holes in the tire, the location of which comes from an input file created by the user. For safety, the machine will be contained within an aluminum frame covered in laser-safe polycarbonate. All automated operations will stop if any door is opened or if the laser head moves too far in any one direction. The machine is expected to halve the current standard deviation in the hole sizes and improve the location consistency as well as considerably increase (by 5x or more depending on number of holes in one tire) the rate at which the holes are made.

# Pokagon Toboggan Run Ice Surfacing Machine

**Members:** **Theron Imhoff, Alex Risk, Benjamin Moricz, James Hendrickson, and Stephen Sieczkowski**
**Advisor:** **Jon Koch, Ph.D.**
**Sponsor:** **Pokagon State Park/Trine State Recreation Area**

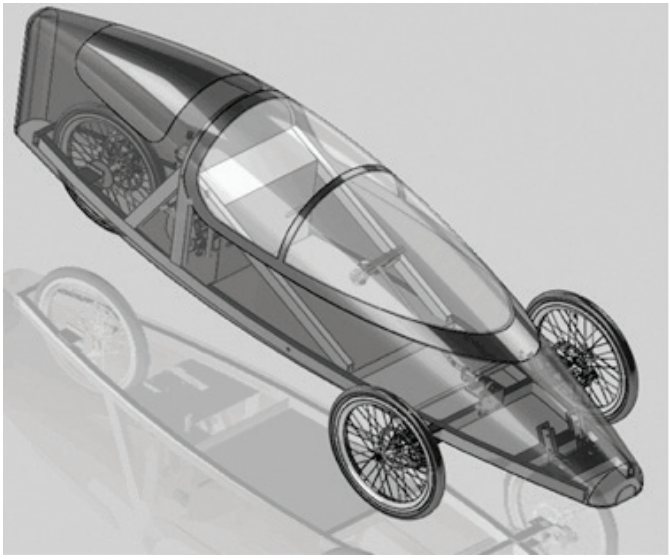


The purpose of this project is to design and construct a machine capable of resurfacing the ice on Pokagon's Toboggan Run. During the day the sun partially melts the ice on the toboggan tracks. That water pools in the lower parts of the tracks and refreezes overnight. This phenomenon along with the way the track is cooled creates an uneven surface for the toboggans to ride on. The ice must be resurfaced to assure riders a safe, comfortable experience. Pokagon currently resurfaces the ice using the strenuous physical labor of many people and hand tools. It is a slow, difficult task that takes multiple days, and the results can be inconsistent. The main goal is thus to develop a machine that can resurface ice more consistently and more quickly, using fewer people.

This project is the second iteration of a prior project with a similar goal. A prior alpha-prototype was never implemented because: 1) the height of the cutter was fixed and could not be adjusted depending on track conditions, 2) the machine had no steering and was too heavy (~450 lbs.) to be manually hoisted into position on the track, 3) the machine was not sufficiently safe due to the presence of exposed high speed blades, and 4) the machine could not gain enough traction to simultaneously cut ice and climb the inclines of the toboggan run. After researching alternative methods to perform the desired functions, the group developed a 3-wheeled design that incorporated an array of saw blades to cut and resurface the ice, an auger to expel the ice from the machine, a trailer jack-style mount to raise and lower the cutting blade and steer the machine, and a hydrostatic transaxle mounted at the front of the machine with rubber wheels to propel the machine along the top of the toboggan pans. The improved machine will be able to have an adjustable cutting height while safely protecting all moving parts. It will also be able to be driven to the track from a trailer near the track, and it will completely resurface both toboggan runs in less than 6 hours using only two operators.

