SMART INTERNSHIP PROGRAM

Mechanical Engineering Field

"Improving Baja SAE Vehicle Design: Ergonomic Comfort and Steering Performance "

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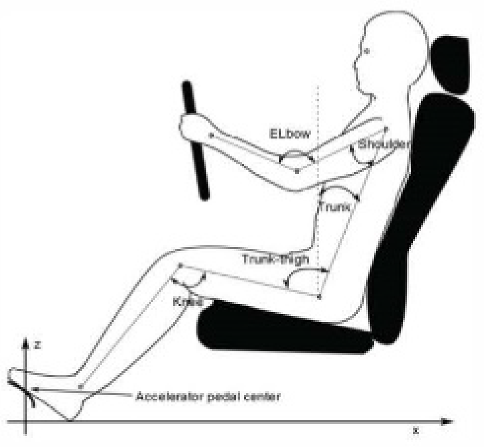
CAL STATE LA

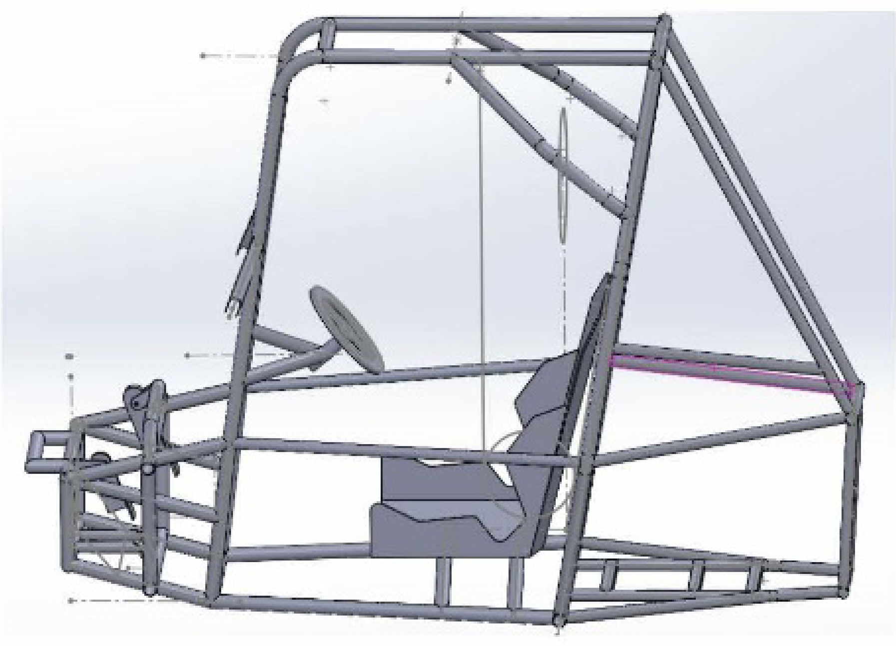
"Enhancing Driver Comfort in Baja Vehicles through Ergonomic Joint Angle and Cad modeling"

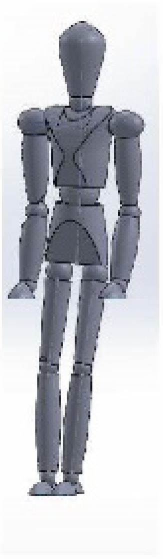
Background

The Cal State LA Baja SAE Team is a student-run engineering team formed in the late 1970s. Comprising over 30 students from mechanical, electrical, computer engineering, and technology backgrounds, the team designs, fabricates, and races a new off-road vehicle each year.

This project focuses on the ergonomics of the Baja vehicle, an off-track racing vehicle. It ensures the safety and comfort of the driver by researching and CAD modeling using SolidWorks to achieve optimal joint angles.







Key components to model in SolidWorks include the seat, steering wheel, pedals, and mannequin. These are essential to analyze driver ergonomics. For the driver's comfort, finding optimal joint angles is important for improving ergonomic posture, lowering physical strain, and avoiding long-term muscle injuries when driving for an extended time.

Table 11
Recommended Ranges for Body Segment Angles from Rebiffé (1969), Grandjean (1980), and Porter and Gyi (1998)
(See Figure 7 for angle definitions.)

Angle	Rebiffé (degrees)	Grandjean (degrees)	Porter and Gyi (degrees)
A. Back	20 – 30	--	--
B. Trunk/Thigh	95 – 120	100 – 120	89 –112
C. Knee	95 – 135	110 – 130	103 – 136
D. Ankle	90 – 110	--	81 – 105
E. Upper Arm*	10 – 45	20 – 40	16 – 74
F. Elbow	80 – 120	--	80 – 161

P. Reed, Matthew. 2000, Survey of Auto Seat Design Recommendations for Improved Comfort.

"Redesigning the Kingpin for Enhanced Steering Performance in the Cal State LA Baja SAE Vehicle"

