UVU MECHANICAL ENGINEERING
UTAH VALLEY UNIVERSITY

BAJA BLASTERS

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Baja SAE

Baja SAE is a worldwide collegiate competition hosted by the Society of Automotive Engineers. A Baja SAE team is an entirely student-run effort from design to fabrication, presentation, and competition of an off-road vehicle.

Goal for 2022

Design, build, and test a robust 4WD system that can be integrated into the existing Baja vehicle.

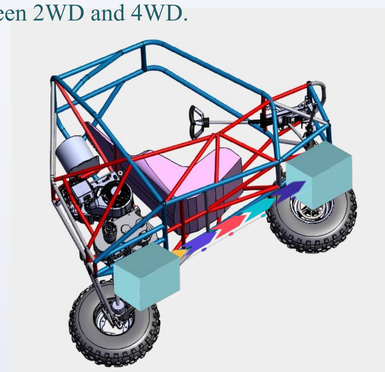
Concept Selection

Over a hundred different drivetrain concepts were evaluated through the team's selection process. The top four concepts were then compared against each other to find the best one.

		Concepts							
		Chain Drive (Differential)		Belt Drive (Solid)		Chain Drive (Solid)		Shaft Drive	
Selection Criteria	**Weight**	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Necessary Frame modifications	25%	2	0.5	3	0.75	3	0.75	2	0.5
Weight of added system	5%	4	0.2	5	0.25	4	0.2	3	0.15
Durability	15%	2	0.3	2	0.3	3	0.45	5	0.75
Ease of engaging 4WD	10%	4	0.4	5	0.5	5	0.5	4	0.4
Ground Clearance	10%	3	0.3	3	0.3	3	0.3	2	0.2
Acceleration	10%	1	0.1	2	0.2	2	0.2	5	0.5
Simplicity	5%	1	0.05	4	0.2	3	0.15	3	0.15
Power loss	5%	2	0.1	2	0.1	2	0.1	4	0.2
Ease of repair	15%	4	0.6	4	0.6	4	0.6	3	0.45
Total Score (out of 5)		2.55		3.2		3.25		3.3	
Rank		4		3		2		1	
Continue?		NO		NO		NO		YES	

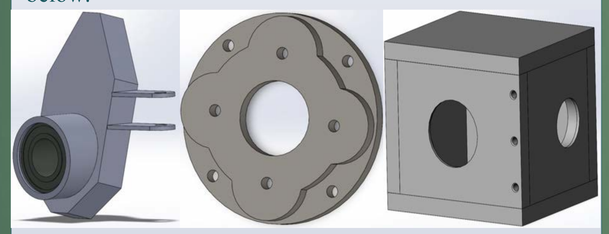
Selected Design

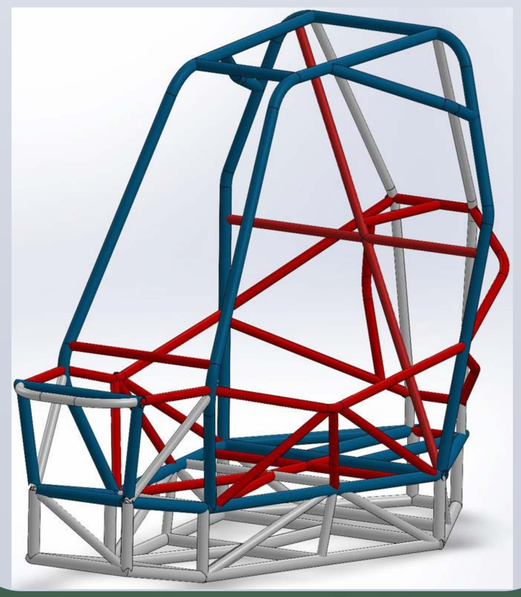
A typical front differential 4WD system was chosen. The specific differential chosen will allow the driver to switch between 2WD and 4WD.



Modeling

Due to a lack of time and resources, it was decided to forgo prototyping in favor modeling and analysis. Some components that were modeled and fabricated are shown below.



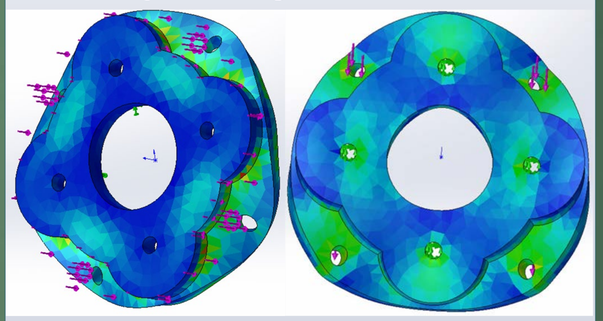


Design Analysis

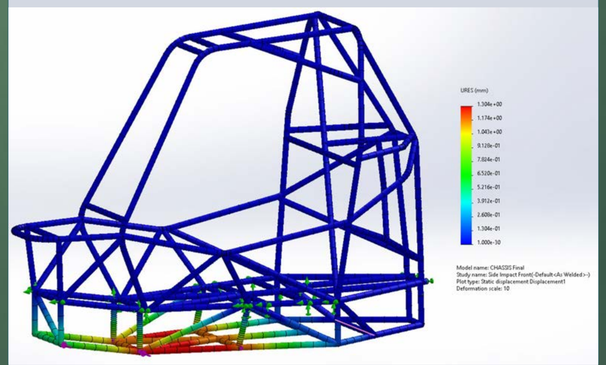
Hand calculations were used to ensure that parts from a Yamaha Kodiak 700 ATV would be able to withstand the forces delivered by the Baja engine.

Power Source	Measurement source		Torque (ft-lb)	HP	Output RPM
BAJA	Dyno'd Motor	max torque	15.85	8.2	2718
		max hp	13.85	9.1	3450
	Max gear ratio 36:1	max torque	570.6	8.2	75.50
		max hp	498.7	9.1	95.83
	Min gear ratio 5.6:1	max torque	88.76	8.2	485.4
		max hp	77.58	9.1	616.1
KODIAK	Dyno'd Motor	max torque (no data)			
		max hp	27.28	32.67	6290
	Max gear ratio 48.18:1	max torque (no data)			
		max hp	1260	32.67	136.2
	Min gear ratio 25.73:1	max torque (no data)			
		max hp	701.9	32.67	244.5

Finite Element Analysis (FEA) was used to verify that the design of our components were sufficiently strong for their application. Shown below is the FEA of the hub adapters the yellow areas show the highest stress which is below the expected loading.

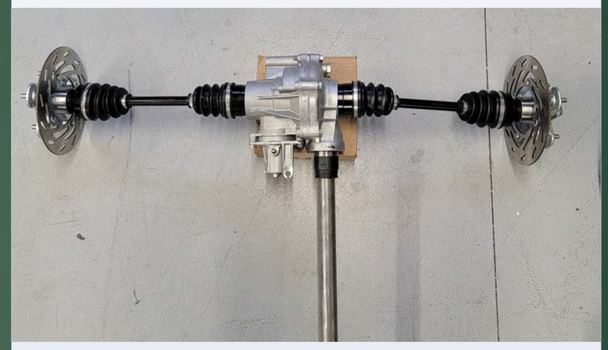


The FEA of the subframe revealed critical locations that would need to be reinforced.



Results

Assembled front differential, driveshaft, CV axles, and brake calipers showing how they will be positioned in the subframe shown below.



Assembled subframe showing additional space added to house differential, driveshaft, and CV axles shown above.

Assembled subframe showing overall addition to vehicle frame. Suspension mounting points will be translated down onto the subframe.