CENTER FOR ENGINEERING
DESIGN & ENTREPRENEURSHIP

2023
SENIOR DESIGN SHOWCASE

GONZAGA UNIVERSITY | School of Engineering & Applied Science

WELCOME

Welcome to Gonzaga University's School of Engineering and Applied Science (SEAS) 2023 Design Expo Day. We're celebrating an important milestone in our student's academic journey—their senior design projects. To transform innovative ideas into proofs-of-concept and prototypes, our students learned about project planning, communications, report writing, budgeting, and resource management.

I am deeply grateful to all those who helped our seniors achieve this daunting feat—supervising faculty, industry sponsors, numerous community members, the SEAS Capstone Committee, and especially Academic Director, Ryan Kellogg.

To our seniors, congratulations on completing this monumental effort. Your design teams have worked hard all year long to take the project from ideation to the physical realization you are presenting today. Thank you for your dedication and commitment to excel in this demanding but gratifying pursuit. I wish you much success in all your future endeavors.

Go Zags!

Karlene A. Hoo, Ph.D.
Dean and Professor,
School of Engineering & Applied Science

The senior design program at Gonzaga has long been a pivotal experience for our students of engineering and computer science. I'm honored to be involved in developing and administrating the program this year through the Center for Engineering, Design, and Entrepreneurship (CEDE).

The entire program and I are extremely thankful for the many sponsoring organizations and professionals who have provided their time and resources to help develop the next generation of professionals. We're proud of the work the students have done this year and look forward to their shouldering of great responsibility to shape the world we know.

Ryan Kellogg
Academic Director,
Center for Engineering, Design, and Entrepreneurship

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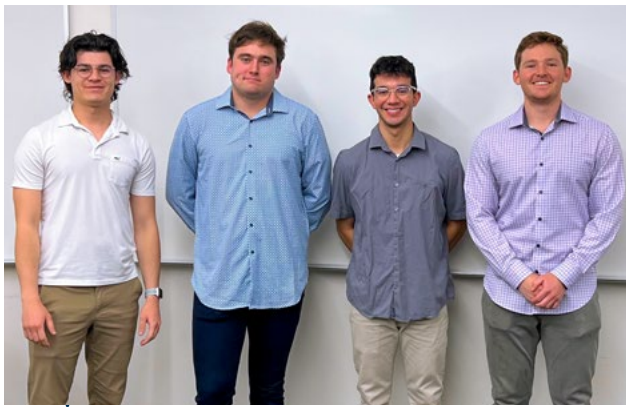
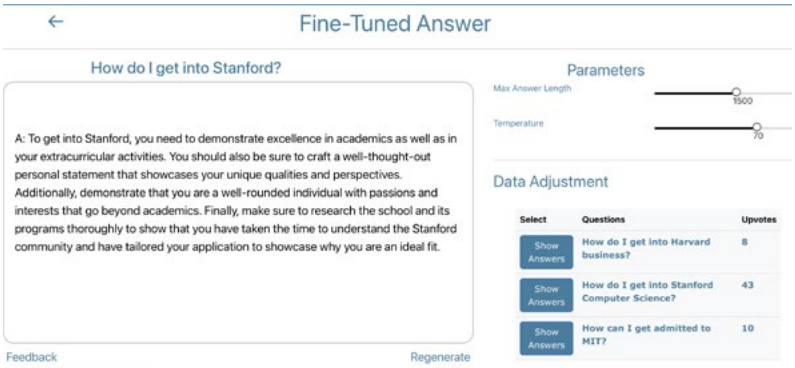
CPSC-01 | Turing Tested NPL Quora Avatar



- Adrian Abeyta, Comp. Sci. & Comp. Thinking
- Anthony Tobias, Computer Science
- Matthew Moore, Business Administration
- Caleb Barker, Computer Science

ADVISOR: Scott Broder
DAB: Michael Herzog
SPONSOR: Xpollin
LIAISON: Scott Broder

CPSC-01 developed Berkeley Bot, a web app that uses Natural Language Processing based on a GPT-3 model and additional fine-tuning data to answer questions from the social question and answer website Quora. One significant challenge with Quora that the team addressed was the wait time between a question being asked and subject experts responding. Moreover, many questions are left unanswered. Our bot is effective at providing fast answers; with the help of true expert responses being scraped and passed into GPT-3, the bot returns meaningful and human-like answers. This project was solely for research purposes and not intended for monetization.

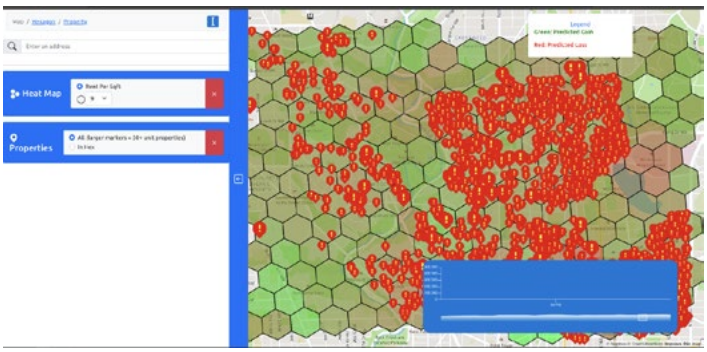


CPSC-02 | Machine Learning for Real Estate & City Planning

- Ryan McKenzie, Computer Science
- Zachary Sahlin, Computer Science
- Ariana Jansma, Computer Science
- Dominic Bevilacqua, Computer Science

ADVISOR: Michael Tobias
SPONSOR: Pangeon LLC
LIAISON: Graham Morehead

The CPSC-02 team engaged with Mr. Graham Morehead of Pangeon LLC to implement a machine learning model able to predict the changes in rental prices on a per-square-foot basis for specific properties at quarterly intervals over a two-year period. CPSC-02 was tasked with finding historical crime, school, and housing data in the Washington DC area. The team worked with Pangeon to implement a novel deep-learning neural network by cleaning up and testing the data querying functions. In addition, the team updated the front end of the software to give more property-specific information as well as solved loading speed issues by improving the API. After back-testing the model, the app was deployed on Pangeon's server to be presented to potential investors as a proof of concept.



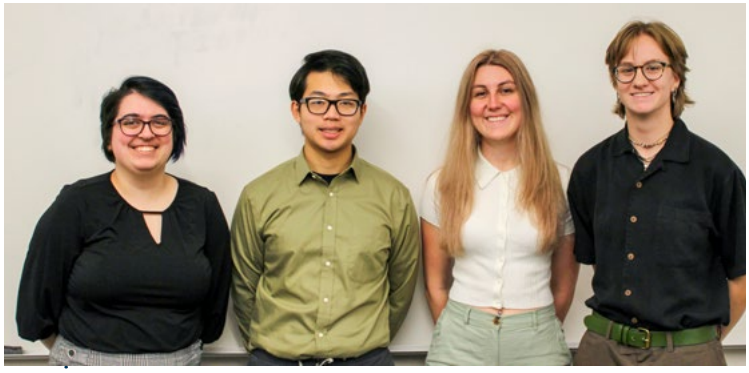
CPSC-03 | Restructuring of Language Translation

- Jason Lunder, Computer Science
- Riley Sikes, Computer Science
- Leon Garcia-Camargo, Computer Science
- Jaymin West, Computer Sci. & Comp. Thinking

ADVISOR: Gina Sprint
DAB: Joe Dumoulin
SPONSOR: Pangeon LLC
LIAISON: Graham Morehead

CPSC-03 successfully created a Lemma-Dependency-Tree (LDT) Translation System that simplifies the learning process for machine translation models. Utilizing a TaggedLemma-Dependency tree as an interlingua, the system eliminates the need for expensive models and extensive training data. The model pipeline involves converting the sentence to an LDT, translating the tree in the source language into a tree in the target language, and converting the resultant tree to a sentence, thus translating a sentence from one language to another. The system is built to be language-independent and was trained on English and Spanish, achieving promising results in both languages. Future research will involve testing the system on additional languages and fine-tuning the component models to achieve even more accurate translations. Nonetheless, the creation of the LDT Translation System represents a significant milestone in the field of NLP and has opened up new possibilities for researchers in machine translation and other areas of study.

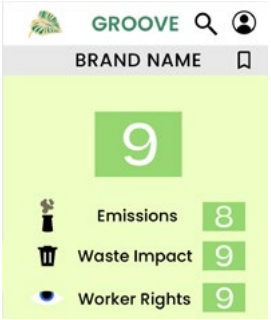
CPSC-04 | Groove Web Extension

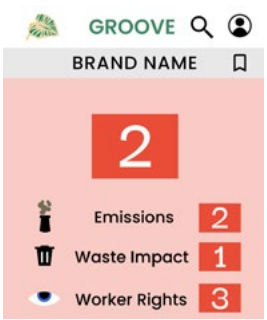


- Nelly Alger, Computer Sci. & Comp. Thinking
- Katherine Stevens, Computer Science
- Linden Beemer, Computer Science
- Ethan Bao, Computer Science

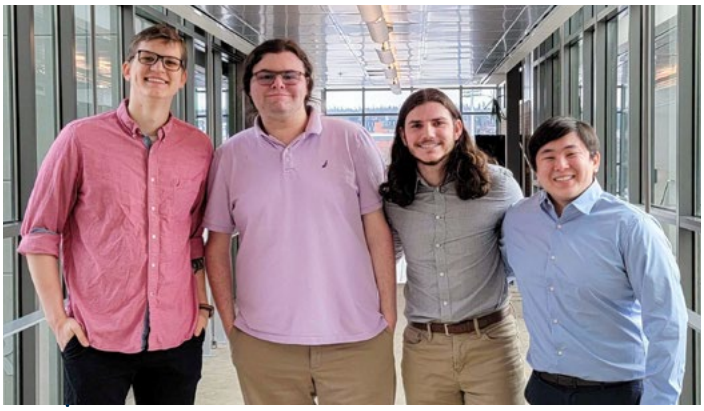
ADVISOR: Daniel Lenz
DAB: Jacob Krantz
SPONSOR: Student Proposed
LIAISON: Linden Rae Beemer

CPSC-04 set out to build out the prototype of Groove, a Google Chrome Web Extension designed to help consumers cut through the greenwashing of large fashion retailers by giving them easy to understand data about how sustainable a retailer truly is. The extension sources data from reputable private and public resources and uses it to generate a 1-10 rating in the areas of emissions, waste impact, and labor standards. The team developed the front and back-end of the extension, and progressed back-end features on the Groove WordPress website. The team leveraged AWS for back-end server infrastructure, as well as a MySQL database and AWS API Gateway service. The front-end was developed with the React Framework.