# Shell Eco-Marathon Prototype ICE Gasoline Team

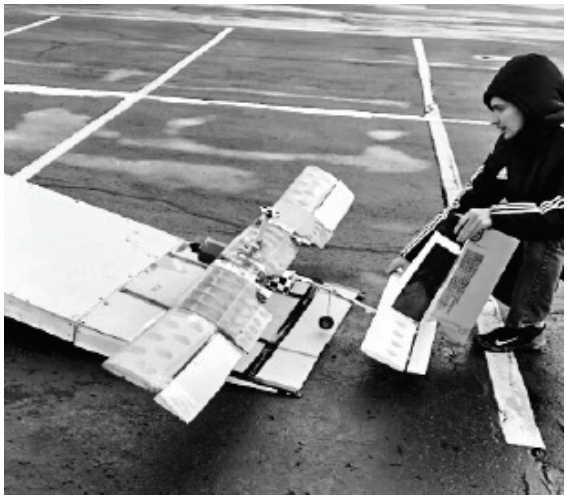
**Members:** **Landon Fellows, Austin Mazura, Justin McConnell, Grant Miller, and Clayton Ayers**
**Advisor:** **Jon Koch, Ph.D.**



The goal of this project is to create a high efficiency gasoline car. It will compete against other cars at the Shell Eco-Marathon in Sonoma, California. The car that completes the course with the best fuel economy wins. For several years, Trine has participated in the Shell Eco Marathon, implementing new ideas for improving fuel economy. This year, two major innovations have occurred. First, the addition of a jackshaft in the drivetrain was used to transform rotational power from the left-hand drive engine to the right-hand drive rear wheel of the vehicle. The use of the jackshaft allowed for the installation of a free wheel so that the vehicle can coast as far as possible without a running engine. Coasting with the engine off reduces the fuel consumption of the car and increases its fuel economy. The second major innovation was the redesign of the steering mechanism to enable optimal turning, meeting a condition known as the Ackermann Condition. Ackermann steering means that the left and right wheels will turn at different angles when the steering wheel is turned so that the inside and outside tires can smoothly travel along different paths when the vehicle is cornering. Designing the steering linkage for an Ackermann Condition helps actual cars maintain traction and control while cornering. For our project, it helps eliminate frictional losses due to sliding or "scrubbing" of the tires along the road surface during a turn. The car can thus corner and coast for a longer time before slowing and achieve a higher fuel economy as a result.

# AIAA Design Build Fly Competition

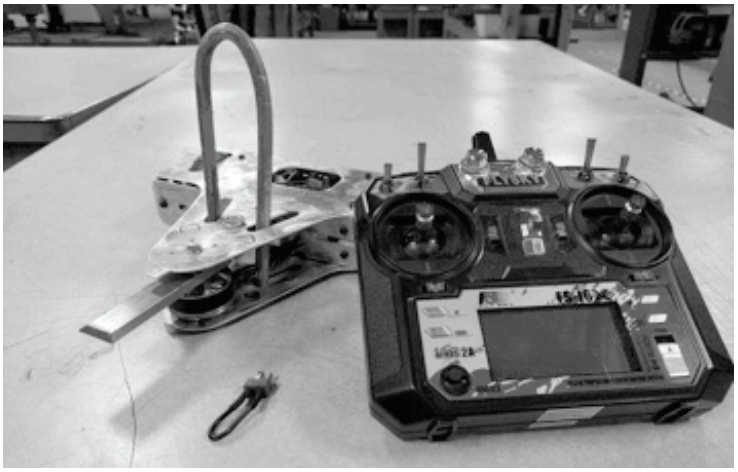
**Members:** **Andrew Maurer (Stability and Control, Tail)**
**Caroline Hipskind (Project Mgr., Budget Mgr., Landing Gear)**
**Jasper Bassett (Aircraft loading/Experiments/Reports, Mfg., Fuselage)**
**John Anderson (Performance/Airfoils, Wing)**
**Ryan Morrow (CAD/Communications/Reports, Quality Tech)**
**Seth Cole (Prop-Testing, Battery/Motor, Electronics)**
**Advisor:** **Pavan Karra, Ph.D.**
**Sponsor:** **Indiana Space Grant Consortium**



The purpose of this project is to design an aircraft that will be able to complete the missions of the 2018-2019 AIAA DBF competition. The aircraft must follow all rules and regulations that are specified by this year's competition and the AMA. The competition focuses on aircraft carrier operations, involving three flight missions and one ground mission. The flight missions comprise of completing laps under established time limits, with or without payload depending on the specific mission. The ground mission is a timed installation and testing of the radome and attack stores. A design concept was chosen to meet all mission parameters and has been kept as the primary design with manufacturing modifications through iterations. The final aircraft then is a sweep folding mono-wing, attached to a built-up fuselage with standard tail design. Tricycle landing gear supports the craft, as well as payload and attachable tampered edge radome. A single motor and propeller connect to the battery and electronics stored in the fuselage, which, while built-up will be as streamlined as possible. Spare components will be brought to the competition in case of necessary field repairs.

