FAMU-FSU College of Engineering

Ghost Controls Lock Mechanism
Design Review 6

Senior Design Team 510

March 20, 2025

Sponsor and Advisor

Engineering Mentor
Darryl Beadle
Head Engineer Ghost Controls

Academic Advisor
Shayne McConomy, Ph.D.
Senior Design Professor

Project Advisor
Simone Hruda, Ph.D.
Professor

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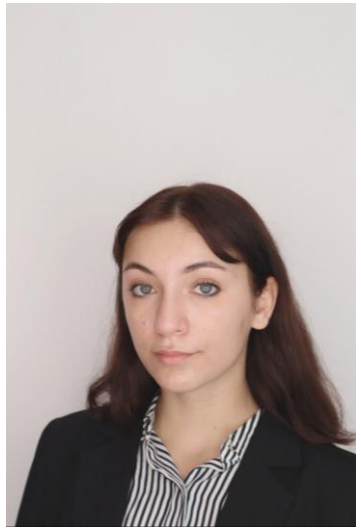
Kayla Boudreaux

Team Introductions



Kayla Boudreaux
Project Manager

Jacob Brock
CAD Engineer

Ernest Patton III
Manufacturing Engineer

Dior Reece
Test Engineer

Olivia Walton
Design Engineer

Bradley Wiles
Materials Engineer

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Boudreaux

Objective

The objective of this project is to design an innovative gate latch receiver mechanism that effectively addresses current customer acclaimed issues with misalignment and improper latching of Ghost Controls' current system.

Our goal is to develop a solution that ensures reliable engagement, enhanced durability, and ease of installation.

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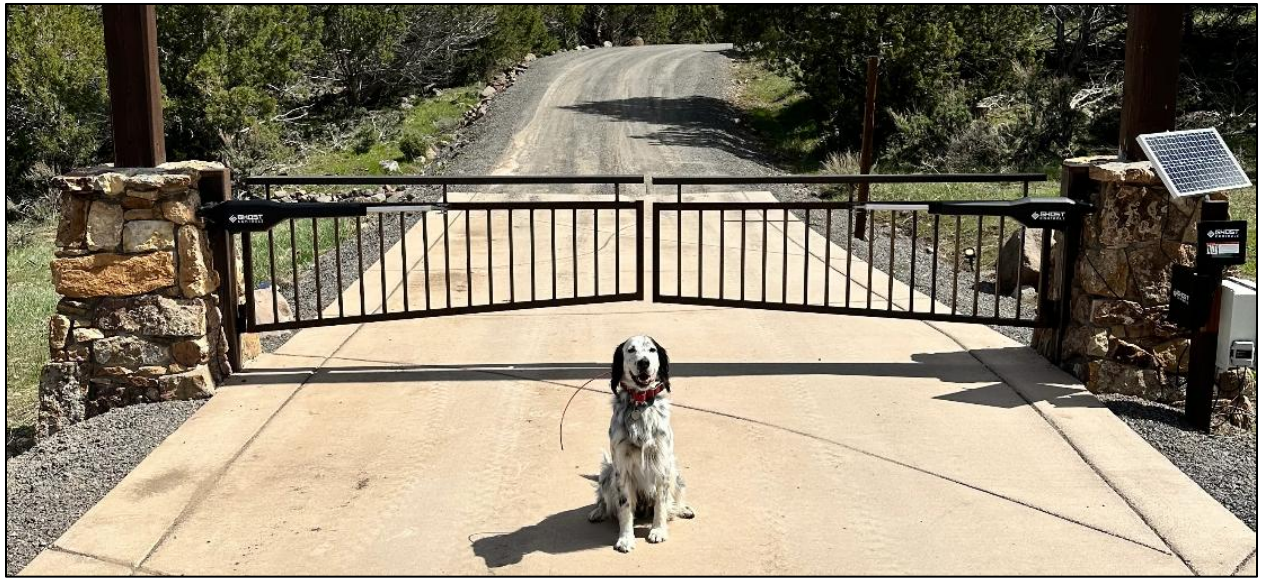
About Ghost Controls



- Local to Tallahassee
- Automatic Gate Openers
- Variety of Applications
- Designed for Do-It-Yourself (DIY) Installation

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Current Product – Zombie Lock

- Latch-Pin Style
- Weather Resistant
- Easy for DIY Install
- Improves Security for Properties and Homes

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Customer Issues

- Latch Misalignment Due to Gate Sag
- Main Cause of Customer Complaints

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Project Focus - Receiver

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Customer Needs

- Easy and Convenient to Use
- Withstands 50 lb of Force Directed at the Lock
- Marketable Design Characteristics
- Performs in Harsh Environments
- Works for Gates up to 20 ft in Length
- Performs on Swing Gates of Various Configurations

