2019 Senior Design Conference Project Abstracts

Architectural Engineering

AE1 - College of Business Administration Building-Renovation
Team Members: Katy Bendele, Destinee Harris, Casandra Ornelas, Haley Wagner

This project focuses on building an all new and approved College of Business Administration building at Texas A&M University- Kingsville, located at 1115 N. University Blvd. The College of Business Administration building was built in the early 1970s, and as the college becomes more popular and enrollment increases, the design no longer suits the growing capacity and needs of the students and staff. Our team will be relocating the building to the parking lot and this building will be three stories tall in order to help accommodate the new students that are entering in the program. Also, the building will be facing east like the original building to help keep the new building similar to the original building. Leadership in Energy and Environmental Design (LEED) criteria will be adopted to design a more sustainable building.

AE2 - Kingsville Mall
Team Members: Haleigh Gonzales, Martin Puente, Farrah Rawashdeh, Raul Gonzalez

The objective of our project is to provide the City of Kingsville with a revamped, commercially and energy efficient multi-purpose building to keep up with the changing socioeconomic and technological building needs. The advantages of demolishing and constructing a new mall/entertainment facility include: creative freedom in designing the space and its designated areas of operation, up to date technological advances that the building systems can compromise of, and aesthetically appealing to the public by promoting Kingsville. We will design the three buildings one at a time to ensure they are efficient, have proper egress, and are up to code in all areas. The new design will have at least the minimum requirements for LEED certification for each of the three buildings.

AE3 - Renovation of John E. Conner Museum
Team Members: Miranda Gonzalez, Alejandra Roldan, Hefzi Gabriel, Mauricio Vega, Ernest Perez

The current Engineering Complex is a three-story building, but cannot satisfy the increasing occupancy need today. To satisfy this need, a new engineering complex is needed, which will: (1) provide large, assembly-style lecture rooms so larger class sections do not have to look for suitable classrooms in different areas of campus; (2) add a service elevator and a skywalk conjoining our new design with the current engineering complex; (3) provide new classrooms, labs, and office spaces that not only rectify the current issue of overcrowding but allows and encourages growth in the future for the engineering department at Texas A&M University-Kingsville. In this design project, our group is considering implementing energy methods that will reduce the amount of energy consumption and incorporating into the new facility. We plan to ensure the building will be environmental friendly by incorporating innovation and various LEED (Leadership in Energy and Environmental Design) strategies "The five critical areas of focus, as laid out by the USGBC, are "sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality."

AE4 - SUB Building Renovation
Team Members: Robert Correa, Allison Aldana, Hannah Walters, Omar Elmekabaty

The Student Union Building (SUB) is one of buildings that is most in need of a redesign. It is a heavily used multipurpose building that could benefit from expansion. The reason the SUB was chosen is because the administration department is in need of office space and the current office space has roof

and window leaks. The current office space leaves little room for the administration department to work as efficiently as they would be able to if they had more room. Their department cannot currently expand from the lack of available space. To improve the department's efficiency, the SUB would be added onto and the current administration department would be redesigned so the roof and windows no longer leak. A second story above the bookstore will also be added to become the new administration department which will lead to a total reconstruction of the structural design of the current bookstore.

AE5 - New Engineering Complex Building
Team Members: Aaron Espericueta, Vanessa Marquez, Daniel Gracia, Marisol Castillo

The project is to design an Engineering Hall for the College of Engineering, which will accommodate the growing needs of TAMUK's engineering program. It will be divided into five components: construction management, structure, architecture, HVAC and electrical system. Each component is designated amongst the four members highlighting each member's individual strengths. Load analysis, duct and equipment sizing will be performed to ensure the most efficient design for our building. Schedule and cost estimations will also be performed to keep track of the project for its duration. The LEED Checklist will be used to analyze the performance of our building pertaining sustainability and friendliness to the environment.

AE6 - Javelina Student Improvement Center
Team Members: Andrea Martinez, Karla Gonzalez, Sally Romero, Rodrigo De La Pascua

This project is to design a new multipurpose building for students with better and larger study facilities. Proposed building is to accommodate the needs for the students to study, eat, and relax. This will help gain students to not only go to the library and the SUB, but encourage them to study in a quieter environment. Compared with the library, noise control techniques will be adopted to provide students comfortable spaces and enough privacy. The design tasks of this project cover five parts: architecture, structure, HVAC, building electrical system and construction management. Revit is selected as the design platform for these design tasks.

AE7 - Expansion of Javelina Stadium
Team Members: Cristian Barriossalas, Ernest Pérez, Joshua Bailey, Nicholas Vasquez

This project will be a renovation/expansion of the Javelina Stadium bleacher seating with an addition of an indoor track and field facility. With this addition and expansion, we hope to make Texas A&M University- Kingsville a Division 1 FCS football program and create a competition indoor track facility that will hopefully attract more student athletes with the additional sports programs the facility will allow. We will focus on the design of architecture, building mechanical system, building structural system, building electrical system and construction management. All the design work is completed based on Autodesk Revit and comply with the current design standards.

Civil Engineering

CE1 - Rehabilitation of the West Avenue A
Team Members: Salem Alazimi, Yaqoub Alazmi, Yousef Alenezi., Zainab Alherz, Marzouq Alhouri

This project includes the method for reconstructing a section of West Avenue A. The existing roadway has many problems such as potholes from poor drainage, no proper stop signs, and narrow sidewalks. Improving the safety of students walking to TAMUK campus is the first priority. The method for reconstructing of the new pavement is made to meet AASHTO standard. Other methods to improve drainage and safety at the intersections are also taken into consideration.

CE2 - Project Proposal for the West Ave. B
Team Members: Mbark Alhouri, Sukina Alismail, Nawaf Alrashidi, Nathaniel Alvarado, Andrew Bujanos

West Ave B is approximately 3,000 ft long and locates East of the Engineering Complex. Three problems were identified to be the major causes of roadway damages. They are 1) Inadequate drainage system, 2) Seepage of water penetrating the base course, which leads to the development of deep potholes and cracks, and 3) No existing sidewalks in order to install drainpipe underneath along the roadway. Methods for resolving these problems to meet AASHTO standards are presented with cost estimate.

CE3 - Renovation of Baseball Fields 4,5,6 of Dick Kleberg Park
Team Members: Isaiah Cano, John Dabbs, Grecia Diaz, Richard Dogbey, Chimenum Elenwo

This group has taken the duty to improve fields 4, 5, 6 of Dick Kleberg park. Existing poor conditions include rusting fencing, rotting scoreboards, poor soil conditions, inadequate drainage system, and a lack of parking space. The concession stands and press box in between the center the fields are needed to be rebuilt as well as a parking lot that meets the ADA stds. The structural system will meet AISC and ACI standards. Upon completion, the park will increase tourism, safety, and economy, as well as enrich the wildlife.

CE4 - Improvement of Kingsville J.K. Northway Exposition Center
Team Members: Jose Fernandez, Eduardo Fortuny, Cynthia Garcia, Fernando Garza, Roberto Garza

The scope of this project includes three parking lots for the J.K Northway Exposition Center that will be examined through cost estimate. In addition, the design includes a warehouse based on structural analysis and steel design to meet AISC code. Soil investigation is conducted in order to provide an appropriate foundation design for the warehouse facility. All calculations and designs are in compliance with AISC and ACI standards.

CE5 - Restoration of TAMUK Verni & Blanche Hubert Softball Fields
Team Members: Brittney Gonzales, Alexei Gonzalez, Gerardo Gonzalez, Jonathan Hinshaw, Kyle Kendrick

The scope of this project include 1) Fixing the drainage issues of the field and 2) Designing a cover to go over the existing batting cages. In the first part, a detention pond is going to store the water from the field so that the nearby roads and parking lots do not become flooded. For the second part, structural frame is designing to be building above the existing batting cages in order to withhold all weather conditions in South Texas based on AISC, ACI, and ASCE 7 Standards.

CE6 - New Harbor Bridge Report
Team Members: Victor Manzano, Marcus Nino, Isaac Ochoa, Salma Pachicano

A section of residential street was examined to show how runoff water could cause damage to the asphalt concrete roadways. The drainage area and runoff along this roadway were analyzed based on the Rational method to make a preliminary recommendation with Engineer's opinion of probable cost.

CE7 - Design Rental Apartments in Corpus Christi
Team Members: Vito Recio, Zaira Resendez, Jaime Salas, David Stevenson

This project includes an estimated cost of land development for a new rental apartment near Del Mar College to house 4 apartment buildings that consist of 186 2-bedroom until per building. A

software called Visual Analysis will be applied for structured design and analysis to meet AISC and ACI codes. To limit flooding, the trenches will be redesigned with hydrological analysis.

