Mechanical Engineering Design and Analysis Portfolio

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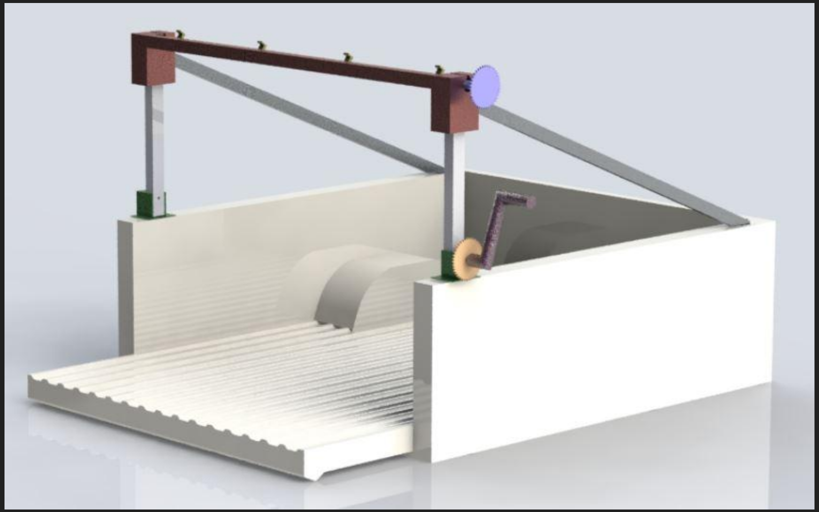
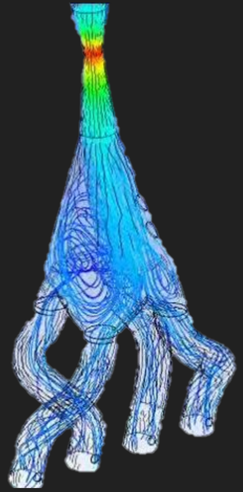




Falcon Enclosure Consulting, Inc.

Goal:

> To assist large scale construction projects with the building enclosure systems, consulting on the progress of construction, conducting field visits and site tests, as well as designing solutions for on site problems found.

Design Approach:

> Following meetings, site visits, water testing and proper documentation, we assessed each of the issues found and discuss them with the general contractors and engineering team and what needs to be done to repair it. Once a solution is decided upon, the general contractor takes appropriate action to resolve the issues we found.

> If the problem was extreme or required a solution beyond the scope of the original architectural plans, we would design and draft the solution using AutoCad.

FALCON ENCLOSURE CONSULTING

Formula SAE-Intake Manifold

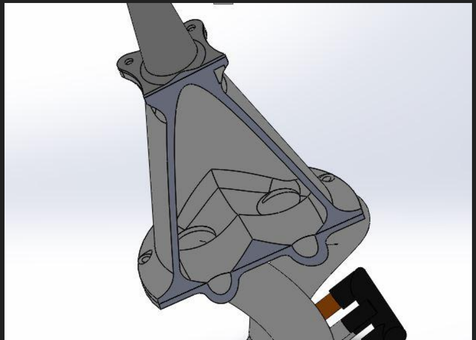
Goal:

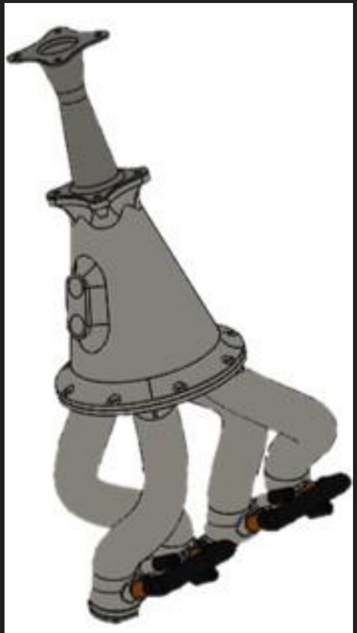
> To design and improve the volumetric flow rate from the 2015 intake for the 2017 IC car.

Design Approach:

> In order to improve the volumetric flow rate from the previous design, a different internal geometry for the plenum was implemented. A conical design was chosen for the smoothest flow in order to avoid air pockets and maximize the intakes efficiency, compared to the previous cubic design.

> The system was SLS 3D printed with glass filled Nylon which met the design specs.