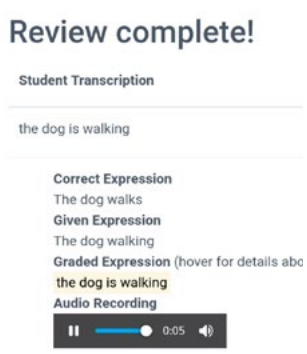
CPSC-05 | ComSem App Development



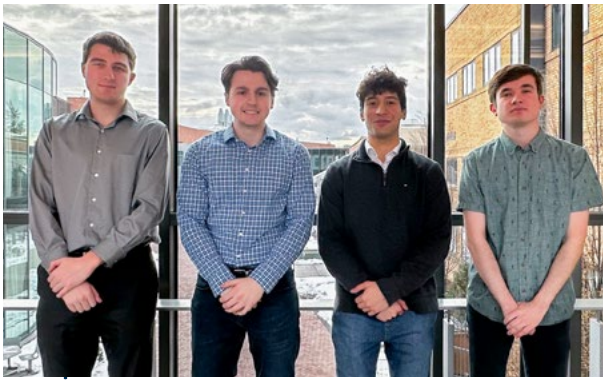
The CPSC-05 team worked with Dr. James Hunter, Gonzaga professor of English as a Second Language (ESL), to develop new features for the program's "Communication Seminar" software, or ComSem. ComSem is an online language learning aid that provides students extra practice and options beyond the classroom. The team helped improve the learning aid through the introduction of three new main features: a speaking practice tool, a teacher assessment tool, and the integration of the YouGlish API.These features have been designed to increase students' English fluency, increase student and teacher interactivity with the site, and improve the overall experience of the site.

- Zachary Ambroseo, Computer Sci. & Comp. Think.
- Avery Edmondson, Computer Sci. & Comp. Think.
- Dominic MacIsaac, Computer Science
- Jared Torii, Computer Science

ADVISOR: Jasmine Jans
DAB: Jesse Phillips
SPONSOR: James Hunter



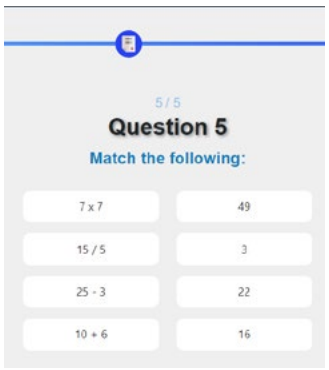
CPSC-06 | HIPPA Compliance Gamification, Phase II



Medcurity is a Spokane-based startup whose goal is to help healthcare companies streamline HIPAA and cybersecurity training. Continuing a senior design project from last year, the CPSC-06 team was tasked to further develop a gamified quiz app designed to introduce healthcare companies to Medcurity's mission in a fun and informative way. The team implemented badges, timed quizzes, bonuses, notifications, and much more. The team also restyled the app to create a visually appealing and modern website. CPSC-06 also worked with Medcurity to introduce administrative tools to support statistical visualization of employee progress in the training platform. The team concluded the project by preparing the app for deployment by Medcurity.

- Jakob Kubicki, Computer Science
- Luke Martin, Computer Science
- Kyle Manning, Computer Science & Computational Thinking
- Ahmadullah Moltafet, Computer Science

ADVISOR: Mike Mudge
DAB: Richard Weeks
SPONSOR: Medcurity
LIAISON: Rachel Kunkel

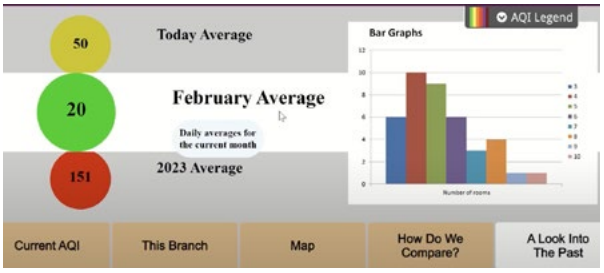


CPSC-07 | Air Quality Monitoring Data Harvest & Com. Display

- Emily Inkrott, Computer Science
- Daniel Balboni, Computer Science
- Andrew Perez, Computer Sci. & Comp. Thinking
- Sarah Hagen, Computer Science
- Jessica Robertson, Eng. Management (Computer Sci.)

ADVISOR: Chris Sharman
DAB: Russell Mann
SPONSOR: Spokane Public Library
LIAISON: Paul Chapin

The CPSC-07 team worked with the Spokane Public Library to develop an interactive display that would showcase the Air Quality Index (AQI) data collected by PurpleAir sensors at each library branch. To do this, the team developed a WordPress plugin that would make the interface available on the library's website to the general public. The interface shows the live AQI at the user's selected library branch, as well as a comparison between the branch's interior and exterior AQI. Other features include an interactive map showing AQI levels in the surrounding area, a comparison of AQI levels in different nearby cities, and a change over time feature that uses calculated averages from each of the sensors. The interface is displayed on touch screens in the central branch of the library to help educate the public about their air quality.

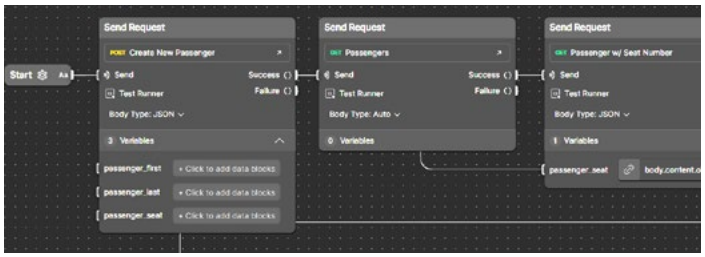


CPSC-08 | Passenger Service App

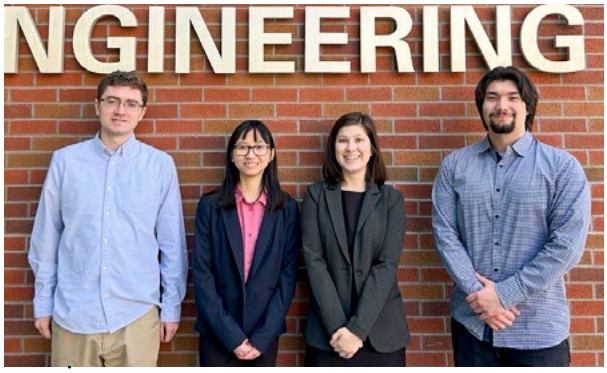
- Alan Poblette, Computer Science
- Samantha Blevens, Computer Science
- Vy Nguyen, Computer Sci. & Comp. Thinking
- Brennan Longstreth, Computer Science

ADVISOR: Chris Sharman
SPONSOR: Boeing
LIAISON: Ethan Owyang, Sally Wei

The CPSC-08 team was engaged with Boeing in creating a tool to improve airline inflight experiences. CPSC-08 was tasked with creating a proof-of-concept application that addresses two main features for users: streamlining the waiting process for the lavatory and providing quick access to food ordering. The team's application will provide accessibility features and reduce the standing time on Boeing airplanes for both flight attendants and passengers. A prototype was designed, built, and tested to ensure that the user interface is user-friendly and suitable for any screen size. The team created a back-end using Express and PostgreSQL as well as a front-end using the Angular framework, all containerized in Docker. Additionally, Swagger and Postman are used for backend documentation and testing.



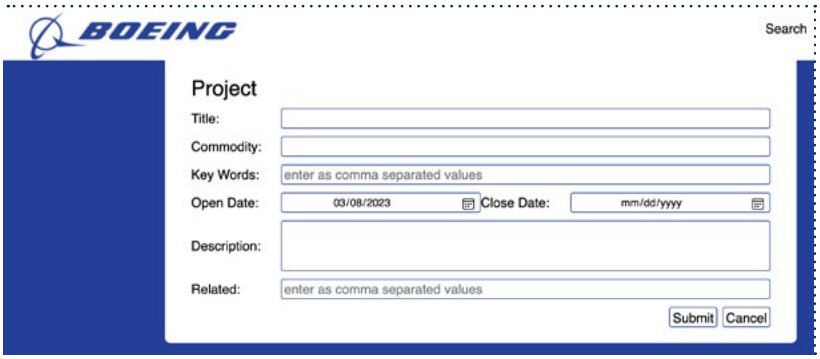
CPSC-09 | Research Project Database/Frontend



The CPSC-09 team was tasked by Boeing to develop a research database prototype that manages metadata and project relationships from engineers' research projects. The system allows for Principal Investigators, or "Project Owners," to insert, edit, and delete research projects through a web interface. General research engineers, or "Basic Users," have the ability to search for and follow projects in order to assist with any active project research. The team created a clean, intuitive front-end for users to interface with. The back-end of the project leverages AWS services to support a serverless architecture for high scalability while ensuring optimal performance and reliability.