CE8 - Reconstruction of West Corral Ave. in Kingsville

Team Members: Roel Tovar, Crystal Vela, Hannah Vigil, Armando Zendejas, Saleh Alyami

Along the distance of 0.8 miles known as a back road in the rural area, W Corral Ave is surrounded by apartments, ranch land, and a school district. The road presents with asphalt failure and an excessive number of potholes. The best solution is to conduct a mill and overlay procedure that will provide a geometric maintenance and a long-lasting service of the road to meet AASHTO standards. This procedure is cost effective with an estimation of $249,344.53.

CE9 - Renovation of Kingsville Mosque

Team Members: Ali Albaqshi, Ahmad Almutairi, Raja Almutairi, Hassan Alnemer, Baeijan Alotaibi

Kingsville mosque is located at 702 W Ave B with occupying land area of 90,000 sqft (2.08 acres). The mosque can only serve 70 people and it should have served 50 more people. This problem will be resolved by building an additional structural system that meet AISC and ACI codes.

CE10 - Design of New Restaurant with Sump Analysis

Team Members: Hunter Kutach, Frank Oranday, Michael Reyes, Abdalrahman Alenezi

In order to meet the increasing demand for new attractions and the estimated population increase of Kingsville, the project will feature a live model of the on-site sewage facility to be used on the property. This project includes building the five star restaurant outside city limit. The project involves soil testing for building an On-Site-Sewage system in order to design a waste collector system. The drainage field will be integrated into the design as a conventional gravity operated system for treating all waste. The structural system and parking facilities will be designed and built to meet AISE and ACI specifications.

CE11 - The Improvement of Kingsville Hospital Facilities

Team Members: Victor Manzano, Marcus Nino, Isaac Ochoa, Salma Pachicano

The Emergency room department of the Christus Spohn Hospital in Kingsville has three issues.

1) It has inadequate capacity for a major influx of patients.
2) The ambulance driveway overlaps with the storage room causing an unwanted obstruction to the ambulances.
3) The distance of helipad is too far from emergency room.

To resolve these problems, a new two-story building is proposed with a reinforced concrete roof built for landing helipad. Emergency rooms and facilities are upgraded to meet a five star satisfaction. Structural analysis, steel and reinforce concrete design are applied to design and build the structures to meet AISC and ACI codes. Parking facilities are designed with drainage system built in compliance with hydrology.

CE12 - Rehabilitation of "Al Wafrah" Road in Kuwait

Team Members: Khaled Alaazmy, Alhaylam Alajmi, Zeyad Alanezi, Abdulaziz Alazemi, Hamad Alazemi

"Al Wafrah street" is a roadway connecting South East to the Al Wafrah city of Kuwait. It is a two-lanes highway and approximately 18.2 km (11.31 miles). The poor existing condition of this roadway includes thermal cracklings, a bundle amount of potholes from over heat and traffic overload. Traffic accidents mostly occur from line of sight, inadequate lighting, and crossing of wild animals. For meeting AASHTO Standards, this highway is designed based on the traffic data obtained from the Committee of Transportation and Traffic of Kuwait. Prokon software and Civil 3D are utilized.

CE13 - Rehabilitation of "Aljahra" Street in Kuwait
Team Members: Mohammad Alazemi, Ebraheem Albawardi, Salim Albwardi, Abdulaziz Aldaway, Ahmad Alenezi

The distance of the two-lane Aljahra Street is only 805.17 meters (0.5 mile). This pavement condition was rated by the PCI (Pavement Condition Index) of the ASTM Standards to be poor. Based on the high degree of distress severity, the asphalt surface and part of existing soil were removed by 1.00m (3.33ft) thick. A storm drain system was upgraded by installing perforated pipes and geomembrane. The pavements are designed and constructed to meet AASHTO standard.

CE14 - Restoration of "Al Ataba" Street in Baghdad
Team Members: Abdullah Alghamdi, Abdullah Alhusayni, Israa Alkazraji, Bader Almohnna Abdullah Almutairi

Al-Ataba Street is located in the north-west of the capital of Baghdad, Iraq. It is only 1,312.34 ft. (0.25 mile)in length. Parts of the pavement near school are expanded from 2 to be 4 lanes. The restoration work was done in 2005 and 2018 after its first construction in 1996. Heavy traffic vehicles larger than specified in AASHTO code were allowed on this road. Compounding with shallow ground water table (only 3.2-ft deep), the roadway damages include 1) Potholes, 2) Shoving, 3) Cracking, 4) Raveling, 5) Rutting, and 6) Upheavals. MS-17 method of Asphalt Institute is used to design and built this pavement.

CE15 - Restoration of "Al kharafi" Road in Kuwait
Team Members: Mohammad Alotaibi, Saleh Alotaibi, Naser Alqahtani, Nassar Alsaeedi Mohammad Alshalahi

Al kharafi road is 51 km (31.69 miles) long. It is a three-lane street located in Central Kuwait. The existing condition of Al kharafi's pavement is very bad because of heavy traffic volume, cracks occurring from high heat with poor drainage condition. The pavement will be redesigned to take higher traffic load and reconstructed to meet the AASHTO specification as approved by Kuwait committee.

CE16 - Design of a Desalination Water Plant in Kuwait
Team Members: Saif Alshammari, Thamer Alshammari, Mohammad Alsuraikh, Ahmed Alsuwailem, Saad Alwasmi

A new desalination water station is needed to be built at the Qasr city in the Northern part of Kuwait. Structural buildings to house the plant will be constructed to meet ACI and AISC specifications. The total load of the new Desalination System will be determined to design steel frames, concrete slabs, pier foundations that will be capable to support the filtration pressure of water, the weight of pipelines and the accumulation of salt, including brackish solutions.

CE17 - Design Shopping Mall in Kingsville
Team Members: Yousef Alwazzan, Danielle Arenas, Naser Bughdadi, Martin Covarrubias, Bader Hashbal, Mohammad Hussain

A method for designing a new 100-ft square shopping mall that contains a 30-ft ice-skiing arena is what the project will delve into. A 40-ft square atrium is located at the center of the 100-ft square mall and the 30-ft square ice-skiing arena is built at the center of the ground floor. The 3rd floor is built to include cinema halls, structural analysis, steel and reinforced concrete designs are applied to build the mall structural system to meet AISC and ACI codes. Parking facilities are designed with drainage systems built to compliant with hydrology.

CE18 - Improving Kingsville with Multi-Facilities
Team Members: Pedro Moreno, Oscar Ramos, Farrah Rawashdeh, Dahlia Reyes, Hannah Walters Michael Yocum

Three multi-facilities are needed for people to enjoy downtown Kingsville. They are as follows:
1) A bus stop for all local and charter buses.
2) An outdoor dining experience with different food truck options.
3) Parking facilities to provide extra spaces for food trucks, tourists and residents alike.
The bus stop and parking facilities are designed to meet AISC and ACI specifications.
Drainage system is designed and built in compliance with hydrology.

Mechanical Engineering

ME1 - Desalination System
Team Members: Alfred Aparicio, Monica Nevarez, Kelsie Ray

With only 0.78% of Earth's water being in a fresh and easily accessible form, water resource engineering is an ever evolving and important process. One method of water resource engineering is desalination. The capacitive deionization (CDI) method of desalination is growing in popularity. The main objective of the research was to develop an industrial mobile and modular system to evaluate the theoretical performance of the system for saline water desalination. In order to determine if the CDI method was comparable to established commercial methods, theoretical numbers were derived and compared to the proven commercial methods. Factors such as reusability and sustainability were considered when comparing the alternatives. Desalination through the CDI method is carried out when the saline fluid flows within two concentric pipes connected through a highly conductive membrane. As the water flows the pipes and inner membrane is subjected to high quantities of electrical currents creating a magnetic field. The anions and cations in the solution are electrosobed within the electric field upon polarization of the direct currents being applied to the pipes. While this method requires copious amounts of electrical current, the benefit comes in the form of reusability, low maintenance, and a reduction in filter replacement costs. This project focuses on the ability with CDI to process saline water to an industrial water state, suitable for crude oil refining applications. The requirements bring the water to a near potable state.

ME2 - Residential Steam Heating System
Team Members: Huzifa Abu-Jarad, Othman Algarni, Ali Alhulily, Ahmad Basawad, Abdullah Jumah, Marwan Alharbi

A low pressure, condensing steam boiler will be designed for residential use. A condensing steam boiler extracts heat from flue gases to preheat the returning working fluid (typically water) in a secondary heat exchanger. The design methodology will include, but not be limited to, the following topics: selecting the appropriate heat exchanger types, selecting optimal materials, sizing and optimizing the primary and secondary heat exchangers, and configuring the heat exchangers inside the air handler.