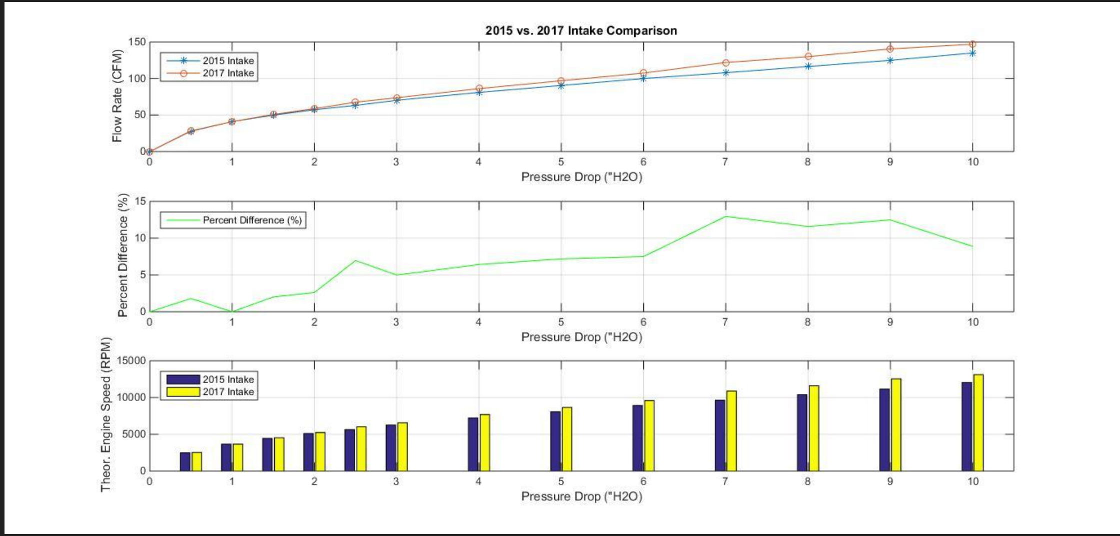


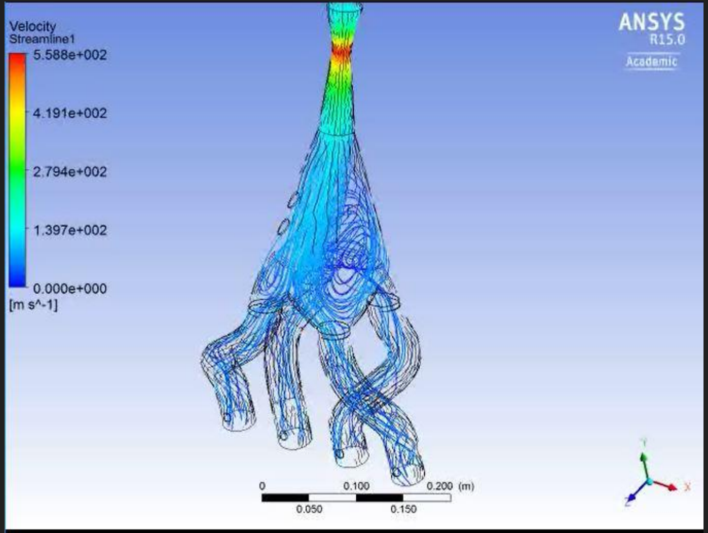
Formula SAE-Intake Manifold

Testing:

> In order to validate an improvement, both intakes were tested on a flow bench using Ansys CFD at 8000 rpms and at aFe Power. Set Pressure drops were tested on each while the volumetric flow rates were measured.

> The first graph shows the raw data with the second showing the percent increase. The 2017 intake had a higher flow rate overall with i peaking at 12.96% increase at 10,800 rpms. The third graph shows the theoretical rpms at each flow rate with the maximum restricted rpm increasing from 12,000 to 13,100. In conclusion, the new design saw an overall increase in efficiency and volumetric flow.





