

Reassessment of the Manufacturing Methods for the Pedals used by Cal Poly's Baja SAE Team



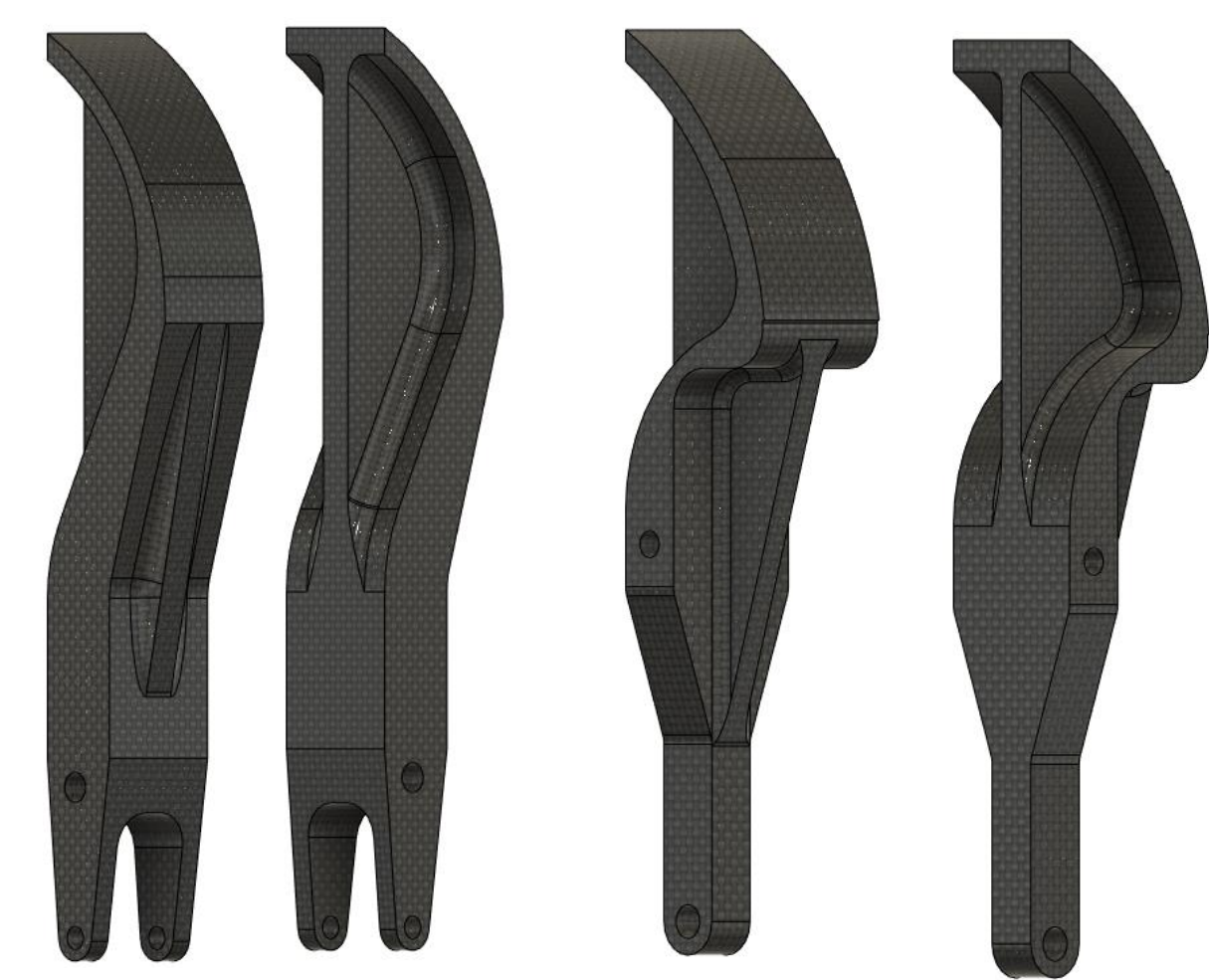
Matthew Burica, Mechanical Engineering Department

