Society of Automotive Engineers - Mini Baja Competition

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Abstract

The SAE Mini Baja collegiate competition is hosted each year by the Society of Automotive Engineers. This competition faces students with the challenge of creating a single-person off road vehicle to be powered by a 10 hp engine. These buggies are then pitted against each other in several static and dynamic events over the three-day competition designed to test the overall performance and reliability of the vehicles. The vehicles are to be prototypes for a theoretical 4,000 unit manufacturing run.

Competition Requirements

The SAE Mini Baja competition consists of six different events designed to test the overall performance of the vehicle and the engineering behind the design. These tests can be broken down into dynamic events and static events. The dynamic events consist of a hill climb, an acceleration test, and an endurance race. The static events are comprised of a sales competition, a design analysis, and a cost analysis. These events will determine which vehicles have been designed and built to the best quality, and will ultimately be the determiner of the competition winner.

Acknowledgements

Lumberjack Motorsports would like to acknowledge the help and guidance of Dr. John Tester, Perry Wood, and the shop managers of the NAU Machine Shop.

Manufacturing

The manufacturing of Lumberjack Motorsports Baja vehicle has consisted of many different processes up to this point. The following list is a compilation of the various manufacturing processes that have been used.

Manufacturing Processes

- Manual Mill and Lathe (NAU Machine Shop/K&M Machine Tool Inc)
- CNC Mill (NAU Machine Shop)
- Rotary Tube and Pipe Bending
- Tube Coping
- Threading, Drilling, and Boring
- Grinding
- TIG, MIG, and Stick Welding
- Plasma Cutting (NAU Art Studio)
- Laser Cutting (Vroom Engineering)
- Wire EDM (AZ Wire Specialists)
- Heat Treatment (Phoenix Heat Treating Inc.)
- Carbon fiber body panels (Nova Kinetics)

All manufacturing that has been completed to this point has been done by the team itself, excluding a few processes specified above such as the Wire EDM process. Pictured below are the results of some of these various manufacturing processes.

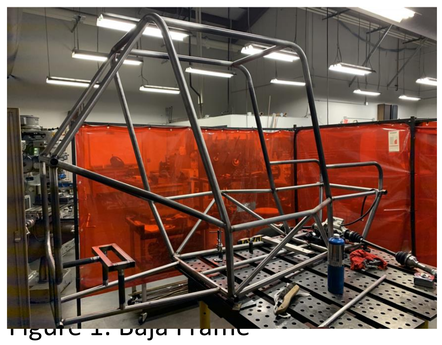

Figure 1: Baja Frame

Figure 2: Gear Housing

Figure 3: Rear Trailing Arm

Figure 4: Front A-arms

Design & Analysis

Rear-end: Designed to be light weight and strong using aluminum. Analyzed the toe and camber angles to maximize the maneuverability of the vehicle. Performed Analysis on the strength of the trailing arm to avoid failure during operation of the vehicle.

Front End: The front end utilizes 4130 steel control arms with the shock mounted to the upper control arm. Since the shock is mounted on the top control arm, FEA was performed to ensure the control arms are able to absorb all possible forces.

Drivetrain: The drivetrain is custom built for this vehicle. Utilizing a four-wheel drive system for the very first time, the team has ensured that all gears and cases have the proper strength required to operate under the stresses to be seen from competition.

Frame: The frame has been put through various FEA simulations to ensure that the driver is safe at all times while operating the vehicle.

Results & Conclusion

Lumberjack Motorsports off-road vehicle has been designed and tested to surpass all obstacles it may face during competition. The team and vehicle anticipated to compete against hundreds of other universities and vehicles in Tucson, AZ. Due to unforeseen effects of the COVID-19 pandemic, the competition has been changed to an online format and the team was unable to finish fabrication of the vehicle. With the four-wheel drive system design, the team was confident that the vehicle would perform well, however without the ability to test the vehicle results of this project are unobtainable.

References

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