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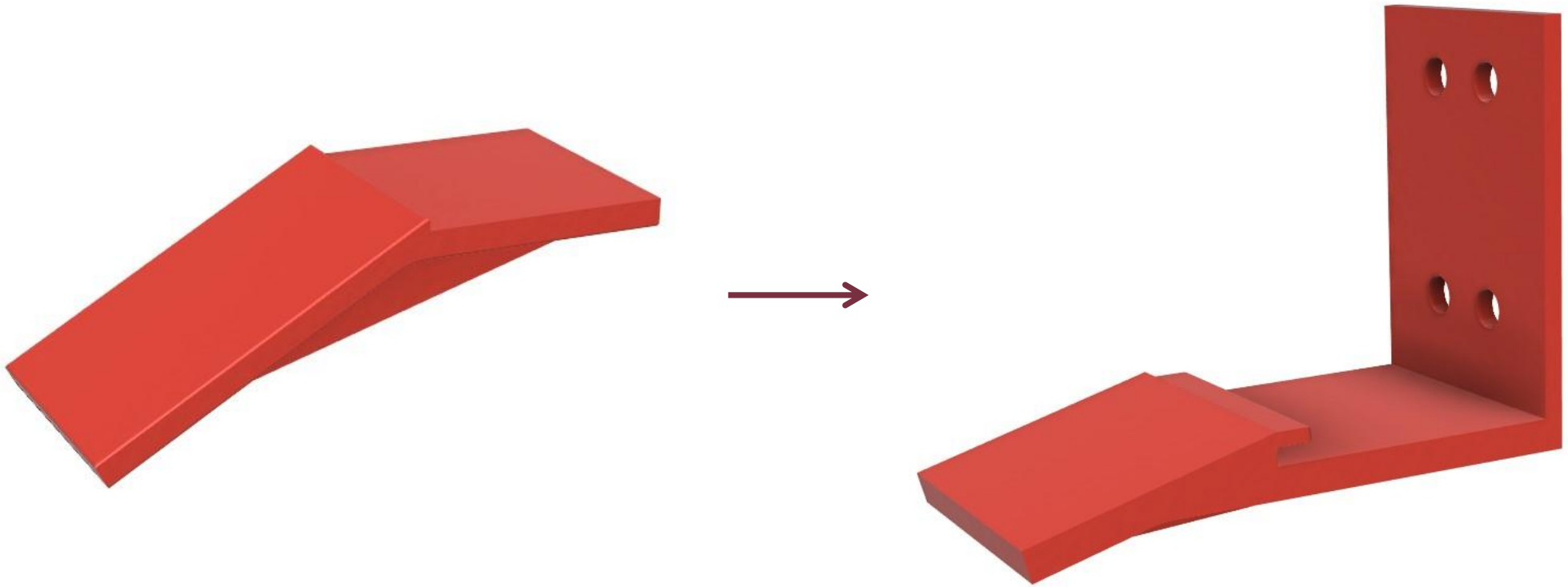
Design Concepts

