Acknowledgement

Thank you to Mr. and Mrs. Woodside for funding our senior capstone project.

Electric Mini Baja: Cockpit Team

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Introduction

The Cockpit crew oversees multiple components of the electric baja: seat, pedal, brake, throttle, and steering assembly.

In each of the assembly sections, the specifications based on the SAE rules, component design features, and analysis will be discussed.

Key
Seat
Pedal
Brake
Throttle
Steering

Design Requirements

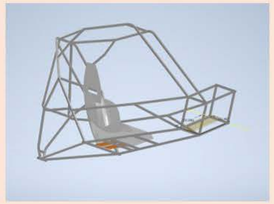
Basic
Mechanical Pedal
Pedal Stop
Pedal Accessibility
Throttle System
Seat Angle (65 - 90 Degrees
Cockpit Egress (exit < 5 seconds)
Brake System on all 4 Wheels
Performance
Minimize Stopping Distance
Maximize Brake Pedal Modulation
Minimize Turning Radius
Minimize Weight
Low Center of Gravity
Top speed of 40 mph
Goverened at 10 hp

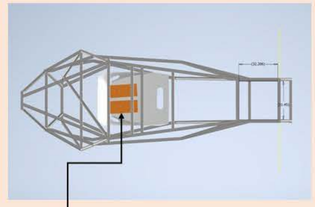
Budget

In capstone groups years prior, many of the components our group is working on have already been purchased. Therefore, our estimated budget was around $700, and this was very graciously given to us from Mr. and Mrs. Woodside.

Seat Assembly

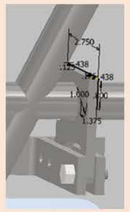
- SAE rules requires at least 6 mounting points from the frame to the seat

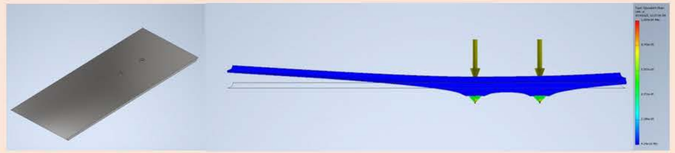




Top mounting point: machined 3/16" steel T bracket that has 2 holes for mounting

Bottom mounting point: 2 pieces of 1/8" plate steel



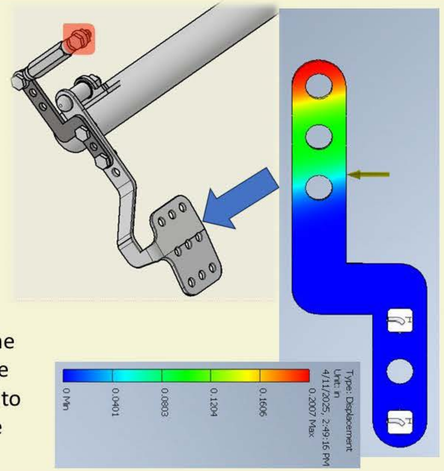


The bottom mounting plate will be welded to the frame and the seat will be bolted to the mounting plate.

Pedal Assembly

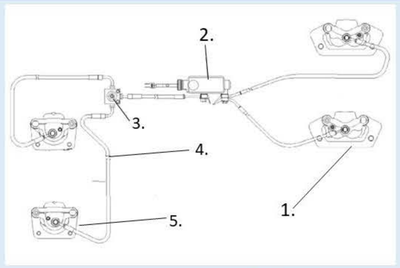
The pedal assembly configuration will have a direct linkage from the top of the machined bracket to both the throttle potentiometer and the brake master cylinder. The bracket will be cut from 1/8 " plate steel and as shown in the FEM analysis it will easily withstand the forces required.

The bolt highlighted red is used to connect the pedal to the potentiometer (throttle) and the brake (master cylinder). This design allows us to easily switch between the right and left side pedals.



Braking Assembly

All braking components—excluding bolts, fasteners, and brake lines—have already been purchased. We still need to specify the brake lines to ensure compatibility with the calipers and compliance with our design requirements.