# NRC Combat Robot

**Members:** **Braden Hale, Stone Miguel, Kyle Munger, Jonathan Phillips, and Kody Snyder**
**Advisor:** **Pavan Karra, Ph.D.**
**Sponsors:** **UWBA Design, LLC; Columbus, IN**
**Polymer Science, Inc.; Monticello, IN**

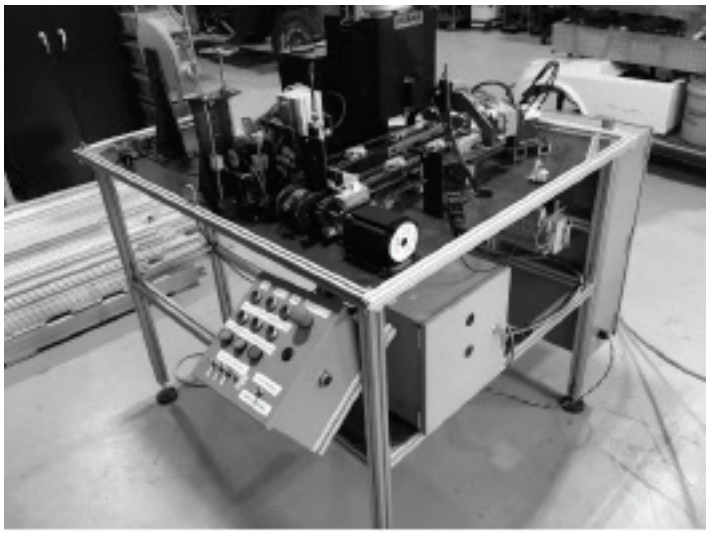


This project consisted of the design and manufacture of a remote-controlled robot for use in the Combat Robot division of the 2019 National Robotics Challenge (NRC) in Marion, Ohio. The Combat Robot division is a tournament style contest consisting of competing robots that use one or more methods of attempting to destroy or disable one another.

The team considered existing robot designs and combat methods from previous winners of the NRC and from the popular television show BattleBots to use in their design. They ultimately found inspiration from "Tombstone", a BattleBots champion with an 88% career win rate. The design and combat approach that the team has implemented consists of a horizontal spinning steel blade that is extended out in front of the robot and two drive wheels. To mitigate the risk of being pinned upside-down, the team's robot has been designed to drive and operate its weapon on two sides. The team tested the robot's weapon against a stationary steel block of equivalent weight to the robot (3 lbs.), and the overall robot performance was evaluated by battling against an identical robot in a custom arena, similar to the NRC competition environment. Various forms of destructive testing were also conducted to evaluate durability of the frame and electronic components. After several iterations, the team finalized their design and created spare parts to keep on hand for repair during competition.

# Tower Ribbon and Awards Automated Awareness Ribbon Folding Project

**Members:** **Caleb Henry, Elias King, Nathan Lee, Eric Romanowski, and Dylan Runge**
**Advisor:** **Pavan Karra, Ph.D.**
**Sponsor:** **Tower Advertising Products, Inc.**



The purpose of this project is to automate the process of folding awareness ribbons for Tower Advertising. Annually, Tower produces an average of 500,000 of these awareness ribbons which has proven to be very labor intensive. The main goal of this project is to reduce the manual labor required to produce these ribbons as well as make it possible for a single operator to run the machine.

The group began this project as a continuation of the 2017-2018 senior design project. The group's main goals for improving the machine were to increase the percentage of acceptable ribbons and replace the existing method of ribbon transport. In order to improve this, the new transport was powered by a stepper motor and constrained the ribbon segments using spring powered clips. The mechanism for feeding the ribbon onto the transport was also replaced with a stepper motor and drive wheel to increase the precision and accuracy of the ribbon length. Dampening for all pneumatic components was also implemented in order to improve the longevity of the machine's parts. The project also started with minimal documentation of parts and wiring for the machine's Programmable Logic Controller (PLC). Documentation of the wiring, PLC coding and a user manual were all assembled to make it easier in the event of troubleshooting a future issue. Lastly, the group made several key improvements to the actual machine and the code to ensure the safety of the operator.