ME3 - Feedwater Heat Exchanger
Team Members: Abdullah Aldawsari, Mohammad Almutairi, Abdulaziz Alqurashi

In this study, a U tube feedwater heat exchanger is designed for a Rankine cycle. U tube feedwater heater is a type of closed feedwater heater which is used in power plants to improve thermal efficiency

and reduce shocks in boilers. Working, major components, and materials used for U tube feedwater heater has been discussed in detail.

U tube feedwater heater was designed based on TEMA standards so that it meets the international requirements for safe operation. It was designed based on given design constraints. In this design, steam is extracted from the turbine to preheat the feedwater entering boiler. Kern's method was used for design of heat exchanger. Various parameters was calculated to determine dimensions of the tube and shell. The heat transfer coefficient was calculated on shell and tube side. Overall heat transfer coefficient was also determine. Based on the dimensions obtained from calculation, a basic CAD model was developed in Solidworks. The design is further going to change based on further work and analysis.

ME4 - Roof Mounted Cooling Tower

Team Members: Fahad Alajmi, Ahmad Alazemi, Mubarak Alazemi, Mohammed Alheelaa, Abdulaziz Alzamanan

Cooling tower is a heat exchanger used for cooling hot water from condenser of a process. In this study, cooling tower is designed for a 100ton air-conditioning system which is water cooled. The water exiting the condenser is cooled by cooling tower utilizing atmospheric air to a required temperature.

In this project, induced draft counter flow cooling tower is designed. The induced draft cooling tower components and materials generally preferred are discussed. The various performance parameters such as approach, range, wet bulb temperature, fill size, etc were calculated. Major dimensions of the cooling towers were obtained from the design calculations. Volume flow rate of air and water are used for selection of pump and draft fan. ASHRAE standards are applicable for safe operation of cooling tower. Based on dimensions obtained and selected components, basic model of cooling tower was designed in SOLIDWORKS. Project plan for further work in this semester was also attached in form of Gantt chart.

ME5 - TAMUK Chilled Water Loop 1 Redesign

Team Members: Jose Alvarez, Jerod Brunick, Roberto Cordova, Zachary Cruz, Michael Nunez

The current state of the loop 1 chilled water pipeline has been diagnosed by university HVAC staff as insufficient in both design and function. A few of the known problems include leaks, corrosion, and calcified buildup on the inside of the pipe. Some of the problems affecting the system have already been quantified. Calcification inside of the pipes has been measured and were shown to reduce the effective pipe diameter by 20%. The recirculation rate of the chilled water is measured at only 80%, which means that only 4 out of every 5 gallons of chilled water actually make it back to the chillers. The first step by the team will be to quantify all of the major symptoms affecting the system. Then use these conclusions as a foundation for the redesign of the system.

Once this project is concluded, the team will present concrete evidence of not only "why", but also the "how" the system should be redesigned. Thereby taking one step forward towards the fiscal and environmental sustainability of the Texas A&M University - Kingsville campus.

ME6 - TSGC Project: Human Tended Inflatable Outpost

Team Members: Mosa Almosbahi, Jorge Banuelos, Israel Flores, Jared Garcia, Victor Vega

The Javelina Engineering team has been provided with the opportunity to design a human-tended lunar outpost for the Texas Space Grant Consortium. As requested, the team will be developing a livable habitat for up to four people at a time. It will also provide a comfortable living space for stay 1 lunar day (14 earth days). The design will also account for the daily

routines of the crew along with regular EVA operations. Along with the various operations the crew many conduct during their stay, other obstacles must be taken into account. The outpost must be a comfortable place to stay, meaning proper space and conditions must be taken into account in the design. The conditions on the moon vary to that of earth and it is important that these issues are addressed. The lunar post will only be operational during the lunar day, thus the day and night cycle does not need to be considered for our design. Lunar dust is a concern. Due to the dust being potentially harmful to the crew it must not enter the outpost. The dust is abrasive and can cause harm to any moving parts on equipment. While there is limited information on the effects of lunar dust on humans, a concern would be the respiratory effects it may have on the human lung. Finally, the last of the concerns are environmental issues on the lunar surface. This includes radiation exposure and potential electrical charging. Because the moon has a limited atmosphere, it does not have much shielding from the harmful rays of the sun; this creates an unfavorable environment. Various solutions to these issues have been suggested. To keep the outpost pressurized, there must be a room connecting the outpost to the outside that will allow pressurization before the crew enters the outpost. This room, typically known as an Air-Lock chamber, which will include a decontamination process. This process will remove any dust on the crew or their suits before this enter the outpost, allowing the outpost to remain uncontaminated and livable. One of the materials that has been selected to be included in the design is Kevlar. This popular material is known for its low thermal conductivity and its high strength. Both of these properties make it a good candidate to protect the crew from the harmful conditions of the moon's surface.

ME7 - TAMUK Campus Thermal Energy Storage Tank System

Team Members: Cooper Engel, Gilbert Hinojosa, Ashley Salinas, Hayden Webel, Landon Whitenton

As anyone here on campus can tell you the classrooms can get pretty warm during the spring, summer, and fall months and this can be attributed to a low efficiency HVAC system. Our solution was to design a Thermal Energy Storage system suitable for our campus. The TES tank will recharge using the existing chillers during off-peak hours of operation. Then provide cooling to the school during on-peak hours of operation, which are typically from 3pm to 7pm, where extra charges are added on to the electrical bill. Diffusers inside the tank slow the water entering to near laminar flow and disperse along the cross sectional area. The slight density difference between the hot and cold water develop stratification and allows up to 90% of the water to be used at the desired $42^{\circ}\mathrm{F}$. The maximum estimated monthly savings this tank can provide is $15,000. But this number can be affected due to several other benefits provided such as reduced maintenance, reduction in annual peak electricity cost, longer lifespan and better efficiency of chillers and cooling towers, and points towards LEED certification.

ME8 - Solar Salt Steam Boiler

Team Members: Colton Dobias, Dominic Escobar, Taylor Hamilton, Noe Martinez, Abraham Rodriguez

The team developed and designed a molten salt boiler that can provide low pressure steam to a chemical manufacturing facility. It uses sunlight as the main fuel source. When this source is unavailable, the boiler will run on stored power from batteries that can keep the boiler active. The boiler will provide critical steam safely and reliably; this supplied steam will be utilized throughout the facility to complete day to day operations such as providing process heat. Although this boiler is designed to provide steam to meet the desired specifications set forth by the chemical industry, it is not limited to this industry. This boiler will be capable of providing steam for any manufacturing process where low pressure steam is desired. This document will shed light on the background of boilers, as well as the codes and constraints involved in their design. It will also define the product's scope and present the design plan for the molten salt boiler. It will analyze the feasibility of such a goal, as well as look at the schedule required to meet this goal within a nine-month time-frame and the progress made over time.

ME9 - Dynamic Locking Glove

Team Members: Omar Garcia, Hayden McKelroy, Matthew Thonsgaard, Nathanael Vickery, Jose Ramos

Our project was to design a mechanical glove system that, when worn, will allow the wearer to lock their grip in position around an object. We initially intended the glove to be used for rock climbing but have also theorized other practical uses, such as search and rescue and holding objects securely. Our design for the glove is composed of various shells for the frame of the glove and hydraulics for the locking mechanism. The shells will encase each link of the fingers allowing bending at the joints and directing the forces through the device and not the users hand. The hydraulic locking mechanism allows for the use of a simple, on/off electronic control to engage/disengage the locking mechanism. We have designed and assembled two prototypes. The first prototype is a simple version to test the concept of the design. In addition, this concept design was also used to troubleshoot any issues with the design's practical use. The second prototype is a full working model of our locking mechanism design. From this second prototype design, the material choices can be better analyzed. Upon the completion of the second prototype, we concluded a third prototype would have to be designed and analyzed to incorporate a second degree of motion for the fingers as well as a locking mechanism design for the thumb. Unfortunately, a third prototype was not within our scope and could not be completed within the time allotted.