- Lin Ai Tan, Computer Science
- Everett Johnson, Computer Science
- Justin Salsbery, Computer Science
- Emily Bodenbender, Computer Science

ADVISOR: Pete Messina
DAB: Graham Morehead
SPONSOR: Boeing
LIAISON: Sally Wei, Ethan Owyang

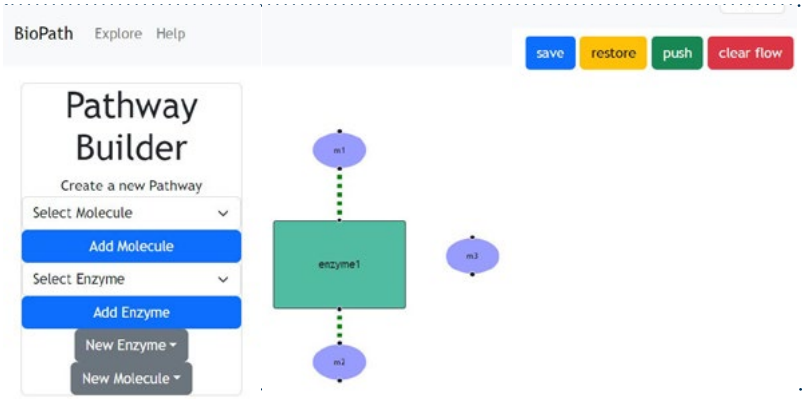


CPSC-10 | BioPath Graphical Learning Tools for BioChemistry

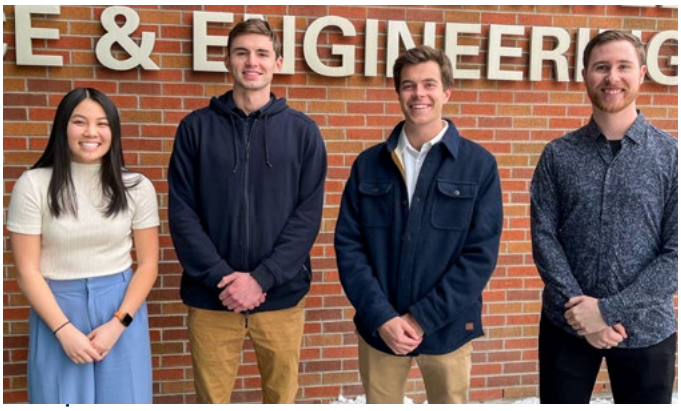
The CPSC-10 team created a full-stack web application for the Gonzaga Chemistry department to visually model Biochemical pathways, such as glycolysis. Intended as a tool for student learning, the web app allows students to change components of the modeled pathway and see the effects of those changes as they propagate through the chemical pathway. The app also aids students in the creation of new pathways in order to potentially model every combination of molecules and enzymes.

- Cole Stainsby, Computer Science
- Zachary Burnaby, Computer Science
- Benjamin Higley, Computer Science & Computational Thinking
- Joshua Schmitz, Computer Science

ADVISOR: Bethany Alcamo
DAB: Mike Mudge
SPONSOR: Gonzaga Department of Chemistry
LIAISON: Jeff Watson



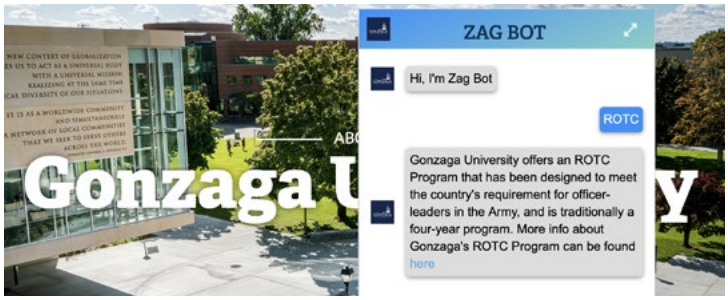
CPSC-11 | Gonzaga Chatbot using RASA Framework



- Maya Fleming, Computer Science
- Adam Kowalchyk, Computer Science
- Hunter Banks, Computer Science
- Joshua Vahlberg, Computer Science

ADVISOR: Cynthia Freeman
DAB: Chris Sharman
SPONSOR: Cynthia Freeman

The CPSC-11 team worked with Cynthia Freeman from Verint Systems to develop a domain-specific chatbot to recognize and respond to at least 250 user intents (goals of the end user) on Gonzaga University's website. This is an ongoing project from previous years of the senior design program, and the current team was tasked with creating a working prototype of this chatbot using the open source RASA framework and integrating it into a mockup of the university's website. User intents were developed using a combination of past Google search queries involving Gonzaga as well as unsupervised data analysis on documents scraped from Gonzaga's website, leveraging machine learning models from Hugging Face and clustering techniques on SciKit-Learn.

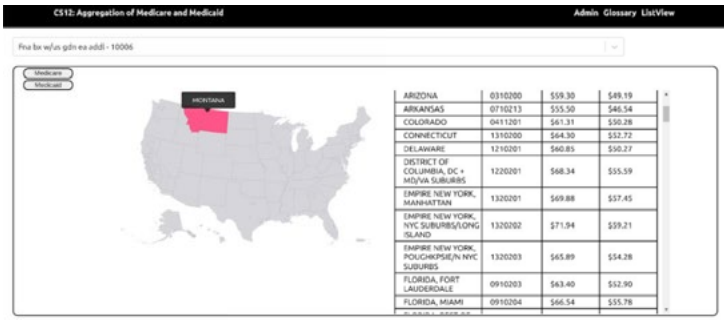


CPSC-12 | Aggregation of Disparate Medicare & Medicaid Data

- Cameron Williamson, Computer Science
- Caden Kim, Computer Science
- Hunter Hauser, Computer Science
- Jacqueline Ramsey, Computer Science

ADVISOR: Gina Sprint
DAB: Chris Sharman
SPONSOR: Amend Health
LIAISON: Andrew Richards

CPSC-12 teamed up with Amend Health to develop a web application named MedBox, which addresses the issue of potential cost for new healthcare startups and how to reimburse them for their endeavors. Due to disparity within federal and state pricing of government healthcare subsidies, healthcare startups struggle to create a profitable and sustainable business in some markets because their solutions may not have a good location and price. The developed MedBox web app not only tells the users federal and statewide Medicare and Medicaid pricing but allows them to interact with the website to see pricing for specific medical procedures by Healthcare Common Procedure Coding System (HCPCS) codes or by description. Medbox aggregates current Medicare and Medicaid data using web scraping, parsing, and text pattern matching and allows users (healthcare startups and practices) to make informed decisions on where to locate their new healthcare startup.



ENSC-20 | Bioretention Media for Treatment of Stormwater

» Justin Gaffney, Civil Engineering
» Sean Mullen, Civil Engineering

ADVISOR: Aimee Navickis-Brasch
Taylor Hoffman-Ballard
DAB: Glorilyn Maw,
Dave Moss,
Andrew Matsumoto
SPONSOR: Evergreen Stormwater
LIAISON: Aimee Navickis-Brasch

At the request of Evergreen StormH2O, ENSC-20 designed two non-vegetated bioretention basins to be constructed with a surface cover using a 60:40 sand to compost mix and a high-performance bioretention soil media. Designed to be constructed on the Gonzaga campus outside the Rudolf Fitness Center, the ponds will feature a rock mulch surface cover and monitoring equipment to measure the inflow and outflow, and consequently, determine the infiltration of the swales. Should these pond designs prove successful in construction and operation, they will offer the city of Spokane a new method for bioretention pond design in the future.

Alternatives Analysis – Surface Cover Material	
Criteria	Description
Cost	Cost to furnish cells
Pollutant Leaching	Potential to leach phosphorous and other pollutants
Availability	Location, lead time, quantity
Durability	Erosion, flooding, temperature, other weathering
Plant Simulation	Soil interaction, runoff control
Aesthetics	Weed growth, overall attractiveness, Gonzaga preference
Maintenance	Frequency, intensity

ENSC-21 | Climate & Flood Resilience along the Shawsheen River

» Ryan Cooper, Civil Engineering
» Sydney Anyan, Civil Engineering
» Megan Fleming, Civil Engineering
» Brooke Baker, Civil Engineering

ADVISOR: Sue Niezgoda,
Alex Maxwell
DAB: Dawson Matthews,
Kaela Mansfield,
Colleen Little
SPONSOR: Fuss & O'Neill
LIAISON: Alex Maxwell

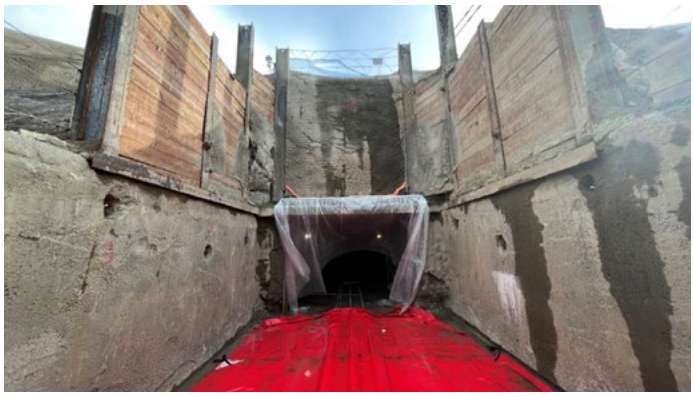
The City of Lawrence, MA has experienced severe flooding from the Shawsheen River. ENSC-21's sponsor, Fuss & O'Neill, has been developing a mitigation solution for the upstream Town of Andover, and has tasked ENSC- 21 with providing the downstream City of Lawrence additional technical information to allow for more accurate flood mitigation strategies in the future. The team developed a set of 15 desktop site screening maps on ArcGIS Pro to identify key properties along the Shawsheen River for potential flood storage and nature-based restoration potential. These maps included the study area, vulnerability and community assets, and environment and ecology characteristics. Additionally, the team developed hydrologic (HEC-HMS) and hydraulic (HEC-RAS) models to evaluate the heavily urbanized reach in terms of existing and predicted future flooding conditions.