# Pokagon State Park Summer Toboggan Project

**Members:** **Richard Spodeck (Finite Element Analysis Technician)**
**Caleb Sanford (Manufacturing Technician)**
**Shannon Scott (CAD Designer)**
**Zach Markley (Project Manager)**
**Alex Wiederman (Electrical Technician)**
**Aaron Lawrence (Communications Director)**
**Advisor:** **Pavan Karra, Ph.D.**
**Sponsor:** **Pokagon State Park**

The purpose of our project was to redesign a toboggan for Pokagon State Park's Toboggan run that does not need ice in order to function. Currently the toboggan track operates from November-February because the track is refrigerated and requires cold temperatures to keep a thin layer of ice on the track. Pokagon requested that a toboggan be redesigned so that it can operate on the track on the weekends during the summer season, therefore increasing the operating season for the toboggan track by three months.

The goal of our team was to redesign a previous design of a toboggan that was created by a senior design team the year prior. It was decided that new wheels and axles needed to be applied from the previous toboggan model in order to ensure safety. The front of the toboggan also needed to be redesigned in order to avoid pinch points for hands and feet. The new model of the toboggan that our group produced can safely carry six hundred pounds on a six-wheel toboggan that can last at least a one year lifetime of operation. This potential product can increase attendance and revenue for Pokagon State Park during their already busy summer season.

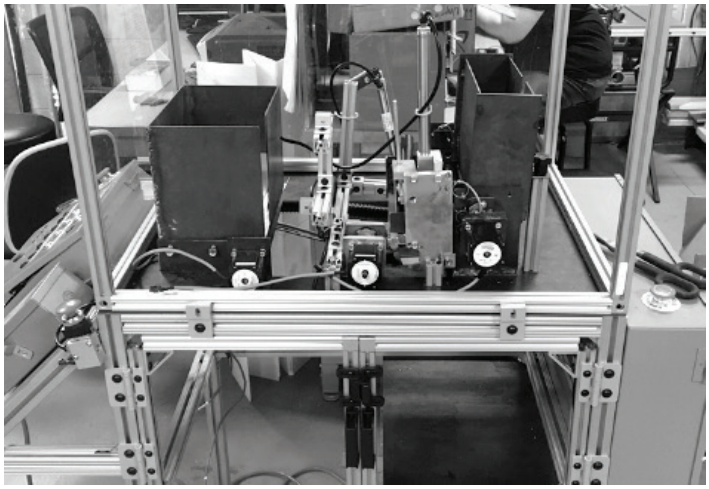
# Shell Eco-Marathon Americas 2019 Prototype Battery-Electric

**Members:** **Jasper Jameson, Olli Jansson, Brian McGuire, Christopher Timm and Kurt Wysocki**
**Advisor:** **Pavan Karra, Ph.D.**

The project consisted of the design, analysis, and manufacture of a prototype battery-electric car to compete in the Shell Eco-Marathon Americas 2019. The team was instructed to improve the car from the previous year by reducing the overall weight, increasing the aerodynamics of the car, and implementing a new motor to, ultimately, increase the efficiency. This was done by numerous CAD Drawings and ANSYS simulations to produce the best results with the minimum weight while still staying within the rules of the competition. These models were then manufactured and implemented into the car. The team then traveled to the Shell Eco-Marathon competition held at Sonoma Raceway in Sonoma, California. Teams from across the United States, Mexico, and Canada 'raced' against each other to produce the most battery efficient car. The four-day event consisted of passing technical and safety inspection and attempting to complete test runs to place at the event. This competition produced the simulation of a real-world engineering project that involved various iterations of several subsystems along with emphasizing organization and time management. The total project needed to be completed following a set of standards and rules as well as staying under a tight budget. The magnitude of the competition taught the importance of preparation and composure as well as providing a once-in-a-lifetime experience.