ME10 - Geothermal Heat Pump

Team Members: Nestor Flores, Miguel Hanze, Dario Leal

Educational buildings across the United States continue to grow old. Antiquated technology leads to demolition more often than renovation. The destruction of these buildings can be mainly attributed to upkeep costs, especially in regard to outdated AC systems. Soon, Texas A&M University Kingsville is going to have to face this great predicament, as many campuses have had to do over the years. In this project we explore the options available to the university in prolonging the lifetime of Eckhardt hall and enabling a new opportunity to save energy costs, all while reducing its ecological impact. In short, the underutilized geothermal heat pump technology has become feasible for both heating and cooling modes, thanks to modern well drilling equipment and high-performance HVAC equipment. This geothermal heat system will not be a stand-alone system like many other systems throughout the country but will instead implement a small portion of auxiliary heating and cooling in order to decrease costs overall by utilizing existing resources. With this system implemented, we can make Eckhardt hall a comfortable space all year round.

<u>Multi-Disciplinary</u>

MD1 - Solar Powered Fuel Injection System for Lawnmowers

Team Members: Alejandro Barrera, John Harney, Alexander Rubio, Robert Trevino, Jonathan Silva

This design project will take an existing machine, the internal combustion engine of a lawnmower, and introduce modern electronic engine controls powered by solar energy. The improved small engine fuel injection system powered by a solar powered battery will be used for lawnmowers and other small engines. This improved design will ultimately provide the customer with a product that is more durable in terms of its lifetime of usage, easier to operate, and better for the environment in reducing emissions. The design process for the fuel injection system requires a manufactured exhaust manifold, and a solar powered battery with a wiring diagram.

MD2 - TSGC Project: Hi Efficiency Thermal Cooling Garment
Team Members: Hannah Beaty, Alexia Bustamante, Matthew Randolph, Bianca Silerio, Isaiah Wilson, David Gutierrez

This project is centered on the optimization of the Liquid Cooling and Ventilation Garment (LCVG) of an astronaut's space suit. This layer of the suit is used to regulate body temperatures while performing work outside of a spaceship (known as extravehicular activity, EVA, or a spacewalk). Research was conducted into how to optimize the suit; some options for project focus were dehumidifying the suit gloves, reducing the weight of the garment, increasing the flexibility of the internal ventilation tubes, or changing the tube dimensions to improve the overall efficiency of the thermoregulation of the LCVG. The design variable chosen for this project was the tube dimension and cross section. The objectives of this garment are to create a heat removal of 100 to 800 W while maintaining or decreasing the weight of the suit. The improved gloves will be able to decrease the humidity to 60% or lower to keep hands dry. These objectives will improve the efficiency and overall comfort in the garment for the astronaut during missions.

MD3 - Central Heating and Cooling System for Cousins Hall
Team Members: Daniel Guerrero, Melody Alfaro, Ryan Hinojosa, Jacob Martinez

This Senior Design project was inspired by a teammate who was given the suggestion of designing a new HVAC system by a Project Manager for campus planning and construction. The topics covered throughout this project touch on the history of Cousins Hall, the current system being implemented, a cost analysis of that system, and the method the team has decided to pursue to meet design specifications. Decidedly, a Hybrid Split system was the best option. Consulting with engineers led us to learn about load calculations, which we applied to the building to determine its heat load. As the project advances, new design work will need to be completed. All of these topics are explained in detail and backed by mathematical analysis to justify our design methods.

MD4 - Silent Drone
Team Members: Cesar Roque, Katrina Sanchez, Adrian Rodriguez, Francisco Gaona

The need for quiet quadcopters for Military reconnaissance and in areas with high population of drones has grown with the advancement of engineering. There are two methods that will be experimented on during the course of nine months. One method will be redesigning the drone's physical shape and the second method will be using active noise cancelling with the use of speakers and microphones. The drone will be made with lightweight material that is low cost but will work effectively. The active noise cancelling subsystem will use various microphones and speakers to help capture the amount of sound the drone produces and output the inverse waves to nullify the noise.

These two methods will be used and tested in conjunction to find the most effective and inexpensive way to silence the drone. The goals for this project are to make the drone register 10 decibels operational noise level at 5 feet.

Computer Science

CS1 - KingTech
Team Members: Justin Contreras, Alfredo Garza, Francisco Geyne, Kevin Reyes

This project focused on developing a platform that allows TAMUK students to communicate with each other for the purpose of purchasing and selling of university materials. The platform was developed into a web application to facilitate its access. The most important goals of the project were to provide a safe and affordable environment for students. Consequently, the web application only allows users to register with a TAMUK email account, and any other email address is restricted from registering

into a new account. Furthermore, no transactions occur through the web application to avoid imposing extra costs on the product. Users can post their university materials with the price for sale, along with images of the product and details of the conditions found. The only products that are allowed on the web application are university materials, e.g., books, calculators, microprocessors, lab materials, notebooks.

CS2 - SpaceCodets: A User Interface for Future NASA Extravehicular Mobility Units
Team Members: Nicholas Bishop, Micah McHugh, Mitchell Weston

Currently, astronauts depend on uninterrupted communication with mission control and an intravehicular activity (IVA) crewmember for effectively completing spacewalks. The National Aeronautics and Space Administration (NASA) plans to integrate information displays into future extravehicular mobility units (EMU) to enhance spacewalk success. The UI will display essential data to the astronaut concerning their health, suit integrity, and spacewalk procedures at the user's request via hand gestures and gaze interaction. The Design uses Microsoft HoloLens mixed reality headset, Unity game engine software, Vuforia image recognition software development kit (SDK), and the HoloToolkit SDK to implement the UI. The development of the design will focus on two main elements. First, the design will ensure that the interface can display all necessary information to the user in order to meet NASA's goals of improving EVA effectiveness. Second, the design will thoroughly consider the human factors between the user and the mixed reality interface to optimize usability and ergonomics. Currently, astronauts depend on uninterrupted communication with mission control and an intravehicular activity (IVA) crewmember for effectively completing spacewalks. The National Aeronautics and Space Administration (NASA) plans to integrate information displays into future extravehicular mobility units (EMU) to enhance spacewalk success. The UI will display essential data to the astronaut concerning their health, suit integrity, and spacewalk procedures at the user's request via hand gestures and gaze interaction. The Design uses Microsoft HoloLens mixed reality headset, Unity game engine software, Vuforia image recognition software development kit (SDK), and the HoloToolkit SDK to implement the UI. The development of the design will focus on two main elements. First, the design will ensure that the interface can display all necessary information to the user in order to meet NASA's goals of improving EVA effectiveness. Second, the design will thoroughly consider the human factors between the user and the mixed reality interface to optimize usability and ergonomics.

CS3 - Vital Recycling
Team Members: Juan Gonzalez, Jesus Quesada, Dangelo Hernandez

Our project is the design and development of a mobile application, Vital Recycling. The purpose of which is to inform people about the recycling process in Kingsville and motivate people to recycle more. The project objectives are informing users about recycling, explaining the profitable benefits that recycling consists of, display lists of accepted materials depending on the location of interests, Real-time pricings of materials and lastly a Mapping system to locate points of interest.

The entire application was created using Android Studio. The layout of the application was created using multiple Activities and Fragments. Google maps was one of the features which took more effort. Using Google Cloud Platform, we generated keys to access services. The keys were used to unlock SDK's and API's to implement services for our needs. For Real Time Pricings, we used Firebase to create an online database.

A user-friendly layout was created to display our collected information and research of recycling. Our Maps are user friendly and easy to access within the layout. Our database consists of accepted materials and pricings to display for the user. Overall the simple design and functionality of the services we provide, informs a user of how the recycling process works within Kingsville.

CS4 - Garden Heroes

Team Members: Dagoberto Garza, Stephanie Garza, Oscar Reyes, Nathan Zelaya

The main goal of the application, Garden Hero, is to leverage data that enables gardeners of all experience levels alike to get the most out of their garden by easily logging and organizing their garden's information. Many people keep track of the progress of their garden by writing down any abnormalities they may come across in a notebook or journal. Garden Hero not only acts as an aid in improving a person's gardening techniques but also brings gardening to the modern age by having a smartphone be the hub for everything related to their garden. The Garden Heroes team decided to incorporate recommendations that accommodate each person's specific garden with respect to what they have planted and what they plan to grow in the future. These recommendations range from how often to water a certain plant to how deep to plant a seed. The Garden Heroes team understands that gardeners never stop learning, and when it comes to gardening, the best education is the experience. Keeping a gardening journal is a great way to build up a record of your experience, so you learn from the things that work - and don't! [1]. Garden Heroes believes it is essential for gardeners to keep track of their plants to document when they are healthy or beginning to die.