ENSC-22 | Construction of Cle Elum Dam Fish Passage Structure

- Nathan Whites, Civil Engineering
- Justin Anderson, Civil Engineering
- Raven Haines, Civil Engineering
- Amy Barber, Eng. Management (Civil)
- Blake Beckwith, Civil Engineering

ADVISOR: Erik Wick
DAB: Vince Poxleitner, Kyle Umlauf, Mark Muszynski
SPONSOR: Garco Construction
LIAISON: Erik Wick

Garco has been contracted by the Bureau of Reclamation to build a fish passage facility at the Cle Elum, WA dam site. ENSC-22 was tasked with designing a shoring system that takes into account the influence of the Cle Elum lake and changes in water surface elevation. The team completed a geotechnical and hydrological analysis to determine site constraints. The shoring design includes an excavation support system, construction sequence, and design drawings. The team designed soldier pile walls in conjunction with wood lagging and tiebacks. The ENSC-22 team completed the project by creating plan drawings in AutoCAD which were submitted to Garco and passed onto the Bureau of Reclamation.



ENSC-23 | Sustainable Drinking Water Filter with Biochar

- Evan Bates, Eng. Management (Civil)
- Emma Accardi, Civil Engineering
- Jem Pedicord, Civil Engineering

ADVISOR: Kyle Shimabuku
DAB: Dave Moss, Katie Larimer, Dave Duncan
SPONSOR: Gonzaga Civil Eng.
LIAISON: Kyle Shimabuku, Mike LaScuola, Mike Petersen

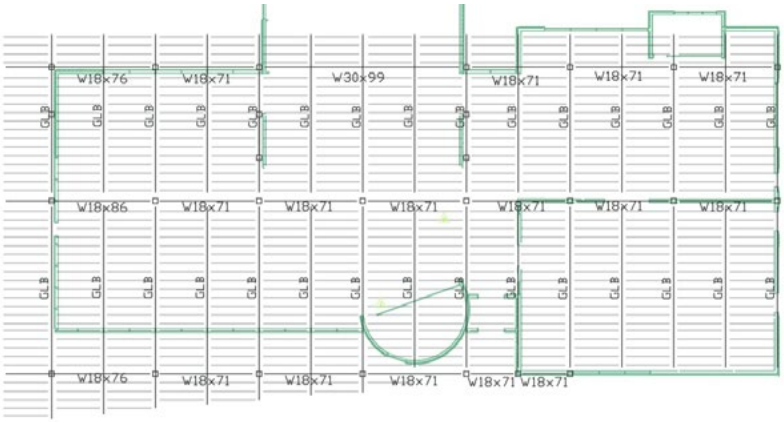
Under an EPA grant, the ENSC-23 team sought to address PFAS contamination in drinking water sources, specifically in Airway Heights, WA. Industry often uses two common treatment methods: Reverse osmosis, which is generally expensive and energy intensive, and granular activated carbon (GAC), which is lower cost but carbon-intensive. The team developed and performed testing on biochar, a byproduct of energy production, in small-scale column tests and found it rivaled GAC filter efficiencies and is ready to be tested in pilot-scale water treatment operations. Currently, there is also no indicator of when a biochar or GAC filter becomes ineffective for PFAS, so in a separate task, ENSC-23 explored partially exhausting filtration media with chlorine to shift chlorine breakthrough before PFAS contaminants. Because chlorine is easy to measure and consumers can smell chlorine upon breakthrough, it can serve as a simple indicator for residents to replace biochar or GAC.

ENSC-24 | New Public Library Building

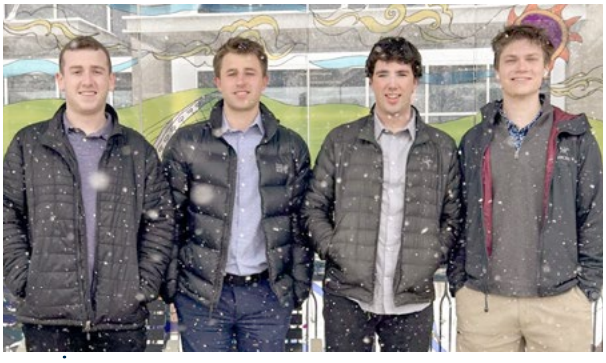
- Drew Barlow, Civil Engineering
- Andres Yalan, Civil Engineering
- Joe O'Hagan, Civil Engineering
- Rory McCarthy, Civil Engineering
- Trenton Uchima, Eng. Management (Civil)

ADVISOR: Aaron Zwanzig
DAB: Melissa Verwest, Emily Sackmann, Dannielle Haraldson
SPONSOR: Integrus Architecture
LIAISON: Aaron Zwanzig

The ENSC-24 team worked with Integrus Architecture to provide Design Development level drawings and a calculation booklet for a new public library in Spokane. Architectural drawings were provided to the team and design loads were determined by the team using the ASCE-16 code. The team conducted analysis and determined that utilizing primary building materials of wood and steel could satisfy a design that handled the calculated loads to insure public safety and meet the aesthetic requirements of the architect. Once the design was completed, the roof framing, vertical structure, and footings of the building were drafted and assembled into construction drawings. Finally, the team completed the project by compiling the calculations made for loads and design into a calculation booklet.



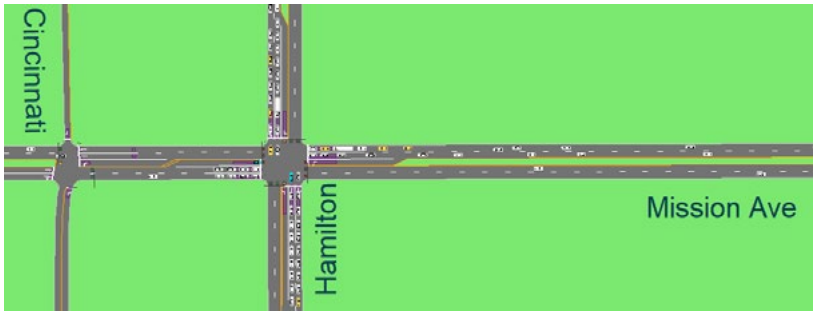
ENSC-25 | South Logan Transit Oriented Development Study



- Sam Novack, Civil Engineering
- Marco Navarro, Civil Engineering
- John Walatka, Civil Engineering
- Jules Wagner, Eng. Management (Civil)

ADVISOR: Rhonda Young
DAB: Jennifer Emerson-Martin, Stu Barton, Adam Miles
SPONSOR: City of Spokane
LIAISON: Maren Murphy

The City of Spokane has been planning a new Transit-Oriented Development in the South Logan neighborhood, which will be supported by the upcoming City Line. ENSC-25 was tasked with developing a parallel plan to the City's overall project to improve safety in the Mission Avenue corridor. Currently, heavy traffic on Mission Avenue causes pedestrians to feel unsafe and effectively acts as a barrier between the North and South parts of the Logan neighborhood. The team studied various transportation components of the corridor including trip generation, vehicle speeds, and crash rates to help address these issues. The team developed a roadway redesign of Mission Avenue that the City of Spokane could use to help support the use of active transportation (e.g. biking, walking, or rolling) in the area.

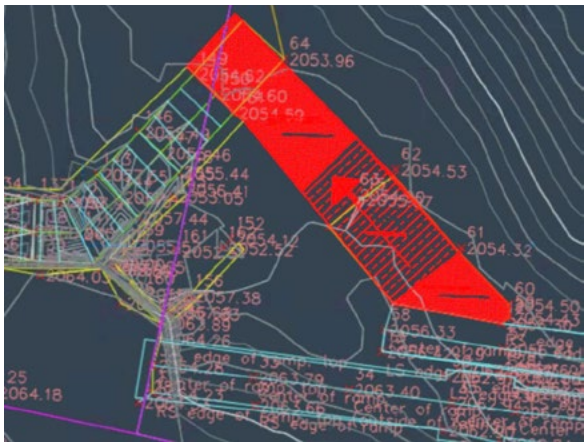


ENSC-26 | Lucky Duck Pond ADA Trail & Parking Design

- Alicia Anderson, Civil Engineering
- Antonio Campos, Civil Engineering
- Sophie Zukowski, Civil Engineering
- Josephine Jankovich, Eng. Mng. (Civil)

ADVISOR: Rhonda Young
DAB: Lindsay Gilbert, Bob Turner
SPONSOR: Wa. Dept. of Commerce
LIAISON: Cynthia Wall Fuller, Bryan Hicks

ENSC-26 was tasked with designing an ADA-accessible pathway and parking area for Lucky Duck Pond, a small park located in Springdale, WA. The pond is seasonally stocked with catchable Rainbow Trout by the Department of Fish and Wildlife and is open for fishing to juveniles, seniors, and anglers with a disability card. The team used Civil 3D design software and developed design plans for the town by conducting surveys, research, and community outreach with relevant stakeholders. Multiple iterations of the design were developed, and a final 90-percent design plan set was presented to the Town of Springdale.