# Tower Ribbon and Awards Automated Awareness Ribbon Folding Project

**Members:** **Katherine Branson, Brady Elliott, Amos Kauder, Michael Metz, and Patrick Twigg**
**Advisor:** **Pavan Karra, Ph.D.**
**Sponsor:** **Tower Advertising, Inc.**



This project is a collaboration effort between Tower Advertising, Inc., a ribbon manufacturing company, and Trine University students. Tower wants to automate the current, tedious process of applying tape to their flat ribbons by hand. This required the team to do extensive brainstorming and research on different types of machinery before selecting the best designs for each individual component of this machine. The team then designed, analyzed, manufactured and iterated these individual components until the machine met all of Tower's requirements. The machine consists of motors, rollers, and pneumatics, which are all controlled through a PLC (Programmable Logic Controller), while also consisting of an HMI (Human-Machine Interface), which allows for an operator to run the machine.

NOTES

# PROFESSIONAL SOCIETY – STUDENT CHAPTERS

## American Institute of Aeronautics and Astronautics (AIAA)

| | | | |
|---|---|---|---|
| **Advisor:** | **James Canino, Ph.D.** | **President:** | **Eric Romanowski** |

The American Institute of Aeronautics and Astronautics (AIAA) is dedicated to the advancement of the aerospace sciences. Membership is open to all engineers, scientists, and other professionals who have an interest in aerospace. The Trine University Student Branch of AIAA has been continuously active since 1940 when Dr. James Doolittle and Maj. Leslie Green visited campus to approve the aeronautical program for membership to the Institute of Aeronautical Sciences (IAS).

## American Institute of Chemical Engineers (AIChE)

| | | | |
|---|---|---|---|
| **Advisor:** | **Jacob Borden, Ph.D.** | **Treasurer:** | **Tyler Eyerly** |
| **President:** | **Noah Weston** | **JR Class Rep:** | **Sherrie Riser** |
| **Vice President:** | **Nate Buening** | **SO Class Rep:** | **Jonah Blanchard** |
| **Secretary:** | **Jordan Baker** | | |

AIChE is a global professional association of more than 50,000 members that provides leadership in advancing the chemical engineering profession. Its members are creative problem-solvers who use their scientific and technical knowledge to develop processes and design and operate plants to make useful products at a reasonable cost. AIChE fosters and disseminates chemical engineering knowledge, supports the professional and personal growth of its members, and applies the expertise of its members to address societal needs around the globe. This past year, members of Trine's AIChE student chapter attended the Regional and National Conferences to compete in both AIChE Jeopardy and Chemical Engineering Car Competitions. In addition to organizing plant tours and hosting guest speakers on campus, the Trine student chapter sponsored fall and spring picnics for the Chemical Engineering Department. As a part of our commitment to encouraging the pursuit of Chemical Engineering and strong community relations between the student body and the community, the local chapter has participated in college visit days, the Steuben County Regional Science Fair, and Introduction to Engineering Day.

## American Society of Civil Engineers (ASCE)

| | | | |
|---|---|---|---|
| **Advisor:** | **Professor TJ Murphy** | **Marketing Coordinator:** | **Ashton Benson** |
| **President:** | **Alex Duran** | **Class Representative:** | **Nicholas Pitts** |
| **Vice President:** | **Taylor Eash** | **Class Representative:** | **Quinten Prieur** |
| **Treasurer:** | **Robert Morehouse** | **Conference Manager:** | **David Gaff** |
| **Corresponding Secretary:** | **Anna Kmec** | **Community Outreach Mgr:** | **Trevor Szelis** |
| **Recording Secretary:** | **Ethan Davenport** | **Professional Outreach Mgr:** | **Ben Bellestri** |

The American Society of Civil Engineers is America's oldest national engineering society, having been chartered in 1852. Trine University's Chapter has been in existence since 1965, aiming to "provide an environment where students can learn about and enhance the civil engineering field while networking with peers, professionals, and the community". In the pursuit of these goals, ASCE student members participate in a wide range of activities. One signature project is the concrete canoe competition, where students can apply engineering principles and practice team and project management skills. ASCE also strives for professional development via guest speakers with local professional civil engineers and field trips such as the Ohio Constructor for a Day event and the annual ASCE Indiana Section meeting. Additionally, service projects such as Adopt-A-Highway, surveying projects, design work, and school outreach allow the organization to promote civil engineering while giving back to the community.