CS5 - CheckUp Android Application

Team Members: Thomas Jones, Joe Hernandez, Twinkle Thakor, Saul Munoz

Creating a way to efficiently self-analyze and diagnose the symptoms that the complex human body exhibits daily can have a large positive impact on the health of an individual. CheckUp is an Android application in development that we have proven can reach an accurate diagnosis for several different ailments using Java-based coded arrays. By simplifying the design of the application through a graphical diagram and keeping the process of diagnosis in a multiple-choice scheme, CheckUp narrows down possible ailments until a final diagnosis is reached. This method has produced an application that is focused on minimizing the work and time of the client, while maintaining a user-friendly experience for Android mobile device users of all experience levels.

Electrical Engineering

EE1 - Autonomous Steering

Team Members: Gabriel Rodriguez, Luis Coronado, Jesus De Luna

These days, autonomous steering is becoming common technology in vehicles and robotics with companies like Tesla and Audi applying the autonomous steering to their cars. The reason as for why the technology is becoming common place is to reduce the strain of driving and to improve robotics to the point that they can function without human interaction. Thus, our object is to see if we can create the same type of autonomous steering that is seen in car and robotics today. Thus, the object is to create a robot to follow the lines of a closed environment maze and for the robot to parallel park in this maze.

EE2 - Fingerprint Based Vehicle Starter Project

Team Members: Abiodun Bello, Abdullah Alzaaqi, Saleh Aldawsari

With the increasing vulnerability of vehicle key fobs to Man-in-the-Middle attacks, vehicle security through fingerprinting is becoming mainstream. Unless one is ready to wrap the key fob with aluminium foil always, in order to prevent any replication of communications between the vehicle and its fob by a hacker, it is important to consider a solution such as a Fingerprint based vehicle starter. Here we propose a solution to keys being lost or misplaced and the vulnerability of the vehicle to theft. The system provides a secure and hassle-free way to start and stop the vehicle engine. This biometric system can be incorporated with a key fob or as a standalone unit to operate the vehicle engine.

The goal of this project is to use an ATMEGA 32 microcontroller which allows multiple users to register fingerprints as authorized users using the R305 fingerprint sensor module. The system scans and confirms the fingerprint which is displayed on the LCD screen. This process in turn starts the motor which is controlled by the L293D microcontroller or stops it via the authentication of the fingerprint of an authorized user. The motor is used to demonstrate the vehicle starter. The team was able meet our objective by successfully designing and implementing a working prototype

EE3 - SMART Irrigation System

Team Members: Oscar Garza, Baldemar Delgado, Jesus Salinas Borrego, Daniel Cervantes

The Irrigation system is a useful tool to water crops, gardens, etc. The projects main goal is to improve the efficiency of water being used by limiting the overflow of water to plants and give the user peace of mind on keeping their plants hydrated. The project will consist of at least two wireless sensor components that will send soil, humidity readings to an online server (database). The purpose of the database is to store the information that can be displayed on an application on the phone. The other purpose is to process that information to open certain water valves and allow water flow to the specific plants. Therefore, by using these sensors the irrigation system will not overwater areas that have the correct soil, and humidity values

EE4 - Smart Cane

Team Members: Firas Alhamdan, Lloyd Pierre, Grace Noyola, Alwaleed Alhejazi

According to the latest survey by the American Foundation for the Blind, it has been estimated that there are about 25.5 million adult Americans (about 10% of all adult Americans) who have reported some vision impairments or that they are blind and unable to see at all. The smart assistive prototype device is intended to assist and relieve one who may struggle with everyday tasks because of impaired vision. The prototype design is printed using a 3D printer and uses state of the art microcontrollers programmed with Python to control the device. The features include:

- Lidar and ultrasonic sensors, a buzzer and vibrating motor to alarm the user of any object in the way within a set range.
- A biometric remote control door lock will give the user uncomplicated access to their home as well as providing an extra level of security.
- Camera implementation for facial/object recognition.
- Google Assistant, Siri Control and voice recognition with the ability to connect to WIFI, and to use voice commands to locate and control the device.

EE5 - Microgrid Sensor System

Team Members: Luke Bernal, Addison Gernhard, James Henke, Jason Phillips

A voltage and current sensor board was designed to provide a feedback path to a microcontroller for monitoring power levels in a microgrid system. The sensor board consists of three voltage and three current transducers to provide voltage values to the microcontroller which interprets those values through an on-board analog-to-digital converter. External circuitry is included for transducer biasing, for voltage scaling to provide the microcontroller analog-to-digital converter with the proper voltage ranges, and for powering the sensor board from an independent power source such as a rechargeable battery. To this end, the sensor board is designed to operate independently from its microgrid for continuous operation with redundancy in mind. While the sensor system is housed on prototyping perforated board, a printed circuit board was designed in a CAD software to provide an opportunity for future improvements and possible implementation. Additional research into dSPACE modeling of the sensor as part of the control system, the microcontroller selected for the project, and

the specifications and design of a power source for the sensor board was also performed. Laboratory testing confirmed accurate transducer operation at the specified voltage and current ranges and provided useful data for the further design and improvement of the sensor board.

EE6 - Karenia Brevis Early Detection System
Team Members: Deanne Start, Garrett Bragg, Agustin De La Rosa, Sarah Sepulveda

The purpose of this project is to design and create a self-sustainable buoy that senses the semi-annual occurrence of the harmful algae bloom Karenia Brevis, commonly known as Red Tide, and reports the readings to proper authorities. The presence of Red Tide ensures a rapid mortality rate when in contact with marine life, causing a chain reaction from the depths of the marine ecosystem to business finances on the coast. The objective of this senior design project is to create a self-sustaining buoy, including solar power energy and a rechargeable battery, in connection with appropriate RGB, pH, dissolved oxygen, and temperature sensors, to detect the presence of Red Tide. This will notify the appropriate authorities and researchers to ensure tracking the potential future location of the bloom is noted, potentially saving marine, coastal and plant life, preventing food poisoning in humans, and preparing coastal businesses for a financial loss**.**

EE7 - Fool-Proof Alarm Clock
Team Members: Kevin Alegria-Valenzuela, Ruben Cantu, Brian Williams

This project is aimed towards ensuring a prompt user meets daily demands without failure. Too many times has an appointment been missed or similar matters as a result of oversleeping an alarm. Students and heavy sleepers that require a more than average alarm clock will have personalized temperature, humidity, pressure, and motion sensors operate cohesively allowing The Fool-Proof Alarm Clock to register sleep patterns and various device activity at an affordable price. An accompanying phone and tablet application will track and adapt to user activity. User activity may become habit and the alarm clock will recognize to better assist user and wake accordingly. Achieving a regular sleep cycle aids in an active immune system, decision making, and memory to name a few. Owning this alarm clock reassures the user wakes at desired time, every time.

EE8 - SPOT The Smarter Outlet
Team Members: Sangel Chapa, Mitchell Weston, Karen Oliva

Most power management is accomplished at the distributer level. As power travels into a building, the distributer charges a fee for each kilowatt per hour consumed. By designing a secure power outlet theft prevention system (S.P.O.T.), the consumer can control and monitor the access to the outlet. By creating a firewall, another layer of security is added and prevents power theft at the consumer level thus reducing the amount of power consumed. An RFID identification card activates the specified SPOT power outlet and temporary grants the user access to the device. The microcomputer monitors the behavior of the current draw and provides data to the admin of the power usage. Finally, the microcomputer will decide if the relay will actuate to restrict the outlet or remain granting access to the user depending on the current draw behavior. This project focuses on contributing towards power security and monitoring to make sure all energy used is accounted for. Not only will SPOT help prevent unwanted power usage but the device aims to add an additional layer of protection to the users from being potentially shocked from the socket.

EE9 - Voice-Activated Vehicle Control
Team Members: Karla Rivera, Pedro Villarreal, Nicole McMillin

This project is aimed towards the goal of improving the convenience of operating a vehicle by using voice commands instead of using buttons, dials or switches. The expected results of this project

are to have a functional voice-controlled vehicle that will execute specific given voice commands by the user. The vehicle will have capability of moving forward, backward, and turning right or left, depending on the command given by voice recognition. The sound sensor will detect the command and interpret the command to control the movement of the vehicle. In case of an imminent unavoidable obstacle, the vehicle should be able to interpret the situation and override the voice command to avoid the obstacle. Targeted consumers of the voice controlled vehicle are people who enjoy playing with remote cars and physically challenged people who do not have the use of their arms.