Mentor: Dr. Brian Ramirez

Cal Poly Pomona RSCA Student Conference 2024

3D Printed Carbon Nylon

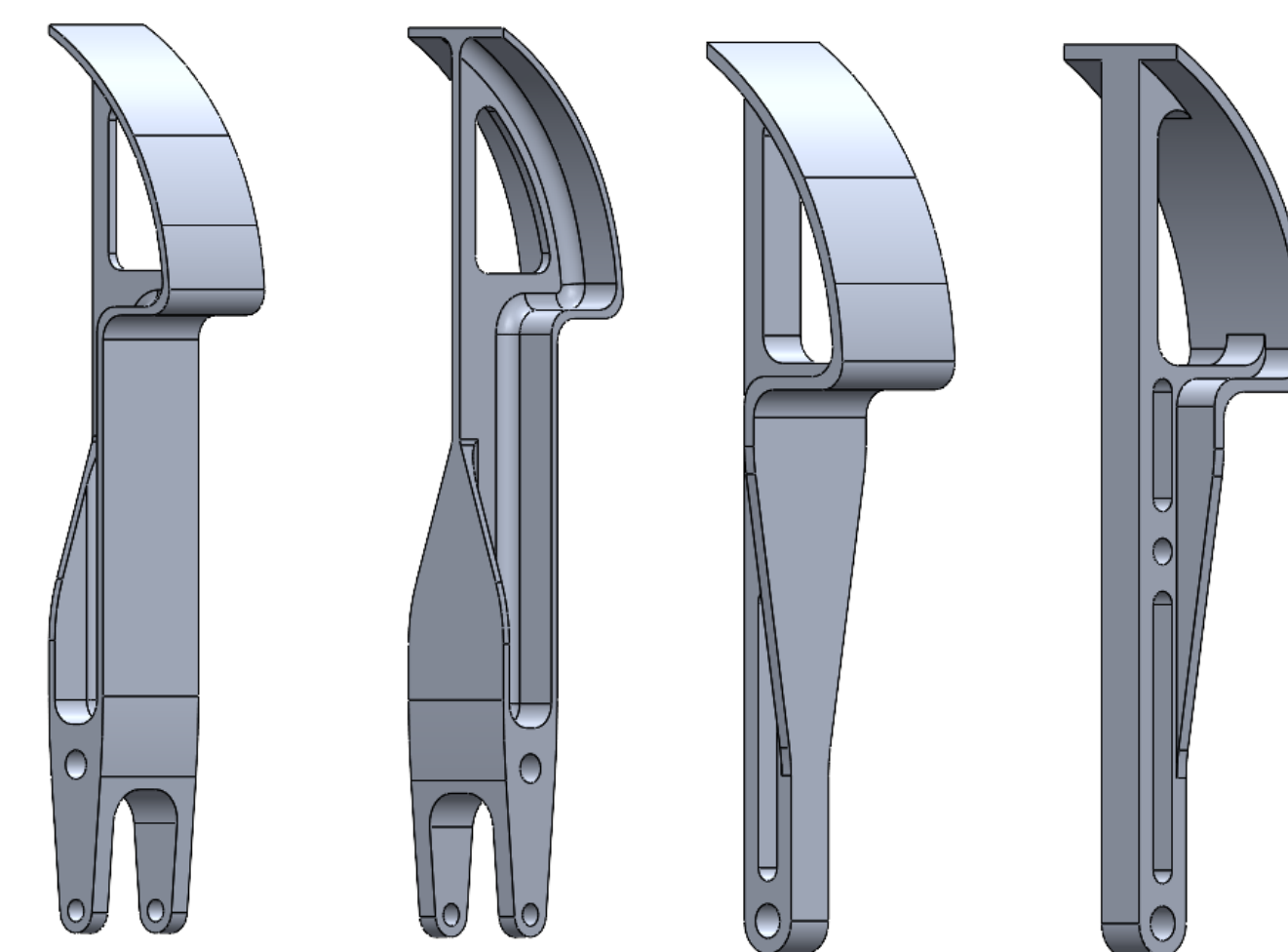
- Brake Pedal Weight – 0.4lb* yet to be made
- Throttle Pedal Weight – 0.2lb* yet to be made
- Mfg. Time – 20-24hr prints*
- Matterhacker NylonX was chosen due to the ability to print with it on campus
 - Currently verifying the material strength using tensile testing of dog bone samples