# American Society of Mechanical Engineers (ASME)

| | | | |
|---|---|---|---|
| **Advisor:** | **Kevin Molyet, Ph.D.** | **Secretary:** | **Jenna Wilson** |
| **President:** | **Kyle Munger** | **Student Gov Rep:** | **Alex Risk** |
| **Vice President:** | **Elias King** | | |

With 120,000 mechanical engineers and mechanical engineering students as members, ASME offers quality programs and activities in mechanical engineering, enabling its practitioners to contribute to the well-being of humankind. Originally chartered by the national governing body in 1971, the Trine University section has a current membership of approximately 50 students. The section usually meets once a month and attends two regional conferences per year. In addition, the section sponsors miscellaneous activities such as design competitions, special speakers, and plant tours throughout the year.

# Biomedical Engineering Society (BMES)

| | | | |
|---|---|---|---|
| **Advisors:** | **Maria Gerschutz, Ph.D.** | **Secretary:** | **David Cervera** |
| **President:** | **Michael Forthofer** | **Treasurer:** | **Marissa Shaver** |
| **Vice President:** | **Katie Kline** | | |

The Vision of the Biomedical Engineering Society (BMES) is to serve as the world's leading society of professionals devoted to developing and using engineering and technology to advance human health and well-being.

The Mission of the BMES is to build and support the biomedical engineering community, locally, nationally and internationally, with activities designed to communicate recent advances, discoveries, and inventions; promote education and professional development; and integrate the perspectives of the academic, medical, governmental, and business sectors.

# Chi Epsilon (Civil Engineering Honor Society)

| | | | |
|---|---|---|---|
| **Advisor:** | **Bill Barry, Ph.D., P.E.** | **Treasurer:** | **David Gaff** |
| **President:** | **Cameron Horan** | **Secretary:** | **Alex Duran** |
| **Vice President:** | **Nicholas Zak** | | |

Chi Epsilon is the national civil engineering honor society for the top civil engineering juniors and seniors in the department. The Trine chapter has been involved in community service projects including judging at the Regional Science Fair, Plank-a-Palooza, Canstruction, and a surveying project for Pokagon State Park.

# Engineers Without Borders (EWB-USA)

| | | | |
|---|---|---|---|
| **Advisor:** | **Tim Tyler, Ph.D., P.E.** | **VP of Membership:** | **Eric Romanowski** |
| **President:** | **Morgan Sapara** | **VP of Finance:** | **Ashton Benson** |
| **VP of Projects:** | **Montana Hermann** | **Secretary** | **Cameron Horan** |

Our vision is a world in which the communities we serve have the capacity to sustainably meet their basic human needs, and that our members have enriched global perspectives through the innovative professional educational opportunities that the EWB-USA program provides. Our mission supports community-driven development programs by collaborating with local partners to design and implement sustainable engineering projects, while creating transformative experiences and responsible leaders. We are currently working on a water supply project with a small community in Ecuador. A construction trip with six members from the student chapter is planned for October 2019.

# Eta Kappa Nu (HKN)
# (Electrical and Computer Engineering Honor Society)

| | | | |
|---|---|---|---|
| **Advisor:** | **Sameer Sharma, Ph.D.** | **Treasurer:** | **Claire Ryan** |
| **President:** | **Travis Riddle** | **Secretary:** | **Samantha Stensland** |
| **Vice President:** | **Alex Lewis** | | |

The Zeta Phi chapter of Eta Kappa Nu (HKN), the honor society for Electrical and Computer Engineering students, was established at Trine University on 1975. The chapter is dedicated to encouraging and recognizing individual excellence in education and admirable work in professional practice, and in any of the areas within the electrical and computer engineering fields of interest.

# Institute of Electrical and Electronics Engineering (IEEE)

| | | | |
|---|---|---|---|
| **Advisor:** | **Sean Carroll, Ph.D.** | **Secretary:** | **Daymon Marlowe** |
| **President:** | **Justin DeClark** | **Treasurer:** | **Jake Garlits** |
| **Vice-President:** | **Gwen Pierce** | **Student Rep:** | **Gwen Pierce** |

The IEEE promotes the engineering process of creating, developing, integrating, sharing, and applying knowledge about electrical and information technologies and sciences for the benefit of humanity and the profession. The student branch tutors, travels, listens, and competes to sharpen the interests and skills of Trine electrical, computer, and software engineering students through interaction with industry and between more and less experienced students.