Environmental Engineering

EV1 - Bohl's WWTP Type I Reuse Permit and Plant

Team Members: Miranda De La Garza, Samantha Ronk, Monica Guerrero, Fatima Martinez-Sastre, Francisco Haces Garcia

Drastic increases in population pressure cities to develop their civil infrastructure while preserving public and environmental welfare. West Travis County Public Utility Agency (WTCPUA) currently serves a population of 10,500 in Bee Cave, Texas. WTCPUA has selected an expansion of Bohl's Wastewater Treatment Plant (WWTP) in order to address an increase in population to 22,000 over the next 20 years. Thus, an expansion plan for Bohl's WWTP was developed. A new average daily flow was calculated at 0.9 MGD with a two-hour peak flow of 3.6 MGD. An expansion to the plant which selects alternatives based on capacity, cost, biological impacts, and hydraulic impacts is recommended. The expansion plan includes, among other considerations, the addition of two bullseye package systems, one disc filter unit, one chlorination basin, and one dewatering centrifuge. The proposed expansion will be performed in two equally-sized phases, will not disrupt plant operation, and will enable the plant to continue meeting Type I Reuse Discharge Permit requirements. The recommended modifications amount to a total estimated cost of $2,660,000. This will provide a financially feasible expansion, which will maintain ease of operation and bolster sustainability in the surrounding area.

EV2 - Bohl's WWTP Type I Reuse Permit and Plant

Team Members: Esperanza Aguilar, Erika Hernandez, Ibrahim Elkashlan, Ricardo Torres

The West Travis Public Utility Agency has called for the expansion of the Bohl's Wastewater Treatment Plant (WWTP), one of its two operating WWTPs. This is to be done to account for the projected increase in the population of Bee Cave, TX. The objective of this proposal is to present a viable design and methodology to expand the Bohl's WWTP. Using historical and statistical data, the new plant parameters were calculated to meet the current Type 1 non-potable water reuse permit. After considering an alternative selection process using a weighted factor chart, the plan of action included the construction of a Biological Package Treatment (BPT) system. This consisted of Anaerobic, Anoxic, and Aerobic zones, and additional upgrades to existing systems to account for these modifications. These tasks will be implemented in two monetarily equivalent phases for funding purposes. The plant would remain operational during construction and expansion. With increased bacterial growth over time, the BPT will process granular sludge allowing for the plant to run at an uprated capacity for future growth. This compact design will provide a sustainable, cost-efficient expansion. From a long-term perspective, the proposed plan of action will be under a reasonable cost-benefit ratio.

EV3 - Bohl's WWTP Type I Reuse Permit and Plant

Team Members: Nicolas Ramos, Jon Taliaferro, Jacob Gore, Juan Marin

The Bohl's WWTP in Bee Cave, Texas must expand its annual average daily flow capacity from 0.325 MGD to 1.525 MGD to support a population increase from 10,500 to 22,000 people over the next 20 years. The expansion must be implemented in two equal phases and the plant must continue

operating throughout implementation. The site is bordered by the Barton Creek Habitat Preserve and must remain within its existing property boundaries. Alternatives for each of the plant processes were compared considering cost, health and safety, sustainability, manufacturability, and environmental effects. After evaluation, it was recommended to expand the existing processes including but not limited to; adding pumps at the influent and effluent lift stations, centralizing the bar screen configuration, constructing additional packages and implementing a BioMag system to the secondary treatment process, expanding and adding an additional disk filtration unit, doubling the disinfection process, and implementing on-site sludge dewatering. The proposed capital cost and operational cost are approximately $5,000,000 and $121,000/year respectively. The proposed expansion utilizes state-of-the-art technology (BioMag), and proven technologies to increase treatment capacity in a safe, sustainable, cost- effective, and operator friendly way.

Chemical Engineering

CH1 - Synthesis of MTBE from Methanol and Isobutylene

Team Members: Elizabeth Holden, Destiny Russell, Daniella Soto, and Sagrario Villalobos

This design project covers the synthesis of methyl tert-butyl ether, MTBE, from methanol and isobutylene. MTBE's main purpose is to be an octane booster in gasoline to reduce the carbon monoxide exhaust. The production process of MTBE includes a continuously stirred tank reactor, distillation column, and a reactive distillation column. In order to achieve higher conversion rate of MTBE, the reaction occurs at a pressure of 20 bar, and a temperature of 80°C. Both the CSTR, and reactive distillation column, are using equilibrium kinetics, and a silicon-aluminum zeolite catalyst, ZCIC-10. The distillate stream of the reactive distillation column is recycled into the first distillation column in order to save approximately 29 tonnes per year of MTBE that would otherwise be sent to waste. By utilizing a recycle stream, the need for a waste stream was eliminated, making the process more environmentally friendly. The overall conversion of isobutylene and methanol to MTBE, for the whole process, is 99.9%.

CH2 - Synthesis of Cumene from Benzene and Propylene

Team Members: Lauren Rodriguez, Samuel Wilson, Chance Goodman, Joseph Martinez, Joe Crawford

The objective of this project is to produce an isopropylbenzene, or cumene, production unit. The unit utilizes two pumps, a feed-effluent heat exchanger, and a fired heater to increase the pressure and temperature of the feed to reactor conditions. The reactor is a cooled tubular reactor that operates isothermally at 360˚C. The reactor effluent is separated by a series of distillation columns. The first column separates unreacted benzene from cumene and byproduct diisopropylbenzene, or DIPB. The cumene and DIPB mixed stream are then fed into a second column to be separated. The liquid phase unreacted benzene recovered from the first distillation tower and the DIPB byproduct are mixed and fed into a second cooled tubular reactor operating at 240˚C. The reactor effluent stream, consisting of cumene, DIPB, and negligible amounts of benzene is fed into a third distillation column. This column separates cumene from the undesired product stream that contains DIPB.

The unit is designed to produce 1.04 billion pounds of cumene annually, at a purity of 99.9%. The unit will also produce 2.12 thousand pounds of diisopropylbenzene with a purity of 99.9% as a byproduct. The unit will be operated 362 days per year, with an operating factor of 99.2%.

The process was simulated using Aspen Plus V10. The economics calculations are being completed using the guidelines from *Analysis, Synthesis, and Design of Chemical Processes* by Turton, Bailie and Whiting. The equipment cost calculations are being completed using the CapCost spreadsheet provided by the course.

CH3 - Synthesis of Methanol for Syngas

Team Members: James Gallagher, Kurtis Kuypers, Nolan Ladewig, Logan Muehlstein

Methanol is the simplest alcohol and is an essential chemical and it is one of the prime candidates for becoming an alternative fuel in substitution for petroleum-based fuels for transportation. Methanol is less expensive to produce and is more environmentally friendly than ethanol, which are both traditional gasoline additives. In addition, methanol has less energy content but has a higher octane level which increases the performance of the vehicle. Methanol can be produced from syngas, oil, and coal. For our process, we chose to produce methanol from syngas, which is generally derived from the combustion of natural gas. Syngas is a mixture of primarily hydrogen, carbon monoxide, and carbon dioxide. Our process was modeled using the software ASPEN Plus, we achieved a production goal of 206,000 metric tons annually. Our production rate is approximately 2.5% of the annual amount of methanol produced worldwide from syngas. With our process, we have achieved approximately 50% energy savings via process sustainability. The economics consider capital, energy, operational, depreciation and land cost. With the assumption of 3 years construction of the plant, we will begin generating profit after approximately 3 years of operation. After 3 years of operation, we determined our profit to be approximately 45 million dollars annually.

CH4 - T-butanol from Isobutane Process

Team Members: Adrian Arredondo Jr., Kenia M. Chapa, Luis Miguel Ramirez, Rolando Morin

The commercial production of t-butanol by the oxidation of isobutane in a two-step reaction process was designed utilizing Aspen. Isobutane and oxygen were fed into a RCSTR to produce water and isobutylene as reaction intermediates, followed by a second RCSTR to produce t-butanol and C4 alkane/alkene by-products. T-butanol was separated from by-products with a flash separator for higher purity and vapor separation. The target production rate is 1 million pounds per year, an operating factor of 91.78%, and a 30-day shut down. Kinetic parameters were determined through linear regression from Microsoft Excel and UNIQUAC method was used in Aspen. The total bare module cost for the process is $13,586,600 and $6,479,200 for utilities. Through a fifteen year evaluation, the commercial production of t-butanol from isobutane is financially feasible.

CH5 - Ammonia Production Process

Team Members: Luis De La Fuente, Robert Palacios, Michele Rendon, Jacorey Bingley

This process is designed to produce Ammonia by utilizing the Haber-Bosch process conditions. The operating factor for this plant will be 0.96 which represents a downtime of 2 weeks per year. With a target production of 100,000 tonnes, pure nitrogen and hydrogen will be mixed together in a 3 to 1 molar ratio to satisfy the reaction stoichiometry. This reactant mixture will then be compressed and heated to the required operating condition, a pressure of 200 atm and temperature 450°C. This process has a single pass conversion of 40% through the reactor with an overall conversion of 92.9% utilizing a reactant recycle stream. After the reaction, the product is separated from the unreacted gasses using a system of 2 vapor-liquid flash separators. In a single pass, these separators recover 90% of the product generated at an operating pressure of 20atm and temperature of -30°C.