Brake Pedal Throttle Pedal

CNC Milled 7075-T6 Aluminum

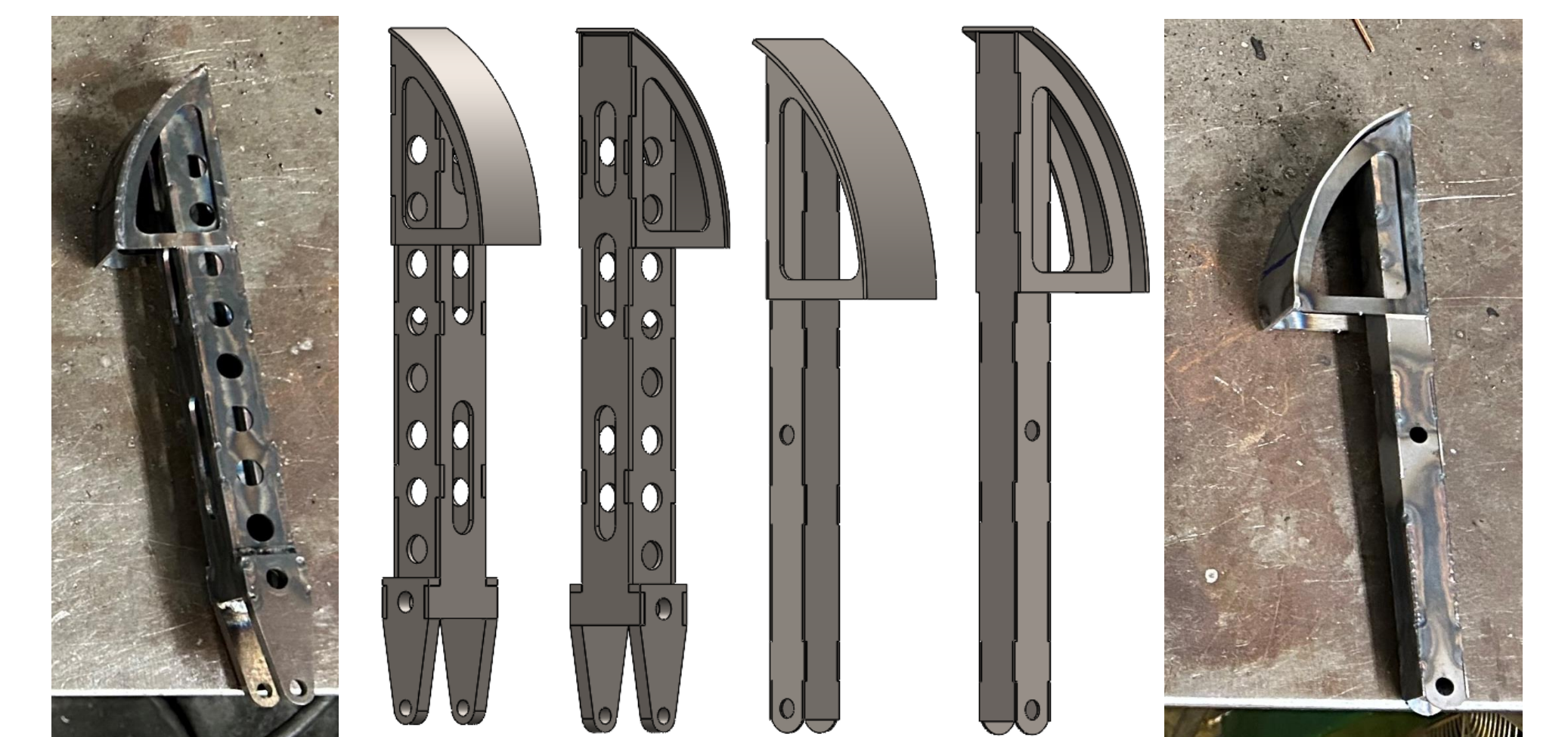
- Brake Pedal Weight – 0.4lb
- Throttle Pedal Weight – 0.3lb
- Mfg. Time – 3hr running + 8hr setup
- 7075 was chosen due to a number of factors
 - High structural strength
 - Welding would not be required
 - Team has historically used large quantities of 7075



Brake Pedal Throttle Pedal

Welded 4130 Steel Pedals

- Brake Pedal Weight – 1.0lb
- Throttle Pedal Weight – 0.4lb
- Mfg. Time – 1.5hr per pedal
- 4130 was chosen for its mechanical strength
 - It is the same steel grade used for all other parts on the car allowing for easy material sourcing



Brake Pedal Throttle Pedal



Requirements

- Pedal mounting systems must be compatible with previous year's mount designs (2020-2023)
- Brake pedal must be design to withstand 450lbf applied by driver
- Must not entrap the driver's feet
- Must be able to install and remove components with hand tools
- Must integrate with front differential and steering components
- Must be manufactured in-house

Goals

- Evaluate manufacturing process for brake and throttle pedals
 - CNC Machined 7075-T6 Aluminum
 - Welded 4130 Chromoly Steel
 - 3D Printed Carbon Nylon

Project Background and Scope

Baja SAE is an international collegiate design competition that students from Cal Poly Pomona have participated in for more than 30 years. One of the major aspects of the competition is that the students design and build large portions of the vehicle.

In more recent years, the team has heavily focused on weight savings of the vehicle due to restrictions placed on the engine. As such all components on the vehicle were subjected to extreme weight savings.

Regarding the pedals, these aspirations for weight savings yielded lighter pedals, at the cost of manufacturing time and skill required due to the materials chosen and the manufacturing methods. The team moved away from welded steel pedals, to CNC machined Aluminum pedals. There was even an attempt at making a carbon fiber pedal.

For the scope of this project, my focus was on trying to find a design for both the Brake and Throttle pedals that yielded relatively lightweight pedals but also minimized the manufacturing time and skill required.

Project Ongoing – Testing Plans

This project is ongoing still. It is intended that 3 samples of each of the viable manufacturing processes are tested to failure to assess real world strength.

This data along with weight, manufacturing time, and manufacturing skill will be input into a decision matrix in order to determine the best method for Cal Poly's Baja SAE team in future years.

Brake Pedal Decision Matrix					
	Weight	FOS (Tested)	Manufacturing Time	Manufacturing Skill	Final Score (so far) (Lowest Score)
Category Weight	1	2	3	4	
Welded 4130	3	X	1	2	
CNC 7075-T6	3	X	3	8	14
	1	X	3	3	
	1	X	9	12	22
3D Printed Carbon Nylon	2*	X	2*	1*	
	2*	X	6*	4*	12*