# Institute of Transportation Engineers (ITE)

| | | | |
|---|---|---|---|
| **Advisor:** | **Ryan Overton, Ph.D.** | **Treasurer:** | **Alex Duran** |
| **President:** | **Taylor Eash** | **Secretary:** | **David Gaff** |
| **Vice President:** | **Rob Morehouse** | **Student Rep:** | **Quinten Prieur** |

The Institute of Transportation Engineers is an international educational and scientific association of transportation professionals who are responsible for meeting mobility and safety needs. ITE facilitates the application of technology and scientific principles to research, planning, functional design, implementation, operation, policy development and management for any mode of ground transportation. Trine University's ITE student chapter was established in 2013 and aims to draw attention to the importance and excitement of the transportation engineering field. Every spring the ITE members compete in the annual Traffic Bowl competition in which they answer transportation jeopardy style questions against other students from Indiana, Michigan, and Ohio. The student chapter attends several conferences each year including the Purdue University Road School and the ITE Great Lakes District Annual meeting in which they attend technical sessions and collaborate with professional engineers.

# Omega Chi Epsilon (Chemical Engineering Honor Society)

| | | | |
|---|---|---|---|
| **Advisor:** | **John Wagner, Ph.D.** | **Treasurer:** | **Roger Chase** |
| **President:** | **Blake Trusty** | **Secretary:** | **Ayasha Faria** |
| **Vice President:** | **Cameron Orr** | **Mugmaster:** | **Cameron Orr** |

Omega Chi Epsilon is the national chemical engineering honor society for the top chemical engineering juniors and seniors in the department. The Trine chapter (alpha nu) hosts the McKetta birthday celebration and department homecoming activities.

# Society of Automotive Engineers (SAE)

| | | | |
|---|---|---|---|
| **Advisor:** | **Pavan Karra, Ph.D.** | **Treasurer:** | **Bethany Blumer** |
| **President:** | **Jacob Stout** | **Marketing Manager:** | **Daria Frame** |
| **Crew Chief (VP):** | **Clayton Ayers** | **Public Relations:** | **Andrew Barrett** |
| **Secretary:** | **Alexander Garcia** | | |

SAE International is "the premier society dedicated to advancing mobility engineering world-wide." SAE provides many student competitions including Aero Design, Clean Snowmobile Challenge, Formula SAE Series, Mini Baja Series, Supermileage, Robot Systems Challenge, and the Micro-Truck Baja. SAE's magazines, such as Automotive Engineering International, Aerospace Engineering, and SAE Off-Highway Engineering, are other terrific opportunities to keep up-to-date with the latest in vehicle technology and breakthroughs.

# Society of Manufacturing Engineers (SME)

| | | | |
|---|---|---|---|
| **Advisor:** | **Tim Jenkins, Ph.D.** | **Treasurer:** | **Matthew Seasor** |
| **President:** | **Jessa McClara** | **Secretary:** | **Allen Richardson** |
| **VP/Student Gov't Rep:** | **Brett Brindenthal** | | |

SME has a rich and evolving heritage spanning more than 80 years. We serve the manufacturing industry as a nonprofit by promoting advanced manufacturing technology and developing a skilled workforce. Since its inception in 1932, SME has worked to make engineers, companies, educators, and others successful in their quest to advance manufacturing industries in the United States. The Trine University SME student chapter, S280, currently has 13 student members. Chapter members attend plant tours and expert presentations from local manufacturing companies. Some of the field trips have included visits to GM Powertrain (Defiance, OH), Steel Dynamics (Butler, IN) and Caterpillar (Lafayette, IN). The chapter also co-sponsors Foundry Night each semester in the Bock Center foundry lab.