CH6 - Aniline from Benzene and Nitric Acid

Team Members: Alejandro Juarez-Navarro, Jesus Iniguez, Gladden Chukwu, Chidubem Chukwudi

Aniline (also known as aminobenzene or benzamine) is a colorless oily liquid with a characteristic sweet amine-like odor. Aniline is partially soluble in water and miscible with most organic solvents. Some of these solvents include ethanol, acetone, and benzene. Aniline has several uses in the real world as well as in the industry. The major product that is derived from aniline is methylene diphenyl isocyanate (MDI). MDI is used as a raw material to produce polyurethane foam, which is widely used in high resiliency

flexible foam seating, rigid foam insulation panels, adhesives, surface coatings, and fibers. Other uses of aniline include manufacturing dyes and pigments, photographic chemical, diphenylamine, and agrochemicals. In the U.S., the total production rate of aniline is 1.08 billion kg per year. For this project, the production rate of aniline is 216 million kg per year with an operating factor of 92%. Aniline can be produced either from direct amination of benzene or a stepwise process, which involves nitration of benzene to nitrobenzene and hydrogenating of the nitrobenzene to aniline. For this project, we have adopted the second process – the stepwise production of aniline. In our first reaction, nitration of benzene, we obtained a 99% conversion of benzene and a 95% yield of nitrobenzene. In our second reaction, hydrogenating nitrobenzene to aniline, we obtained 99% conversion of aniline and 94% purity of aniline.

CH7 - Production of Hydrazine

Team Members: Paola Cuellar, Andres Garcia, Alberto Hernandez, Rodolfo Lara, Yulissa Robles

Throughout the semester our group has been working on creating an efficient and profitable chemical process. The reactants, ammonia and hydrogen peroxide, are fed into our system in order to produce our desired product, hydrazine hydrate. Hydrazine is a versatile component used as rocket fuel as well as pharmaceuticals and pesticides; however, this chemical is quite volatile and can self-ignite at certain temperatures, which is why it is produced as a hydrate and not at high quantities. The simulations of our system were performed utilizing the ASPEN Plus software in attempts of obtaining a purity composition of sixty-four percent hydrazine and the rest water. Upon completing the simulations, all of the costs involved in this process were calculated and presented in a cash flow diagram in order to best summarize our results. Additionally, safety features were implemented on how to handle and manage the product as well as waste given off by our system. Our group of five individuals input ten hours a week this semester in order to create the chemical process of hydrazine to the best of our ability.

CH8 - Synthesis of Ethylene Glycol from Ethylene Oxide and Water

Team Members: Andrew Shows, Skyler Blinka, Katie Becker, Belize Escobar-Ellison

The production of ethylene glycol senior design group has designed a chemical process for the production of ethylene glycol from ethylene oxide and water through an uncatalyzed thermal hydration reaction mechanism. The desired product from the process is monoethylene glycol, and the undesired by-products are diethylene glycol and triethylene glycol. A target production rate of 500,000 tons/year of monoethylene glycol was selected as the basis for the design, and the completed simulation is producing 507,000 tons/year. The overall conversion of ethylene oxide to ethylene glycol is 99.7%. The process was designed using ASPEN simulation software, CAPCOST economic analysis, and life cycle analysis. The process design can be separated into three phases: the reaction process, the evaporation process, and the product distillation process. The primary sustainability measures are a recycle loop to minimize water consumption, heat integration, and waste water treatment methods. Process safety considerations focus around the hazards of ethylene oxide and are evaluated in a HAZOP analysis table for the reactor.

CH9 - Synthesis of 1-Hexene from Ethylene

Team Members: Melanie Barrera, Kelsey Fuchs, Divina Ortiz, Nico Rico

Linear alpha olefins (LAO's) are alkenes with their double bond located in the terminal-position. 1-hexene is a LAO used in a variety of industrial applications such as a precursor for polyethylene and heptanol; additionally, it is used for the synthesis of flavors, perfumes, dyes and resins. The market for 1-C_6 and 1-C_8 olefins continues to grow at a much higher rate than larger LAO's. Conventional technology utilizes triethylalumium as a catalyst, TEA, to produce a wide array of LAO's. To target the

production of 1-hexene, we are replicating a process detailed in a recent patent that illustrates LAO formation based off of stoichiometric amounts of a chromium-based catalyst. Ethylene in the gas phase is reacted with Chromium III acetyl acetonate / Methylauminoxane (MAO) as catalyst and uses cumene as a solvent in a non-rigorous equilibrium reactor. Using the thermodynamic package Predictive Soave-Redlich-Kwong Equation-Of State Model, a purity of 99.4% of the desired product 1-hexene was obtained and a single pass conversion of 99.99%. Aspects to our project include: design, simulation using Aspen Plus Software, sizing, economics, safety hazards, project management and sustainability.

CH10 - Synthesis of Pyrolysis Oils

Team Members: Laura Dame, Gabriela Diaz, Alexa Cano, James Constante

It is estimated that across Europe and the United States, about 4.6 million tons of rubber tires are generated annually. Globally, disposed rubber tires accumulate in landfills, where they decompose, leach contaminants into the soil, and are known to spontaneously combust. Pyrolysis offers a way to mitigate the hazards of waste tire accumulation, while harnessing a greater percentage of the high calorific value of tires, compared traditional methods of energy recovery. The proposed process utilizes pyrolysis to depolymerize passenger car waste tires, in the absence of oxygen, to produce noncondensable light gases, oil, and solid char. The crude pyrolysis oil is further separated into gasoline, diesel, and heavy fuel oil fractions. Primary unit operations consist of a circulating fluidized bed reactor, an atmospheric crude distillation column, and an amine processing unit. It is projected that the plant will produce 700,000 gallons per year of the gasoline fuel fraction while operating 85 percent of the year.

CH11 - Direct Hydration of Ethylene to Ethanol

Team Members: Derrick Bruce, Alvan Chen, Jordan Cole, and Ronald Williams

The direct hydration of ethylene produces ethanol by reacting ethylene and steam with a phosphoric acid catalyst. The process typically consists of three major steps including: reaction, recovery, and purification. The direct hydration reaction is typically conducted at an elevated pressure and temperature where only 5% of the ethylene is converted with each pass. To compensate for the low conversion rate, the design implements a series of recovery streams. By separating the ethanol from the crude mixture and recycling the unreacted ethylene, a 95% overall conversion can be achieved. During the purification step, special distillation techniques are needed for the ethanol-water mixture to achieve a purity of 96%. These techniques are centered on a series of distillation columns with different specifications. The targeted ethanol production of this design is around 120 million gallons per year with an operating factor of 90%. The economic feasibility of the ethylene hydration process is dependent on a country with low agricultural yield and high petrochemical production. These combined factors allow target production to be met so that profitability can be achieved.

CH12 - Acetaldehyde from Acetic Acid

Team Members: Jared Medina, Brandon Mourer, Gerardo Rodriguez, and Jorge Rodriguez.

Acetaldehyde is a chemical compound is highly used by manufacturers for the production of perfumes, fruit and fish preservation, and as a flavoring agent. It is liquid at room temperature and ambient pressure, with classification as a carcinogen and fire hazard. The production method we are using is the hydrogenation of acetic acid. Our design will be able to yield us a by-product, acetone, which we can sell to increase our profit. Our reactor is operating at a temperature of 850˚F and a pressure of 252 psi. In aspen, this temperature allowed us to recover more acetaldehyde instead of at a lower reactor temperature where production of ethanol is favored. After the reactor, acetaldehyde is purified in a series of equipment involving flash vessels and distillation columns. Low temperature flash vessels improve the separation of acetaldehyde from the other components. After purification in the

distillation columns, our group of student engineers were able to reach a total production rate of twenty-million pounds per year of acetaldehyde with a 99% purity.