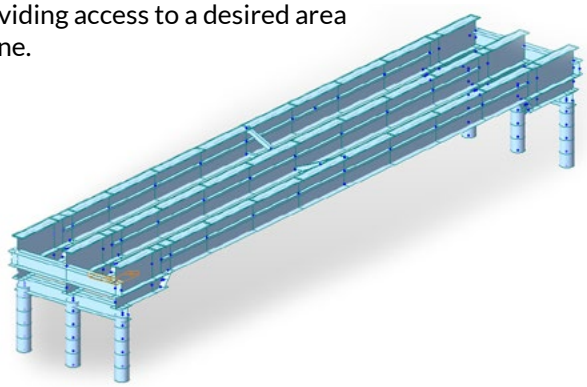


ENSC-27 | Waikiki Springs Bridge Inspection and Design

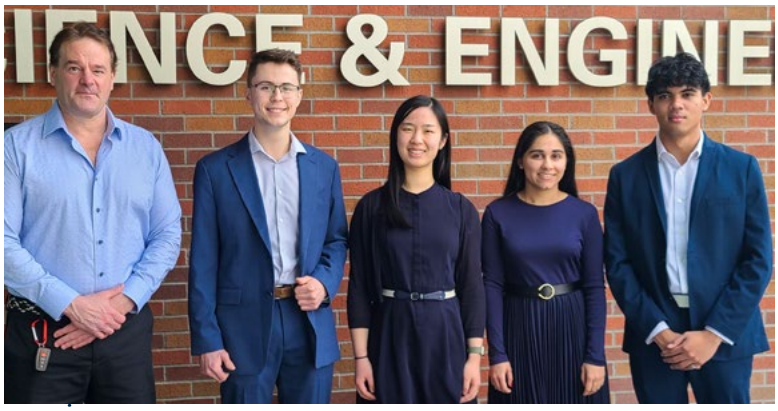
- Iain McDaniel, Civil Engineering
- Alan Champagne, Civil Engineering
- Rachel Fields, Civil Engineering
- Grace Dojan, Civil Engineering

ADVISOR: Ted Bernards
DAB: TJ Bolser, Brenna Doll, Kyle Ryan
SPONSORS: Coffman Engineers, Inland Northwest Land Conservancy
LIAISON: Damiano Seghetti, Todd Dunfield

ENSC-27, or Textbook Engineering and Design (TED), developed the Waikiki Springs Bridge Inspection and Deck Design project for the Inland Northwest Land Conservancy and Coffman Engineers. Through site visits and topographic information provided by Coffman Engineers, TED documented the existing conditions of the bridge and provided design deliverables including an existing superstructure bridge inspection report, load rating determination, decking material selection, and a final detailed bridge design. In addition, TED considered the bridge's impact on the surrounding environment and worked with the Inland Northwest Land Conservancy to ensure the design and construction of the bridge would minimize any potential negative impact. The bridge was designed using a structural configuration of an aesthetically pleasing material which satisfied anticipated loads and preserved the natural beauty of the area while providing access to a desired area in northern Spokane.



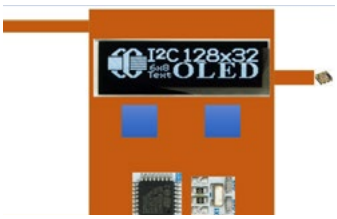
ENSC-40 | Incentive Spirometer

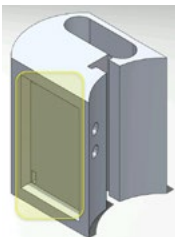


- Gage Bockenstedt, Computer Engineering
- Jaspreet Kaur, Computer Engineering
- Yuchen Huang, Mechanical Engineering
- Joshua Santiago, Mechanical Engineering

ADVISOR: Shane Pacini
DAB: Doug Pooler
SPONSOR: Lung Technologies LLC
LIAISON: Kerry Curran

Kerry Curran founded Lung Technologies LLC in order to develop pre-surgical platforms that help eliminate post-surgical complications. ENSC-40 was tasked with creating a working prototype of an enhanced incentive spirometer. The goal of the prototype is to introduce new features to a pre-surgical tool used to strengthen the lung capacity of patients before surgery, as well as provide care after surgeries that require general anesthesia. The team's final working prototype was a 3D-printed prototype using SLA (a plastic that closely mimics medical grade PVC) of an ergonomic spirometer with a max volume level of 4000ml; and an "electronic housing" that contains components that allow it to provide usage reminders, display the target inhalation volume, indicate the exercise progress, and provide positive reinforcement after each inhalation. The team provided engineering drawings, circuit schematics, and the electronic parts list to Lung Technologies.



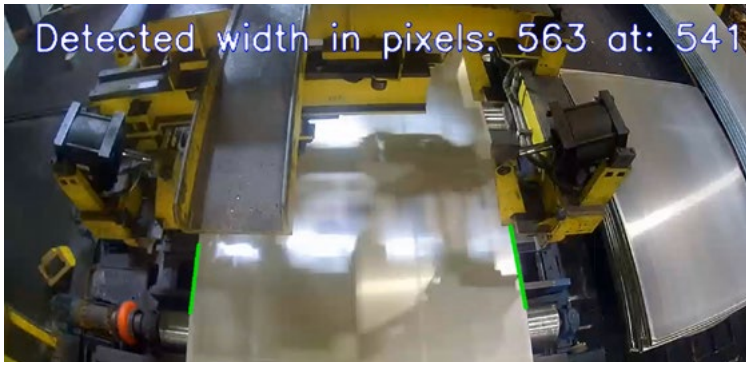


ENSC-41 | Pick & Place Technology Trial

- Ethan Higa, Computer Engineering
- Dylan Brown, Electrical Engineering
- Jovan Koledin, Electrical Engineering
- Jason Dhanota, Computer Engineering

ADVISOR: Chris Nicol
DAB: Gary Holmesmith, Scott Schwartz
SPONSOR: Kaiser Aluminum
LIAISON: Chris Nicol, Scott Warnick, Ken Lucas

ENSC-41 worked with Kaiser Aluminum to design an automation system framework to help automate the cranes which Kaiser uses to move plates from their assembly lines onto various wagons. This automation system consists of a camera and collection of Python scripts that work in tandem to identify and locate plates and communicate their location to the cranes PLC controllers. The team's system can locate the edges of a plate coming down the assembly line to an accuracy of +/- 1 inch and communicate that data quickly to the crane's controller system. The wagon location and height are also detected and relayed to the crane. The crane can then use the locations of the plate and wagon to pick the plate up off the assembly line and place it on the intended wagon.

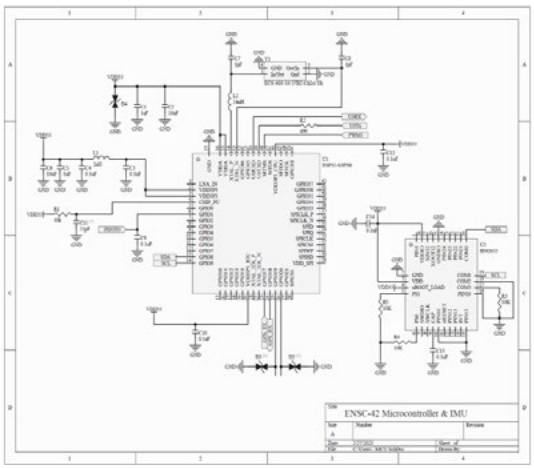


ENSC-42 | Inclinometer & Speed Sensor Suite

- Elwyn Frailey, Computer Engineering
- Luke Johnson, Electrical Engineering
- Ryan Leahy, Computer Engineering
- Kevin Wolff, Computer Engineering

ADVISOR: Vladimir Labay
DABS: Kaitlyn Helsing, Duane Radmer
SPONSOR: Orebaugh Ent. Ltd.
LIAISON: Chad Orebaugh

The ENSC-42 team was asked by Orebaugh Industries LLC to create a device using a speedometer and inclinometer to trigger an LED. The team created a circuit board to implement a sensor suite controlled by a microcontroller with an ultra-low cost and portable design in mind. When the device reaches a certain angle threshold, it marks the current speed, and once the speed changes to a predetermined value, an indicator is turned on. It does this by using a 9 degree-of-freedom inertial measurement unit for orientation in conjunction with a GPS module communicating with a microcontroller for control of an LED.