# Society of Women Engineers (SWE)

| | | | |
|---|---|---|---|
| **Advisor:** | **Andrea Mitofsky, Ph.D.** | **Secretary:** | **Jenna Wilson** |
| **President:** | **Erin Boles** | **Treasurer:** | **Katie Jutte** |
| **Vice President:** | **Karina Bruce** | **Student Sen Rep:** | **Gwen Pierce** |

The Society of Women Engineers (SWE), founded in 1950, is a not-for-profit educational and service organization. SWE is the driving force that establishes engineering as a highly desirable career aspiration for women. SWE empowers women to succeed and advance, and to be recognized for their contributions and achievements as engineers and leaders. The Trine University student section of SWE provides networking opportunities for students pursuing degrees in engineering, technology and science. Activities include guest speakers, attending career fairs, plant trips, and outreach activities to encourage K-12 students to pursue technical degrees.

# Tau Beta Pi – The Engineering Honor Society (TBP)

| | | | |
|---|---|---|---|
| **Advisor:** | **Ryan Overton, Ph.D.** | **Corresponding Secretary:** | **Brittani Smith** |
| **President:** | **William Steffel** | **Recording Secretary:** | **Alex Jasper** |
| **Vice President:** | **Kandra Tubbs** | **Treasurer:** | **Kaitlyn Steers** |

Tau Beta Pi is the only engineering honor society representing the entire engineering profession. It is the nation's second-oldest honor society, founded at Lehigh University in 1885 to mark in a fitting manner those who have conferred honor upon their Alma Mater by distinguished scholarship and exemplary character as students in engineering, or by their attainments as alumni in the field of engineering, and to foster a spirit of liberal culture in engineering colleges. In order to be eligible for membership, one must be in the top one-eighth of the junior engineering class or the top one-fifth of the senior engineering class at their university. There are now collegiate chapters at 248 US colleges and universities, 32 active alumni chapters in 16 districts across the country, and a total initiated membership of approximately 536,000. Trine University's Indiana Epsilon chapter was founded on February 22, 1975. Each year, the student chapter hosts Engineering Futures sessions – professional seminars focusing on the "soft" skills that engineers need to succeed in their career. As a community service, TBP also organizes a series of fundraising

events called Creating Christmas where all of the proceeds go to purchasing hats, gloves and candies for local elementary students. Additionally, the students are encouraged to travel to regional and national conferences to expand their professional networks as well as polishing their leadership skills.

## Trine University Materials Society

**Advisor:** **Darryl Webber, Ph.D.**
**President:** **Erin Boles**
**Vice President:** **Mike Metz**

The Trine University Materials Society is a combined student chapter of the American Foundry Society and Material Advantage, which incorporates membership in the Materials Information Society (ASM); the Minerals, Metals, and Materials Society (TMS); American Ceramic Society; and the Association for Iron and Steel Technology (AIST). These professional organizations seek to promote research and knowledge in the area of material science and engineering design. Student members actively participate in meetings with their professional counterparts, host technical presentations from working engineers and scientists, as well as opening the foundry laboratory to the Trine community for foundry nights. Many students in the Materials Society are also involved in FEF, which was established to assure a continuing supply of engineers for the metal casting industry through scholarship programs. FEF acts as an interface between students and industry to promote internships, cooperative educational opportunities, and full time employment and provides funding for laboratory equipment; travel to professional meetings, and for industrial tours.

# TRANSPORTATION & DEVELOPMENT CONSULTANTS

CrossRoad Engineers is a civil engineering firm with a focus in transportation and development consulting based in Beech Grove, Ind. established in 1995. CrossRoad Engineers helps clients build quality infrastructure across the state, providing a variety of services such as residential and commercial site development design, surveying, road and bridge design, construction inspection, right-of-way engineering and roundabout analysis and design.


Trent Newport - 1992


Greg Ilko - 1994


Mark Beck - 2000


Willie Hall - 2004


Dustin Myers - 2004


Derek Snyder - 2007


Matt McElroy - 2008


Kevin Lee - 2010


Michael Kalberg - 2012

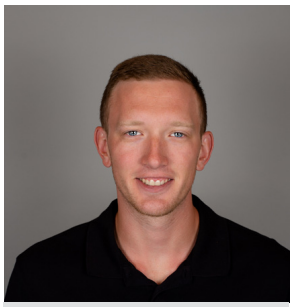

Curtis Holcom - 2013


Charles Stewart - 2016


Justen Hochstetler - 2017


David Webster - 2017


Michael Trader - 2018


Charlie Mattox - 2018

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