CH13 - Isobutylene from Isobutane

Team Members: Zhehaoran Wang, Walter Scott, Jorge Salazar

The purpose of this project is to successfully simulate the dehydrogenation of isobutane to form isobutylene. Isobutylene is a colorless, liquefied gas, which is highly flammable. Isobutylene is highly sought out because of its exceptional versatility. It can be used to make products such as rubbers, fragrances, plastics, and fuels that we encounter in our everyday lives. Using a mixture of operations such as compressors, reactors and heat exchangers, the dehydrogenation of isobutane to form isobutylene can be simulated within a program called Aspen Plus. Aspen Plus is a chemical process simulator, which offers designing, optimization and performance monitoring for processes. Using a pure isobutane feed, we are able to simulate a 99% conversion of isobutane to both hydrogen and isobutylene. Then, engineering economic calculations will quantify how costly and profitable the project could be in an industrial environment.

CH14 - Isopropanol from Propylene

Team Members: Ali Alghamdi, Pablo C Gonzalez, Ian C Lauer, and Kasi Yannamani

Isopropanol is an important compound that was used commercially for the first time in 1920. Isopropanol is important as it is used as a solvent, dehydrating agent, disinfectant agent (killing bacteria), and a base for making compounds such as acetone. In 1920, isopropanol was obtained by hydrating propylene (direct hydration) with the use of concentrated sulfuric acid. However, that process consisted of 2-stage esterification-hydrolysis, which caused severe corrosion of reactor materials. Due to economic and environmental disadvantages, todays processes of producing isopropanol use catalysts that can achieve faster conversion of propylene and maintain the least number of by-products. Our process uses a reactive distillation column, with the catalyst Amberlyst DT, instead of the more conventional CSTR since we will be able to save up to seven equipment. The process of producing isopropanol from propylene, with the use of a reactive distillation column, begins with propylene and water entering the reactive distillation column at 20 atm, 25 ˚C and reacting to form isopropanol. The bottoms are sent to the extractive distillation column where isopropanol is separated from water using dimethyl sulfoxide (DMSO). Coming out of the distillate we have 99.7% pure isopropanol and the bottoms, water and DMSO, are sent to another distillation column where DMSO is separated out the bottom and recycled back into the extractive distillation column.

CH15 - Production of Methyl Formate from Methanol

Team Members: Veronica Fisher, Cristina Garza, Nancy Nandha, Sunday Sokle, Sendy Sosa

Our goal for our Spring 2019 Senior Design Conference is to produce Methyl Formate (MF) by reacting Methanol (MeOH) with some other compound. For our process we choose to react MeOH with Carbon Monoxide (CO) and we are expecting to obtain MF with over 90% purity. To achieve our desired purity, we will have to use a catalyst and we found that Sodium Methoxide is the most popular catalyst to use in the industry. MF is primarily used in the manufacturing of formic acid derivatives, such as blowing agents for foams and agricultural fumigant. We plan on operating our plant 341 days a year with a downtime of 24 days. We also have a yearly production rate of 30,000 ton per year of the MF and plan on selling our product for $5.04 per gallon. To reduce cost my team has planned to implement a recycle stream for our unreacted CO and we also plan on using heat integration for at least two of the heat exchangers. Overall the main reason to get the purest MF is because we can sell our desired product off.

CH16 - Methanol to Olefins

Team Members: Audrey Alegre, Jasmine Briant, Chelsea Robinson, Shae Smith

The production process of creating the light olefins propylene and ethylene from a feed of pure methanol is continuously growing in industry as the desire for the usage of these materials increases. Although there are several methods to attain either ethylene or propylene at a higher level, the focus of this project emphasizes the production of propylene over ethylene and thus operates at a temperature and pressure which promote this goal. In order to generate an understanding of the production process, a simulation of the overall manufacturing procedure is created, optimized, and analyzed. This material is presented through our project which is completed using a series of continuous stirred tank reactors to emulate a plug flow reactor which is most often used in industry for production. By use of sustainability procedures such as application of a recycle stream as well as recycling of waste water to cooling utilities, the MTO process has been modified for increased profit margins. As multiple byproducts are produced to attain our desired products, these materials can be utilized for side profit by selling to other vendors for further processing. As a result of this overall process simulation a sustainable and profitable process is produced which aligns with the current interests of industry as supply and demand continue to escalate for these product materials.

CH17- Production of Phenol from Cumene

Team Members: Thomas Rogers, Derek Flores, Alex Vimolseng, Jay-U Kamara

Our group has designed a chemical process that will produce 120,000 tonnes of phenol per year. The main processes that make up our chemical process are the oxidation of cumene to form cumene hydroperoxide, the acid catalyzed cleavage of cumene hydroperoxide to form phenol and acetone in equal molar amounts and finally the hydrogenation of alpha-methylstyrene, a minor by product, to form cumene for recycle back into the process. Cumene and air is fed into the oxidation reactor, where the oxidation of cumene occurs to form cumene hydroperoxide. Cumene hydroperoxide is then cleaved in a cleavage reactor by a sulfuric acid catalyst to yield the main product of phenol and by-product acetone. AMS is then sent to the hydrogenation reactor and is hydrogenated back into cumene, then recycled back to the oxidation reactor. Our chemical process design consists of seven CSTR reactors in series, one plug flow reactor, and five distillation columns.

CH18 - Syngas from Natural Gas

Team Members: Ahmed Al Yasin, Abdullah S. Alhajri, Baltazar Ramirez, Paul Griffith

Synthesis Gas (syngas) is a mixture of carbon monoxide (CO), hydrogen (H_2), and small amounts of methane (CH_4) and carbon dioxide (CO_2). Syngas can be produced from many sources including natural gas, coal, biomass, or virtually any hydrocarbon feedstock. The name syngas comes from its use as a crucial intermediate resource for production of hydrogen, ammonia, methanol, and synthetic hydrocarbon fuels. Our project focuses on the production of syngas via Steam Methane Reforming (SMR) using a proven catalyst with known kinetics used for structured bed reformers but sized for pellets due to the sizing of this catalyst being more readily available. The simulation data for our production process was produced using ASPEN Plus (ASPEN) with a target production rate of 517.6 thousand metric tons per year and a yearly operating factor of 95.8%; this correlates to a production rate of 6000 kmol/hr. Using SMR we were able to achieve a 95% fractional conversion of CH_4.

Natural Gas Engineering

NG1 - Oil Well Performance Analysis and Optimization

Team Members: Itohan Agbonkina, Sergio Arciniega, Rebecca Adkins, Oscar Layton Gonzalez

A well located in Mentone, Texas, Loving County in the Permian Basin was selected to perform a production performance optimization study. The selected well is producing from Wolfcamp reservoir since January of 2019 at a rate of 550 barrels of oil per day. Data was collected from Drilinginfo database and the operating company. The idea is to analyze performance of this well and a neighboring well producing from the same reservoir since about five years ago. Assuming a well spacing of 320 acres, common in this area, we predict the life span at current production rate and estimate the best way to optimize well performance.

Some alternatives of production optimization are tubing redesign, and artificial lift. Wolfcamp formation is a calcareous shale formation applicable for acid-fracking to remove damage in order to increase reservoir permeability. This study includes inflow performance relationship to redesign the size of the tubing and primary recovery, and a benefit/cost ratio analysis to determine its economic profitability.

NG2 - Directional Drilling: Well Planning and Design

Team Members: Cole Liendo, Carlos Beltran, Frank Thompson, Raul Rojas

Tracing its roots back to the 1920s, directional drilling intended to provide remedial solution to drilling problems such as straightening crooked wellbores and sidetracking around a stuck pipe. It slowly became a method to access offshore oil sands from an onshore location in the 1930s to increase well productivity while accessing a wider area of the reservoir. The project uses the concept of drilling wells at multiple locations to increase productivity. It does this by deviating a wellbore along a planned course in order to reach a target with a lateral distance depth and direction from the surface. The objective of this project is to design a deviated well in the Wind River Basin field located in Wyoming. The goal underscores the advantages of directional drilling such as increasing production rate and avoiding a fault to reach the targeted pay zone in the area. Tangible and intangible cost estimation is included in the economic analysis of this study.

NG3 - Estimation of Hydrocarbons in Place and Recovery using Geological and Fluid Property Data

Team Members: Ares Benitez, Jacob Perez, Marco Cortez, Nicolas Munoz

This report presents the results of a study of estimation of hydrocarbon in place and reserves using geological and fluid property data. Hydrocarbons in place are calculated using a volumetric method. Reserves estimation is of primary importance to declare commerciality of new reservoirs. Prediction of the recovery factor is performed using decline curve analysis method. We selected a reservoir in Olmos formation located in the same area of the Eagle Ford Shale Formation in the State of Texas. The main sources of information are the Drillinginfo database and the Texas Railroad Commission publications. We prepared a base map and a net hydrocarbon isopach map using geologic information of the area and logs of selected wells. An economic analysis method is used to evaluate the project profitability.