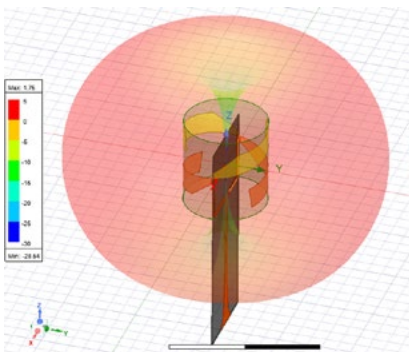


ENSC-43 | Helical Antenna Array Feed Network

- Christopher Chock, Electrical Eng.
- Joshua Sonn, Electrical Engineering
- Michael Erickson, Electrical Engineering
- Colin Guy, Mechanical Engineering
- Jared Marshall, Mechanical Engineering

ADVISOR: Bob Conley
DAB: Wayne Johnson
SPONSOR: Gonzaga SARL
LIAISON: Bob Conley, Steve Schennum

The ENSC-43 team worked with the Smart Antenna Radio Lab (SARL) on a hybrid electro-mechanical project to feed a multi-element helical antenna array to improve manufacturability and cost of such systems. The antenna array is comprised of two pairs of co-polarized helices with left-hand circular (LHC) and right-hand circular (RHC) polarization respectively. The feed network was designed, simulated, and optimized using Ansys HFSS on a double-layer PCB that connects to the helical antenna array. The team iteratively designed, prototyped, and tested in-house using the LPKF U4 Protolaser and the SARL full-anechoic chamber, ultimately submitting the design for out-of-house manufacturing. This dual-polarized array, when completed, will facilitate interference mitigation and covert communications by using polarization modulation.

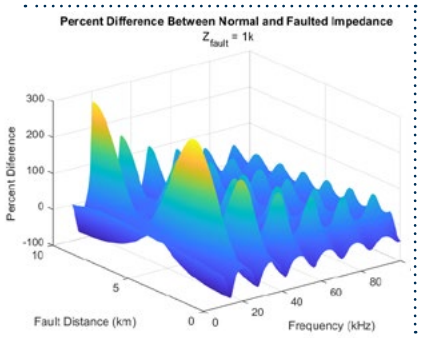


ENSC-44 | Distribution Line Lateral Integrity Detection System

- Joci Anderson, Electrical Engineering
- Matthew Gauss, Electrical Eng.
- Andrew Thompson, Electrical Eng.
- Rhys Williams, Electrical Engineering

ADVISOR: Meirong Zhang
DAB: Nathan Cutler, Brent Barr
SPONSOR: Avista
LIAISON: Doug Forkner

The ENSC-44 team engaged with Avista Utilities in developing a distribution line lateral integrity detection system. During hazardous weather conditions such as windstorms, protection devices on Avista's distribution network are set to trip instantaneously to mitigate the threat of wildfires in high-risk areas. In order to accelerate the required inspection process before re-energization, which can be time-consuming on long, rural feeders, ENSC-44 developed a software model in MATLAB aimed at using a span of frequencies and measured impedance to indicate to dispatch crews if each lateral has maintained integrity. A change of impedance characteristics indicates the line has not maintained integrity and needs service before re-energization. The team validated the project by first modeling a single conductor and then expanding the model to mimic a complete power system resembling one of Avista's longest and most rural feeders.

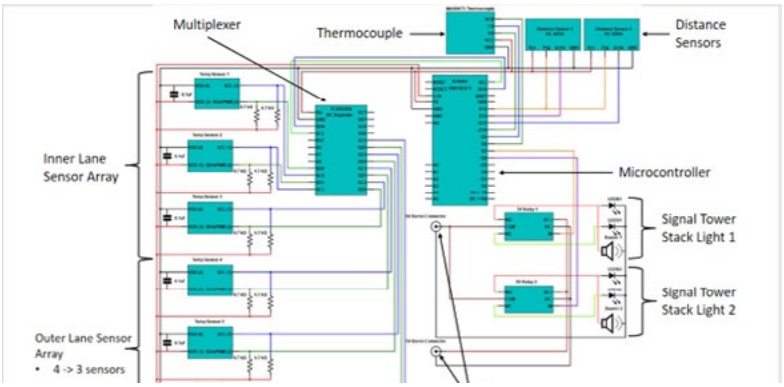


ENSC-50 | Weld Testing/Inspection Equipment

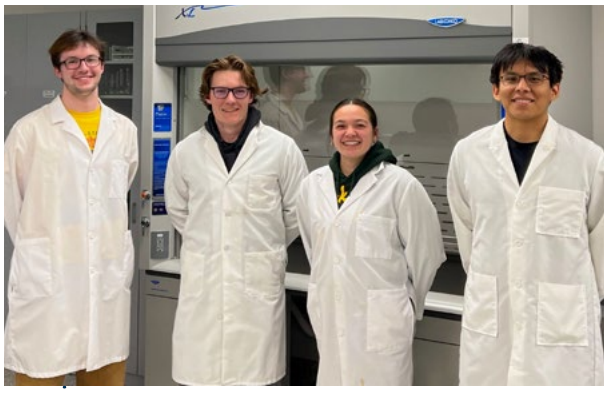
- Carter Roth, Computer Engineering
- Tyler Adams, Mechanical Engineering
- Jacob Delger, Mechanical Engineering

ADVISOR: Andy Johnston
DAB: Karch Polgar, Chad Orebaugh
SPONSOR: Keytronic
LIAISON: Austin Clement

The ENSC-50 team engaged with Keytronic to address the issue of subjective inconsistent testing of vacuum sealed water bottle weldments. When new bottles are produced, they are run through a series of polishing procedures which may remove material and cause weldments to fail. ENSC-50 was tasked with creating and integrating an automated application for factory operations to indicate possible failures by displaying LED alerts to the operator with enough time to remove the bottle prior to failure. The system consists of distance and infrared (IR) sensors to indicate when a bottle is present and when a bottle is 5°C above ambient factory temperature, which indicates a failure. After design, build, and testing, the system was deployed to one of Keytronic's production facilities where it was able to deliver the desired results and notify the operator of a bottle weldment failure.



ENSC 52 | Respirable Crystalline Silica Collection Cassette



- Megan Giacobbi, Mechanical Eng.
- Lake Etsitty, Mechanical Engineering
- Jacob Weston, Mechanical Engineering
- Alexander Zerfass, Mechanical Eng.

ADVISOR: Dave Parks
DAB: Erik Ryan
SPONSOR: NIOSH/CDC
LIAISON: Dave Parks

The National Institute for Occupational Safety and Health (NIOSH), a subdivision of the CDC, has been working toward improving the current method of testing concentration of respirable dust in metal/nonmetal mines. ENSC-52 was tasked with developing, testing, and prototyping a method to test dust concentrations in real time, as well as a system to dilute dust concentrations from air samples to improve the lifetime of a particulate sensor. The team worked through a theoretical experimentation process before testing real components to determine the best design assembly. Once the system design was finalized, the team consolidated the benchtop design into a more portable layout and deployed the system in a mine for final field testing. The project was completed by demonstrating that dust concentrations could be effectively diluted to maintain the longevity of the sensor.

ENSC-53 | Fastener Push-In vs. Rivet Gun Installation

- Adan Saldana, Mechanical Engineering
- Jackson Karcz, Mechanical Engineering
- Beraca Luboya, Mechanical Engineering
- Van Rivas, Mechanical Engineering

ADVISOR: Sam Shoemaker
DAB: Jung Kim
SPONSOR: Boeing
LIAISON: Monica Brockway, Tanni Sisco, Nicholas Reasoner

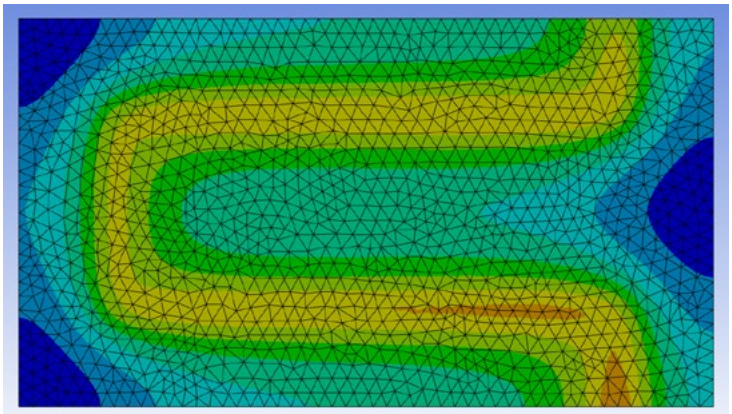
The ENSC-53 team partnered with Boeing to develop a correlation between different insertion methods of fasteners. The two methods studied in this project were a constant-press method using a hydraulic press and a rivet gun insertion method. Press fit bolts are easily tested in the lab, as well as inserted on the shop floor, but there is no correlation between the forces required between the two methods. The team created adaptors for the rivet gun and test coupons in order to instrument them with a load cell to collect data. A procedure was created for a repeatable process to mitigate error and created consistent data. After all the testing, the team found a mathematical correlation between the two methods of bolt insertion.

ENSC-54 | Sustainable Aircraft Deicing System Design

- Claire Martin, Eng. Management (Mech.)
- Avery Steward, Mechanical Engineering
- Olivia Tufte, Mechanical Engineering
- Thomas Wigfield, Mechanical Engineering

ADVISOR: Alireza Toghraee
DAB: Jeff Barnhart
SPONSOR: Boeing
LIAISON: Richard Loftis, Karlene McCauley

The ENSC-54 team engaged with Boeing to develop a more environmentally and financially sustainable solution for airplane deicing. The current deicing process utilizes different types of glycol fluids which are harmful to the environment. ENSC-54 was tasked with creating a design for embedding a thermal emitter into the composite material that makes up the outer mold line of an airplane to melt ice that would accumulate on the wings. The team ran simulations and calculations using ANSYS to confirm that the system meets constraints and restrictions while successfully melting contaminants. Using the models from ANSYS, the team manufactured a working prototype to accurately test the thermal effects of the chosen emitter material.



