University of Utah's Formula SAE Chassis

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Department of Mechanical Engineering

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Introduction

The goal of this project was to create a new chassis, or vehicle body, for the University of Utah's Formula Society of Automotive Engineers (FSAE) team. This new chassis was required because the old one was heavy and large which reduced the vehicle's performance on the track. With this in mind, we were tasked with building a lighter, sleeker, and easier to manufacture chassis that maintained compliance with the FSAE rulebook.

Previous competition season (2019) Formula SAE vehicle and driver

Project Scope

Due to the complexity, time constraints, and costs associated with building a chassis, the team opted to instead design a chassis, build a buck, or the interior structure of the chassis, and manufacture the two molds used to create the chassis.

Metrics

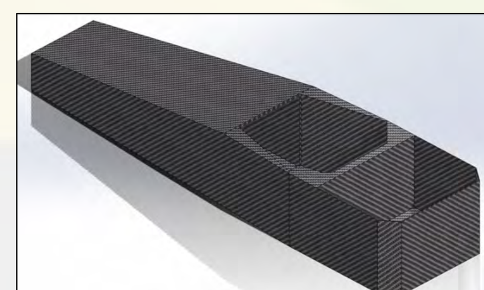
To ensure this project was successful, we developed a number of metrics, that we had to meet using the FSAE team's requirements and our project scope. A list describing these can be seen below:

Metric	Target Value	Achieved Value
Overall weight of chassis	X <=37 kg	X = ~25 kg
Undercuts	0	0
Clearance for removal/insertion of accumulator (length, width, height)	X > 550 mm Y > 275 mm Z > 230 mm	X = 533 mm Y = 406 mm Z = 478 mm
Dimensions of chassis (length, width, height)	X < 3050 mm Y < 1550 mm Z < 1300 mm	X = 2,470 mm Y = 790 mm Z = 500 mm
Follows composite requirements	Y/N	Y
Cockpit opening dimensions (length, width)	X > 600 mm Y > 550 mm	X = 605 mm Y = 581 mm

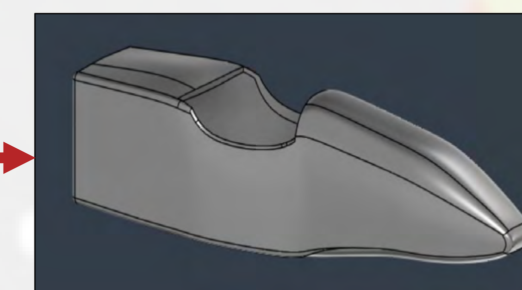
Methods

To fulfill our goals, we decided to break up the manufacturing of the chassis into many smaller stages. These stages consisted of researching chassis, gathering detailed specifications, designing and iterating a CAD model of the chassis, building the buck (or the interior structure of the chassis), and creating a two-piece mold to prove the design is compatible with the FSAE team's goals. The mold is still being worked on due to budget constraints and scheduling conflicts.