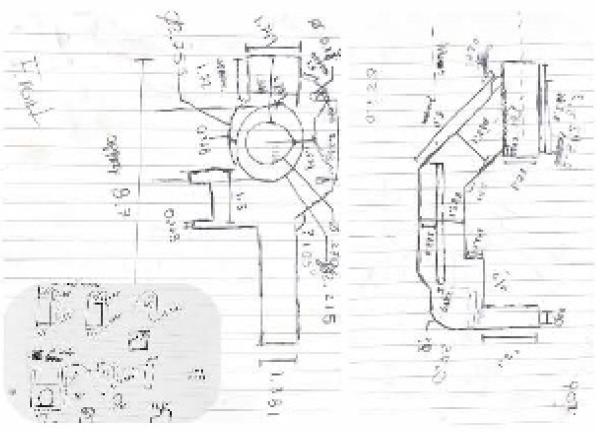
Engineering Process

1 **Problem Identification**

Recognized that the current kingpin angle limited the turning radius and caused damage to components due to friction and misalignment.

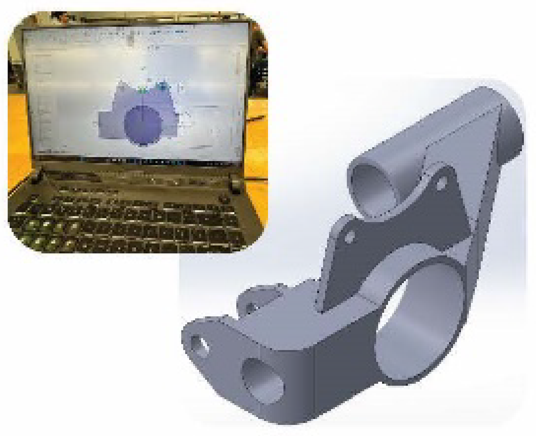
2 **Initial Measurement**

Used a vernier caliper to take precise measurements of the existing part before modeling.



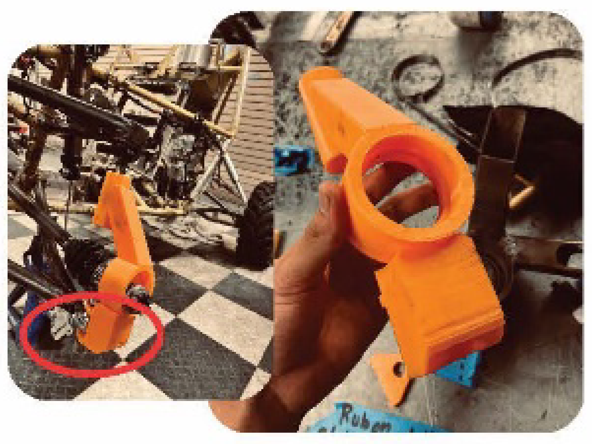
3 **3D CAD Design (SolidWorks)**

Redesigned the kingpin in SolidWorks, modifying the turning angle and repositioning the bolt and bracket orientation for better performance.



4 **3D Printing Prototype**

Printed a prototype of the redesigned part using a 3D printer to verify the geometry and assess fitment before manufacturing.

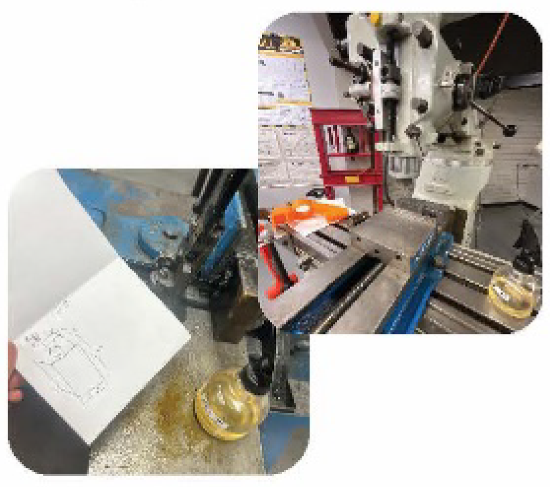


Project Summary

This project focuses on the redesign and fabrication of the kingpin—a critical part that connects the frame to the wheel and controls the steering pivot. Our goal was to adjust the steering angle to allow for a wider wheel turn and reduce component wear caused by friction during turns. The process involved reverse engineering, CAD modeling, 3D printing, machining, and welding.

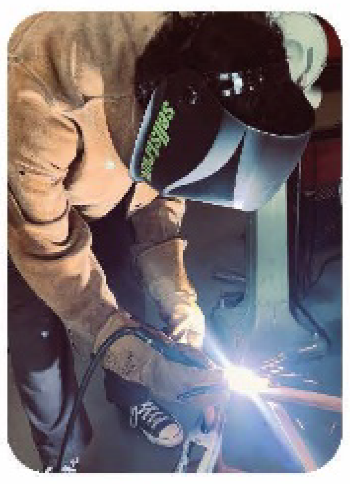
5 **Machining (Milling Machine)**

Fabricated the final metal part using a milling machine, executing most of the machining personally to ensure dimensional accuracy.



6 **Welding**

Under supervision, learned welding techniques and performed some of the welding on the part while the TAs supported critical joins.



7 **Assembly and Fit Test**

Installed the new part on the vehicle and verified its effect on turning radius and component clearance.