1. Front Caliper
2. Master cylinder
3. Line splitter
4. Hydraulic line
5. Rear caliper

Stopping Distance Calculations

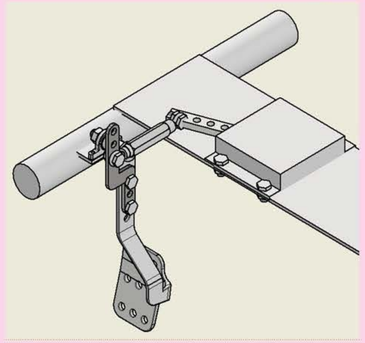
$P = \frac{F_{pedal}\, R_{pedal}}{A_{Master}} \longrightarrow \frac{250\ x\ 6}{1.98\times10\text{^}-4} \approx 7.58\times106$ Pa = 7.58 MPaP

$F_{clamp} = P\ x\ A_{Caliper} \longrightarrow$ (7.58 x 10^6 Mpa) x (7.07 x 10^-4) = 5358 N

$T = F_{clamp}\ x\ \mu\ x\ r$ 5358 N x 0.4 x 0.1 = 214.3 Nm per wheel

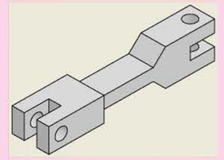
$d_{stopping} = \frac{v^2}{2a} \longrightarrow \frac{(11.1\frac{m}{s})^2}{2\left(6.87\frac{m}{s^2}\right)}$ **Esimated Stopping Distance = 8.97 meters = 29.4 feet**

Throttle Assembly



The Heim joint directly connects the leveraged top of the pedal bracket to the switch arm of the potentiometer.

This connects and converts the action of pushing the throttle pedal forward into a reversed and leveraged force which will linearly increase the amount that the potentiometer switch is moved, causing the Mini Baja to increase power output to the rear wheels

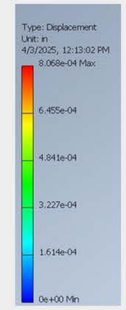


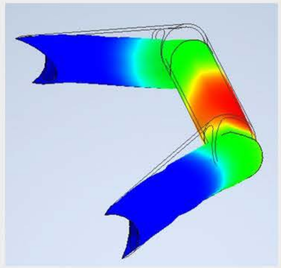
The direct linkage or Heim joint from the pedal bracket to the potentiometer can be replaced by this 3d printable yolk in order to save cost if necessary.

Steering Assembly

Parts Included

1. Steering Wheel
2. Steering Wheel Connector
3. DD Steering Column
4. Universal Joints
5. Rack & Pinion
6. Tie Rods





FEM analysis given 60 lbs of downward force directed onto the top mount for the steering shaft

One of the hardest battles we've had is the ergonomics of the Baja. With very limited room its very hard to fit everything in the baja and still be able to fit a 5,8" to a 6,8" person. A result of this was our team splitting the steering shaft into 4 separate sections using Universal Joints. This solution imposed a second challenge. How do we mount these sections of the steering shaft?

Ackerman Steering Calculations

Ackerman steering is a geometric arrangement of steering linkages that ensures the inner front wheel turns more sharply than the outer wheel during a turn. This allows all four wheels to follow their natural turning arcs, reducing tire scrub and improving cornering efficiency.

Results

- **Inner wheel angle ≈ 23.67°**
- **Outer wheel angle ≈ 18.69°**
- **Ackerman angle = 4.98°**

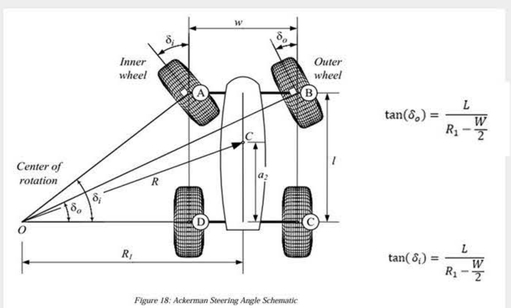


Figure 18: Ackerman Steering Angle Schematic