Chassis Design Evolution



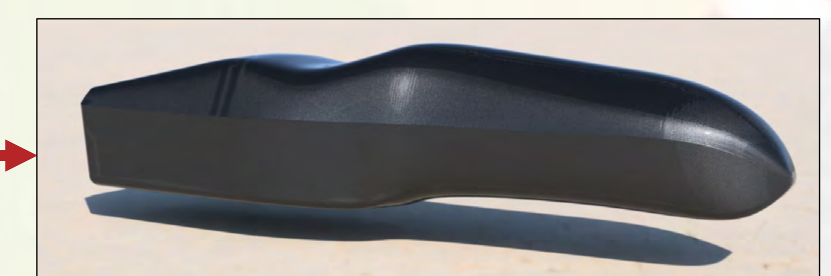
Finding the minimum dimensions



Determining the basic shape

Improving the geometry

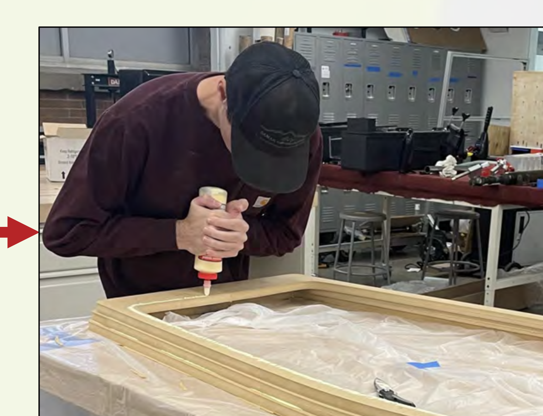
Spring semester final design



Final chassis design

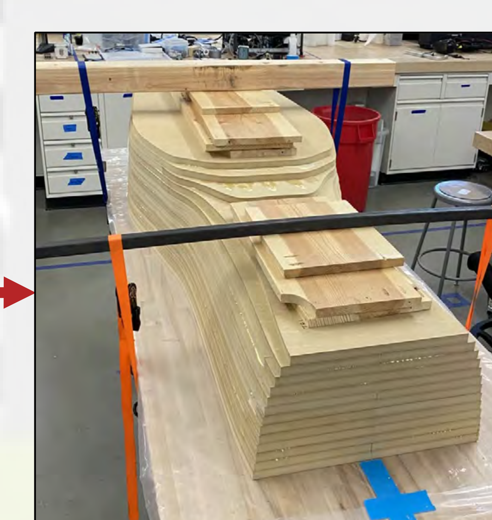
Building the Buck

Cutting out the buck pieces

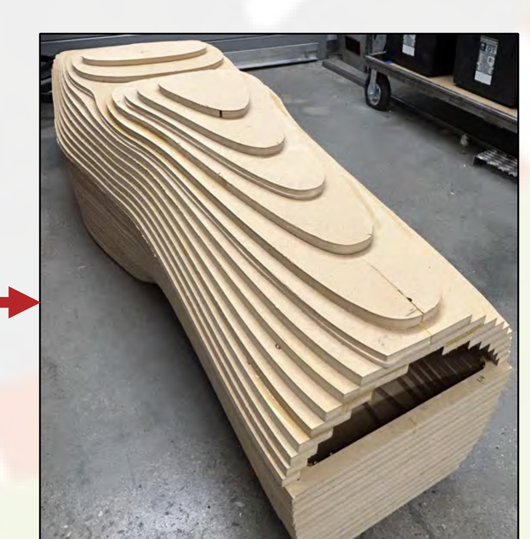


Assembling the buck

Top half of the buck



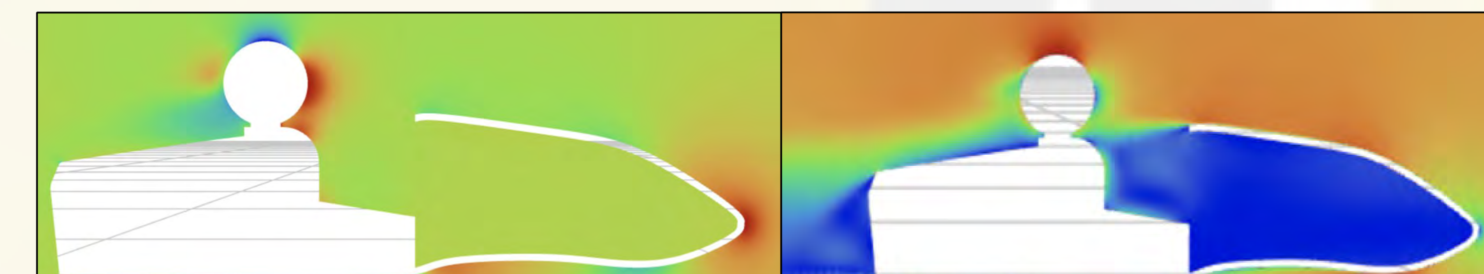
Bottom half of the buck



Complete buck

CFD Analysis

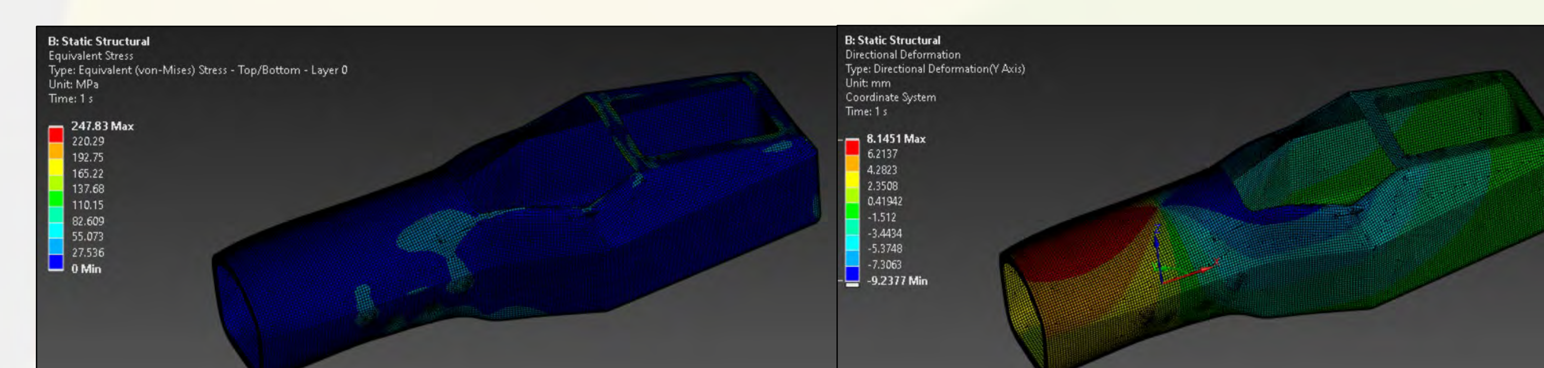
To determine the aerodynamics of the chassis, we ran various CFD simulations. The results show that the model encountered a high level of accuracy over a short period of time due to the structure of the chassis and simulation design. The simulations themselves reveal that in terms of the velocity the chassis experiences during operation, there are no causes for concern. The static pressure forces agree with the results of the velocity magnitude. They also show that the drag force coefficient of the chassis is approximately 5.96 N.



Symmetric contour simulation for static pressure and velocity magnitude. The left image shows the static pressure simulation, and the right image shows the velocity magnitude.

FEA Analysis

Once the CFD analysis was complete, we ran a torsional load simulation using FEA to determine the stress and strain effects on the chassis. The torsional load simulates the loading the chassis would be affected by during maximum turning and shows us any directional deformation on the chassis because of it. The torsional stiffness of the chassis came out to 2.434 kN*m/rad.



Equivalent stress and directional deformation torsional load test results. The equivalent stress results are on the left, and the directional deformation results are on the right.

Conclusion

Our project was a success, because we were able to build a lighter, sleeker, and easier to manufacture chassis that maintains compliance with the FSAE rulebook. These results were verified as we designed our CAD model to specifications, analyzed it using CFD and FEA simulations, and built the buck. It will continue to prove its success once we finish manufacturing the two halves of the mold and as the University of Utah's FSAE team builds the chassis in the future for their 2026 competition season.