

Design Improvement of a Baja SAE Suspension Package

Mechanical Engineering

Students: Cody Scheidt, Touchy Yang, Matt Soderstrom
Advisors: Walter Mizuno, The Nguyen

FRESNO STATE

Lyles College of Engineering

Abstract

The objective of this project is to redesign the suspension package on the currently built 2016 – 2017 Baja SAE vehicle. The redesign should make a 15% improvement to the vehicle's time around a skid pad test. The vehicle will also be fitted with several strain gauges in order to verify loads and stresses in the suspension components to be compared with expected results from FEA analysis.

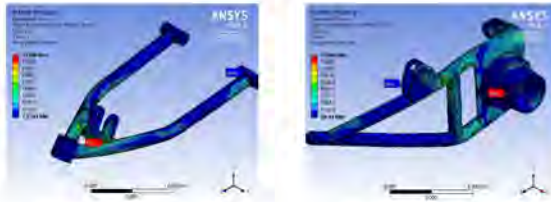
Existing Design Flaws – Front Suspension

- The close inboard shock mounts on the A-arms result in a high reaction moment
- The lack of camber gain as the suspension travels results in poor dynamic stability
- The excessive caster angle results in large camber gain as the wheels turn and high steering effort due to high caster lead
- The Heim joints on the knuckle are close to their misalignment limits at static ride height

Existing Design Flaws – Rear Suspension

- The trailing arm is good for linear stability, but not for dynamic stability
- The design had a high un-sprung mass
- There were many clearance issues
- There was a large amount of axle plunge, which caused the axle to slip out during operation
- The design was not tunable or versatile

Analysis



Lower Control Arm

Rear Trailing Arm

The pictures above show the stress plots simulating the car falling from a height of 5ft. According to simulations, the parts will withstand the forces.

New Front Suspension Design

- Moved the inboard shock mount on the lower A-arm out to reduce the reaction moment
- Increased camber gain during the suspension travel to improve dynamic stability
- Reduced the caster angle to help with steering effort & limit camber gain with increased steering angle
- Redesigned the joints at the knuckles to keep the misalignment from its limits at static ride height
- Recalculated the desired spring rate and damping coefficient

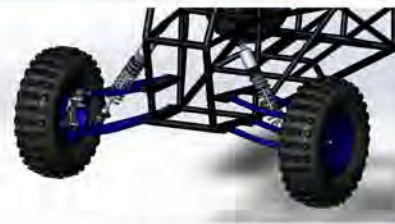
New Rear Suspension Design

- Changed to a 3-link suspension design
- Reduced the un-sprung mass
- Eliminated all clearance issues
- Increased manufacturability and serviceability
- Redesigned the geometry to avoid large amounts of axle plunge
- Recalculated the desired spring rate and damping coefficient

Sponsors & Supporters

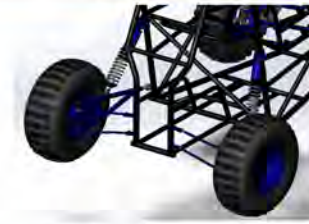


Front Suspension



New front control arm design

Rear Suspension



New 3 link rear suspension design.