ENSC-55 | Sustainable Airplane Seat

- Emily Andresen, Mechanical Engineering
- Micah Donald, Mechanical Engineering
- Hannah Dunn, Mechanical Engineering
- Brady Jurgens, Mechanical Engineering

ADVISOR: Andrew Asper
DAB: Dannielle Haraldson
SPONSOR: Boeing
LIAISON: Karen Hills, Leah Freed

The ENSC-55 team partnered with Boeing to research and recommend methods for improving the sustainability of economy airplane seats. The team dismantled and analyzed a current seat model to pinpoint areas for the largest potential decrease in carbon emissions. The team then performed a redesign for sustainability focused on the seat cushion's design and materials. ENSC-55 researched and recommended alternative materials, suppliers, and assembly methods, which effectively decreased shipping emissions, decreased in-service fuel consumption, increased seat durability, and increased use of post-consumer recycled materials in place of virgin materials. Upon completion of their research, the team formally compiled their findings for further testing and implementation by Boeing.

ENSC-56 | Future Passenger Service Unit

- Patricia Graterol, Mechanical Engineering
- Sarah Jones, Mechanical Engineering
- Tristan Caryl, Eng. Management (Mechanical)
- Ryan Hardinge, Mechanical Engineering

ADVISOR: Marc Baumgardner
DAB: Nick Questad
SPONSOR: Boeing
LIAISON: Nick Questad, Andrew Fabry

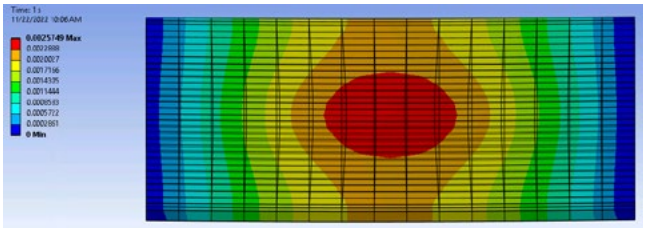
Team ENSC-56 worked with Boeing to generate innovative ideas for the Passenger Service Unit (PSU) in a Boeing 737 to meet the needs of the future passenger. Using market research, creative idea generation, and frequent collaboration with their sponsors at Boeing, the team not only produced updates for existing features in the panel above the passengers but also proposed a handful of brand-new features for the PSU. Using feedback from presentations to both peers and Boeing engineers in Everett, the team then took their list of concepts and compiled them into a set of complete panel designs. ENSC-56 then used SolidWorks to design and 3D print parts which were used to assemble a semi-functional prototype to demonstrate how their ideas would look, feel, and operate in a real passenger plane setting.

ENSC-57 | Temporary Walking/Working Surface Panels

- Nathan Gerken, Mechanical Engineering
- Molly Peters, Mechanical Engineering
- Zachary Tyree, Mechanical Engineering
- Cameron Wright, Mechanical Engineering

ADVISOR: Brandon Sargent
DAB: Connor Garand
SPONSOR: Boeing
LIAISON: Jose Villarreal III, Don Russell

Team ENSC-57 collaborated with Boeing to identify an alternative material to serve as a temporary walking/working surface panel used to assist in aircraft assembly. The current material in use has been found to be inadequate in the categories of durability, cost, and weight stipulations. ENSC-57 was tasked with researching and testing materials that increase ergonomic efficiency, decrease weight of the panel, and meet all other design requirements established by Boeing. The team narrowed down the list of potential materials through finite element analysis and performed an extensive design process that led to the development of several prototype concepts. After fabricating and running tests on these panel prototypes, the team made revisions to better suit Boeing's requirements. Based on additional testing results, the team fabricated a final prototype and reported the material recommendation to Boeing.



ENSC-58 | Recycled Thermoplastic Composites

- Andrew Kelley, Eng. Management (Mech.)
- Nolan Miller, Mechanical Engineering
- Samantha Ward, Eng. Management (Mech.)
- Michael Wiest, Mechanical Engineering

ADVISOR: Jeff Nolting
DAB: Brenna Doll
SPONSOR: Boeing
LIAISON: Jamie Langabeer, Karen Hills, Davis Tran

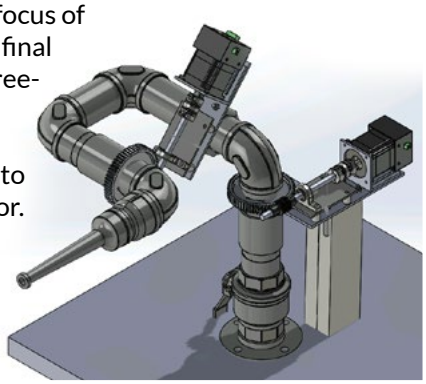
Boeing has been working to decrease their environmental impact by utilizing a fully recycled carbon fiber composite material in their aircraft interiors. This is intended to greatly increase long-term sustainability by reusing material as well as reducing the weight of interior plane panels, thereby increasing fuel economy. Team ENSC-58 worked with ATC manufacturing to stamp form a nonwoven carbon fiber and polymer PEI (Polyetherimide) material into interior aircraft panels. The team evaluated several factors of these new parts to characterize acceptable surface quality for such parts. The final deliverable was a set of qualitative and quantitative grading criteria that Boeing can use to assess future PEI panels. This included acceptance limits for surface roughness and defects common in the stamp forming process.

ENSC-59 | Fire Extinguishing System

- Alexander Delgado, Mechanical Engineering
- Brandon Duff, Mechanical Engineering
- Bryce Eppler, Mechanical Engineering
- Brian Applonie, Mechanical Engineering

ADVISOR: Damon Taam
DAB: Philip Pintor, Gregory McFadden
SPONSOR: Spokane Waste to Energy
LIAISON: Damon Taam

ENSC-59 engaged with Spokane Waste To Energy to create a solution for the ongoing issue of lithium-ion fires in their waste holding pit. When fires occur at the facility, the current method of putting them out relies on direct interventions of plant workers or the Spokane Fire Department. Lithium-ion fires, specifically, require unique suppressant applications which differ from historical systems. ENSC-59 was tasked with designing and building a mechanical prototype for an automated fire monitor to combat fires without putting plant worker's lives or health in danger or requiring the deployment of the fire department. Design and development of the prototype has been the sole focus of ENSC-59 with the final plans including three-inch diameter piping and electronic motors to actuate the monitor. The team then created a physical prototype for testing and application.

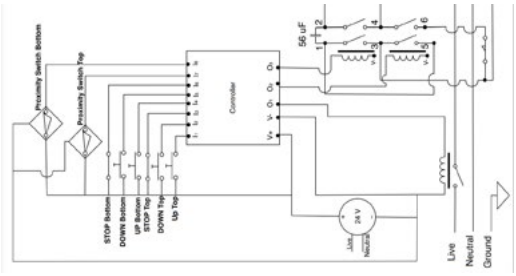


ENSC-60 | Document Lift System

- Michael Ashe, Electrical Engineering
- Diana Garcia Diaz, Electrical Engineering
- Alexander Jones, Mechanical Engineering
- Andrew Wilson, Mechanical Engineering

ADVISOR: Shane Pacini
DAB: Alek Marinos, Terra Donley
SPONSOR: Transitions (help4women.org)
LIAISON: Edie Rice-Sauer, Randy Brown

Transitions, an organization which addresses women's poverty and homelessness, built a fire-safe room in the basement of their main facility to store required records and documents. Using the stairs to move file boxes to the basement posed a potential safety hazard and challenge to their employees. ENSC-60 was tasked with designing and prototyping a lift system to move the boxes containing the documents safely to the basement. The team developed a lift design and analysis package of the loads and electrical components. The designed lift system is composed of three segments for ease of integration on-site and sub-scale testing. A prototype was designed, built, and tested using one of the three segments to validate the selected components and verify the lift system operates safely. The team submitted assembly drawings, a structural analysis report, wiring schematics, a user manual, and an installation guide.



ENSC-61 | Roll Table Polishing Sled

- Andrew Breemer, Mechanical Engineering
- Chase McSweeney, Mechanical Engineering
- Matthew Mikita, Mechanical Engineering
- McCallister Wahl, Mechanical Engineering

ADVISOR: Colleen Nolting
DAB: Bob Reed
SPONSOR: Kaiser Aluminum
LIAISON: Colleen Nolting

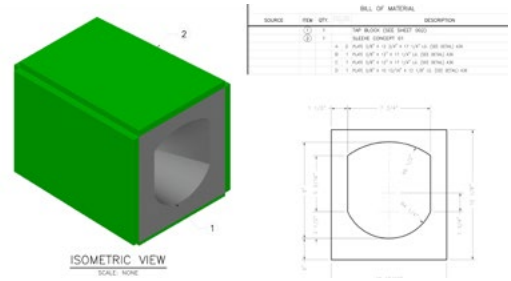
During the production of aluminum plates, slabs of aluminum are reduced to the desired thickness using several rolling mills. The slabs are transported between mills on powered roll tables. Over time these powered rollers develop aluminum buildup and surface imperfections from the aluminum slabs. To prevent this, Kaiser Aluminum polishes the rollers using a sled that presses sandpaper against the rollers while they are being operated. The sled was previously held in place using an overhead crane, resulting in an unfavorable loading condition on the crane, and contributed to lower downtime efficiency. To correct this problem, ENSC-61 has developed a jib crane deployment system for the polishing sled. The deployment system is designed to be portable throughout the Kaiser Aluminum facility by allowing it to be slotted into inset pockets in the concrete at points alongside the transport tables.