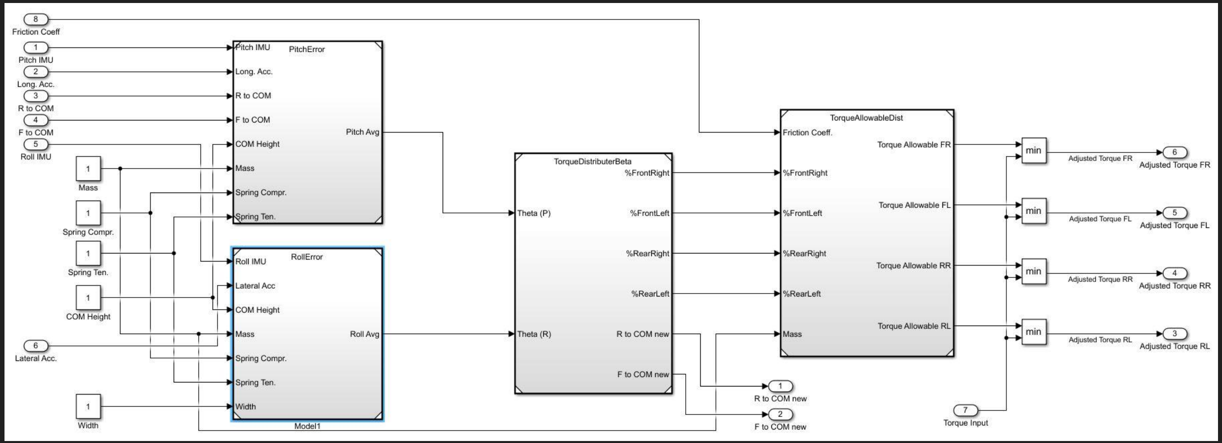
Formula SAE-Torque Vectoring System

Goal:

> To design a control system for the synchronous motors on the Formula SAE Electric Vehicle that would designate a specific torque to each motor depending on the position and readout of the cars angular accelerations and weight distributions.

Design Approach:

> After researching and defining the constraints, a Simulink model was made using MATLAB was made with varying solutions. One used an IMU to measure the cars weight movement and the other a theoretical motion of the car based on initial position, which adjusted torque depending on the given data. This was first tested on a scale version of the EV Car, then on the car itself following all hand calculations.

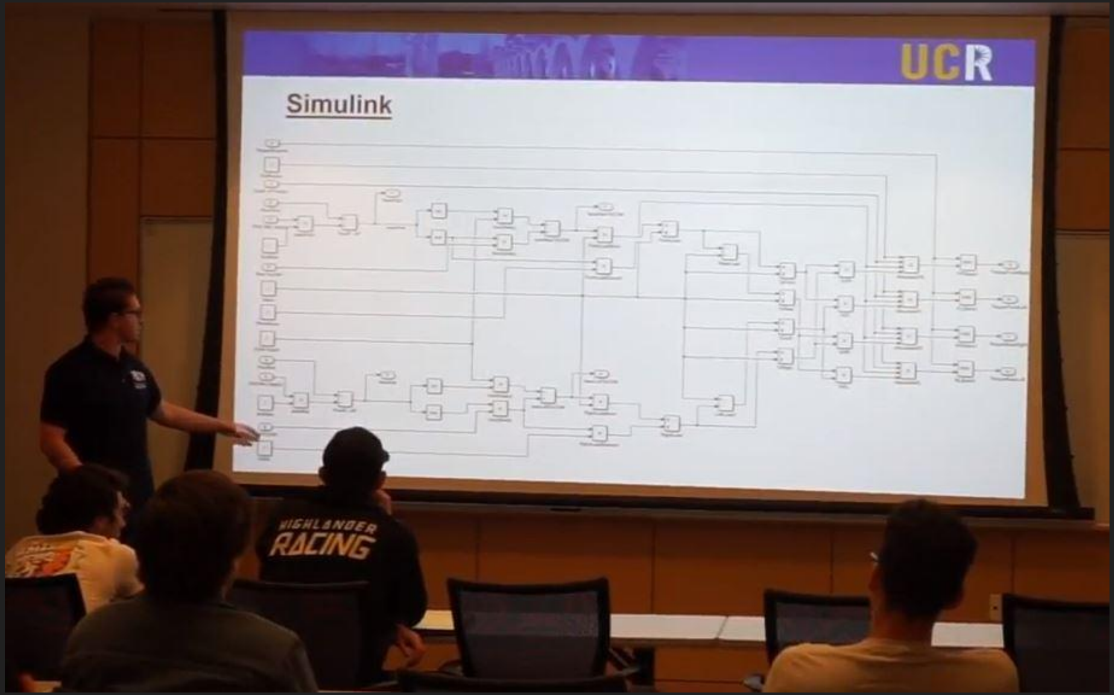


Formula SAE-Administration, Workshops, and Presentations

> Worked with the business team to create a financial plan for investors and a potential company.

> Schedule and organize meetings with the Torque Vectoring System team and train incoming members.

> Recorded presentation on “Control Systems” (https://www.youtube.com/watch?v=ZIRm2C_pxtU)



Toyota Tundra Rapid Unloading System

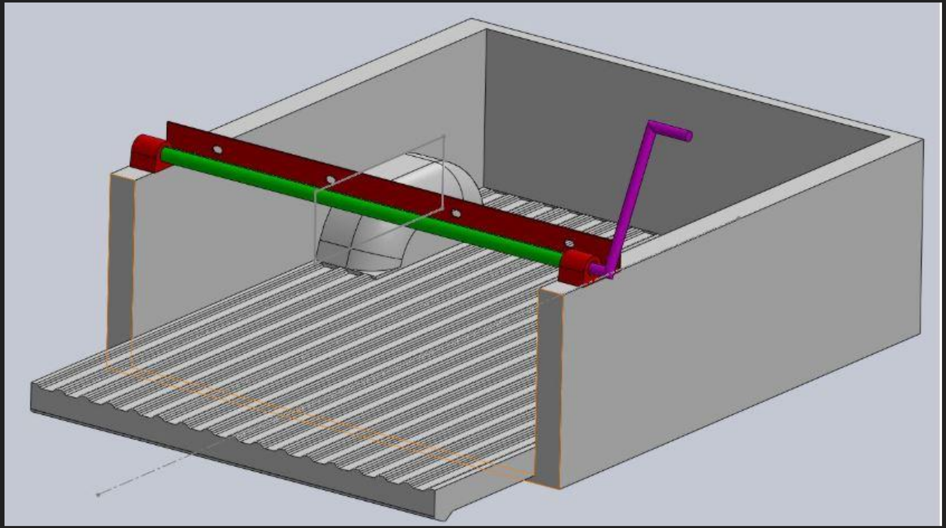
Goal:

> To design and build a mechanism that allows for the rapid unloading of bulk materials and bulk packaged items such as dirt, pebbles, and other loose landscaping materials without causing damage to or exceeding the capacity of the Toyota Tundra and its bed.

Design Approach:

> Tasked with a general problem, the team researched whom to design this product for, accounting for cost and ease of accessibility. This product would be catered towards landscapers and other fields that work with lumped and bulked loose materials that can be unloaded in less than a minute.

> The design team brainstormed various solutions, which were further detailed and narrowed down to a few feasible concepts. These concepts and ideas were detailed to their fullest to understand the further feasibility of each, which was narrowed down to the first iteration of our design, shown here.



Toyota Tundra Rapid Unloading System

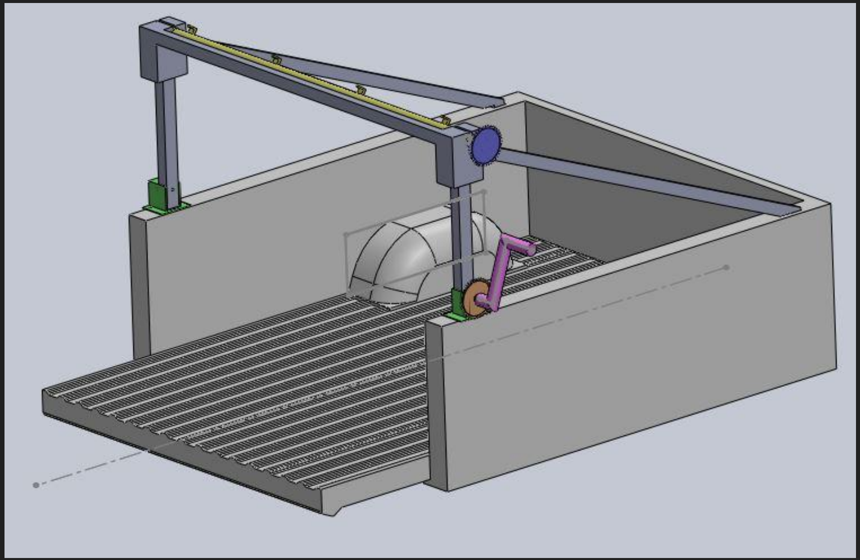
Design Approach:

> Once a base design was chosen and initially modeled, we ran various calculations and simulations based on the volume of materials to be unloaded and its feasibility. After testing, the first draft was found to be strong enough to carry the loads, but was not tall enough to account for the truck bed at capacity.

Redesign and Modeling:

> The design team decided on lifting up the mechanism to a height that would be unaffected by any rollover, supporting the system with a support bar on either side and implementing a different rolling system to allow for a simple install process.

> A model was made using SolidWorks, with various iterations done before the model shown. Early models were similar but lacking the height and support, which were later added to ensure the products safety and reusability. Due to the design strength, material options were plenty, although 6061 T6 Aluminum was chosen to be the safest material.



Toyota Tundra Rapid Unloading System

Testing:

> Following the design process, force simulations were successfully run on each part using SolidWorks, showing minimal stress at areas of concern under worst case scenarios.

> After confirming the design's strength at a factor of 8 at maximum load, a prototype was made using a material of similar stature to the chosen aluminum, steel, and a frame built at ⅓ scale.

> Following assembly, the prototype was successfully tested using various test conditions, such as testing the system at capacity and after undergoing lifecycle testing and strain.