ENSC-62 | Aluminum Casting Tap Block Puller

- Alexander Babij, Mechanical Engineering
- Gabriel Barahona Rapalo, Mechanical Eng.
- William Bays, Mechanical Engineering
- Murad Hummatov, Mechanical Engineering

ADVISOR: Chris Nicol
DAB: Justin Chin
SPONSOR: Kaiser Aluminum
LIAISON: Chris Nicol

The ENSC-62 team worked with Kaiser Aluminum to address safety concerns surrounding the removal of tap blocks from their furnaces. The tap block, a ceramic block with a tunnel through it to control the flow of molten aluminum between production stations, is currently removed through manual or robotic jackhammering. This method has potential to cause injuries such as sprains, strains, and exposure to flying debris. ENSC-62 developed a new removal process utilizing a titanium sleeve with pre-tapped threads to surround the tap block. When the tap block needs to be removed, eyebolts can be threaded into the sleeve and steel cables routed through the eyebolts. A pulling device using a hydraulic cylinder can then break the tap block free, and a crane can finish safely removing it.

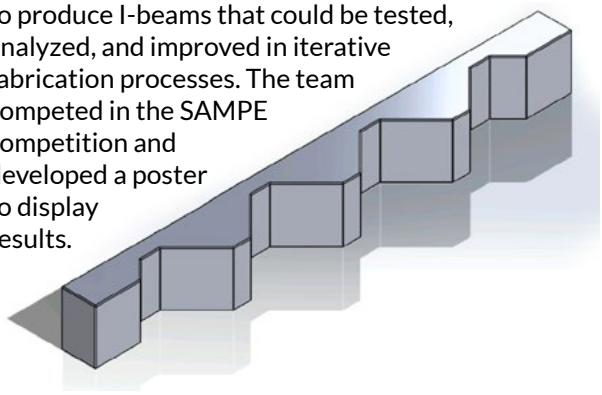


ENSC-63 | SAMPE Student Bridge Competition

- Andreas Andersson, Mechanical Engineering
- Connor Lotzkar, Mechanical Engineering
- Claire Powell, Eng. Management (Mechanical)
- Aubrey Scott, Mechanical Engineering

ADVISOR: Rudy Lauth
DAB: Gary Weber
SPONSOR: Student proposed, Materials Advantage Club
LIAISON: Scott Aubrey, Andreas Andersson

ENSC-63 utilized the Society for the Advancement of Material and Process Engineering's (SAMPE) Student Bridge Competition to explore topics in composite manufacturing, material properties, and different geometric behavior in I-beams. The team analyzed a concept for an I-beam that would have an inner web following a trapezoidal shape rather than the straight line geometry found in a typical I-beam. This uniquely shaped beam provided potential to create an I-beam that could withstand greater loads during a three-point bend test and granted the team the ability to explore different fabrication processes. With this information, the team developed and manufactured a tooling concept that would allow for a repeatable fabrication process of a trapezoidal shape. ENSC-63 utilized a lay-up process in order to produce I-beams that could be tested, analyzed, and improved in iterative fabrication processes. The team competed in the SAMPE competition and developed a poster to display results.



ENSC-64 | Product Re-Design of Slumber Party Tent

- Camelon Bain, Mechanical Engineering
- Cassie Eskicioglu, Eng. Management (Mechanical)
- Natalie Ryan, Mechanical Engineering
- Victoria Young, Mechanical Engineering

ADVISOR: Alireza Toghraee
DAB: Trevor Longbottom
SPONSOR: Modern Dreamers Slumber Co. LLC
LIAISON: Njal Lundberg, Lili Klein

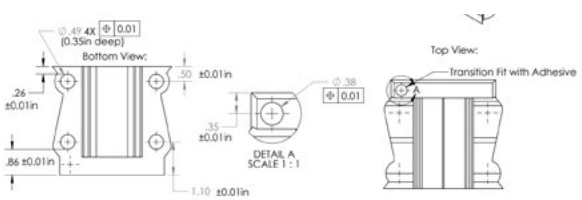
The ENSC-64 team engaged with Modern Dreamers Slumber Co. to redesign their existing slumber party tent product to be more portable, professional, and manufacturable. To accommodate these desires, two tent designs were created. The first design included a collapsible telescoping rod for efficient portability and minor set-up required. This design retained the original A-frame tent structure, but the collapsible hollow aluminum rods allowed the product to shrink to one third the original size for packaging. The second design was created to expand Modern Dreamers market share. By retaining the A-frame and exchanging the original dowels for ½" threaded PVC pipe, this design allows for cost-efficient narrow packaging and increases set-up time only slightly.

ENSC-65 | 3D Printed Golf Putter

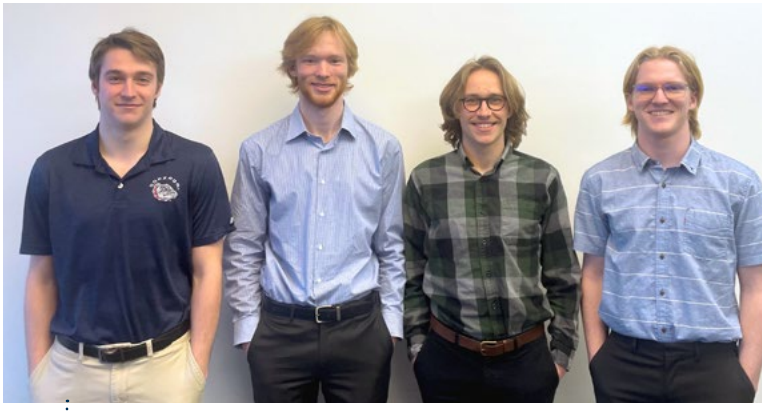
- Collin Beil, Mechanical Engineering
- Devin Jenkins, Mechanical Engineering
- John Marty, Mechanical Engineering
- Dara Murphy, Mechanical Engineering

ADVISOR: Brandon Sargent
DAB: Les Bohush
SPONSOR: Student Proposed
LIAISON: Devin Jenkins, Collin Beil

Team ENSC-65 was tasked with a student-proposed project of developing a 3D printed golf putter head that uses innovative technology to create a high-performing and cost-effective product. The main objective was to create a putter head made from aluminum that maximized its moment of inertia and could compete with similar products on the market. A high moment of inertia reduces the putter head's twist to help the golfer's accuracy and consistency. The team designed, developed, and tested prototypes against a current top-selling putter to ensure they were creating a quality product. By utilizing advanced metal printing technology and a design that leveraged its manufacturing capabilities, the team created a putter that appeals to a range of golfers by being both forgiving and having the feel of a high-end putter.



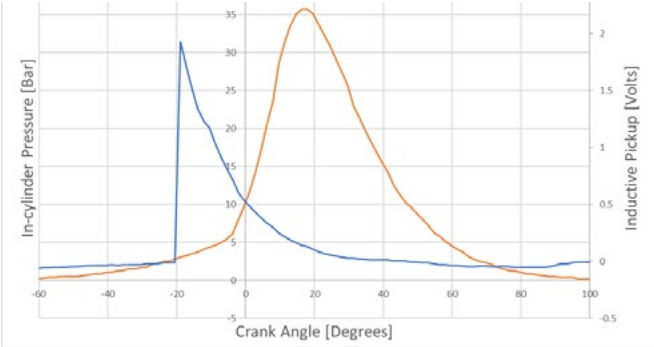
ENSC-66 | Hydrogen Piston Engine



- Anthony Graves, Mechanical Engineering
- Keegan Hilt, Mechanical Engineering
- Luke Larson, Mechanical Engineering
- Connor Nordell, Mechanical Engineering

ADVISOR: Marc Baumgardner
DAB: Gregory McFadden
SPONSOR: Avista
LIAISON: Jason Graham

The ENSC-66 team, under the guidance of Avista Utilities, was tasked with putting together a comprehensive report on the effect of converting natural gas power plants to run on a mixture of green hydrogen and natural gas. With growing restrictions on emissions and increasing power demand, new solutions are needed. The team studied the theoretical effects of hydrogen enriched natural gas in academic reports around the world and adapted these methods to a 319cc single-cylinder Briggs and Stratton engine. The engine was integrated, instrumented, and tested in a test cell which allowed the measurement of output power, theoretical power from fuel chemistry, and emission species. ENSC-66 created a report that blends academic studies, documented results from the conducted testing, and the current state of green hydrogen for Avista to use as a starting point for analyzing new technologies.



41 projects undertaken by enginering and computer science seniors

3 new student project labs in the Bollier Center for Integrated Science & Engineering

40 fabrication requests processed through the Manufacturing Technology Center making use of dozens of materials and processes

THANK YOU

Sponsors

Sponsoring organizations provide projects, resources, and professional influence to the senior design teams. Diverse sponsors provide a wide range of project options, giving students a more engaging learning experience.

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- Evergreen Stormwater
- Cynthia Freeman
- Fuss & O'Neill
- Garco Construction
- Gonzaga Deptment of Civil Engineering
- James Hunter, Ph.D.
- The Inland Northwest Land Conservancy
- Integrus Architecture
- Kaiser Aluminum
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- Medcurity
- Modern Dreamers Slumber Company LLC
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- Pangeon LLC
- SARL (Smart Antenna Research Lab)
- Spokane Public Library
- Spokane Waste to Energy
- Materials Advantage, Gonzaga chapter
- Transitions (help4women.org)
- Washington Department of Commerce
- Jeff Watson, Ph.D.
- Xpollin

Design Advisory Board (DAB)

Design Advisory Board members are experienced professionals who volunteer their time and talents with the teams, offering diverse guidance and mentorship.

- Jeff Barnhart
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