Two Concepts are Better than One

1. Modification of Receiver
   - Guiding Ramp
2. Receiver Mounting Plate
   - Provides Vertical Adjustment

Jacob Brock

Prototyping - Ramp



Original Design

Modified Design

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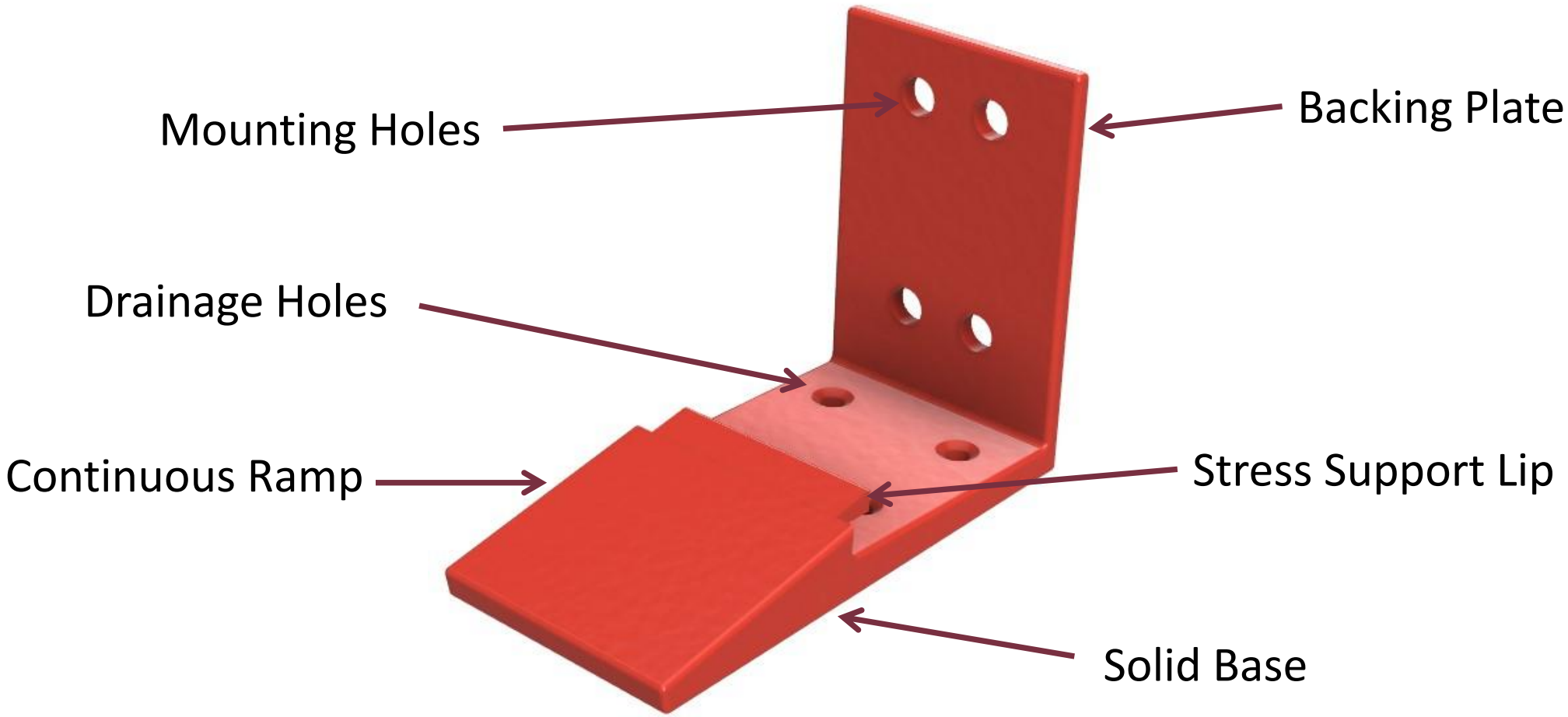
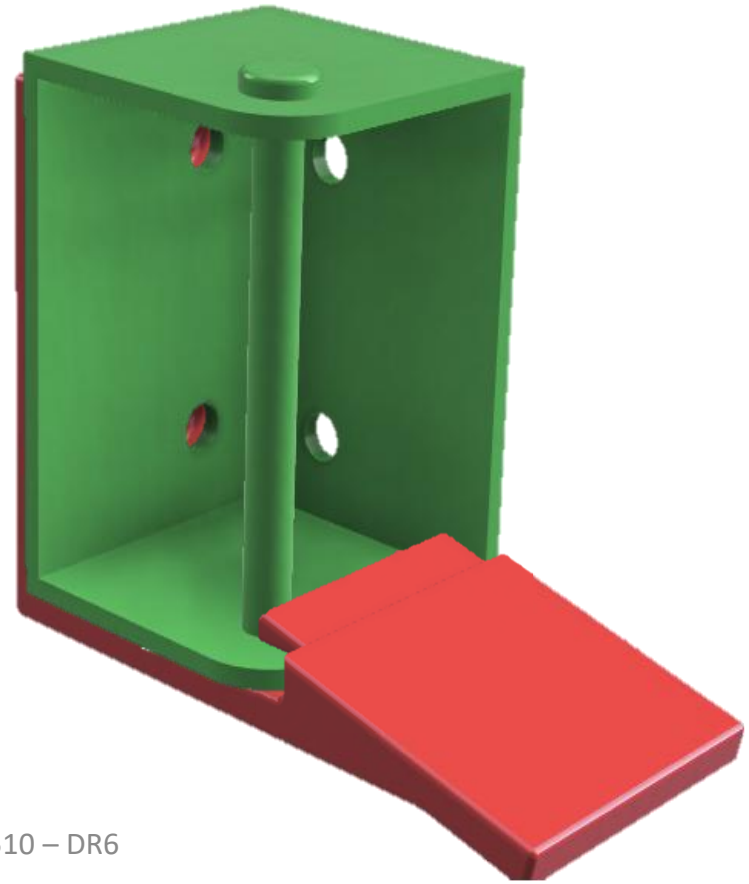
Current Ramp



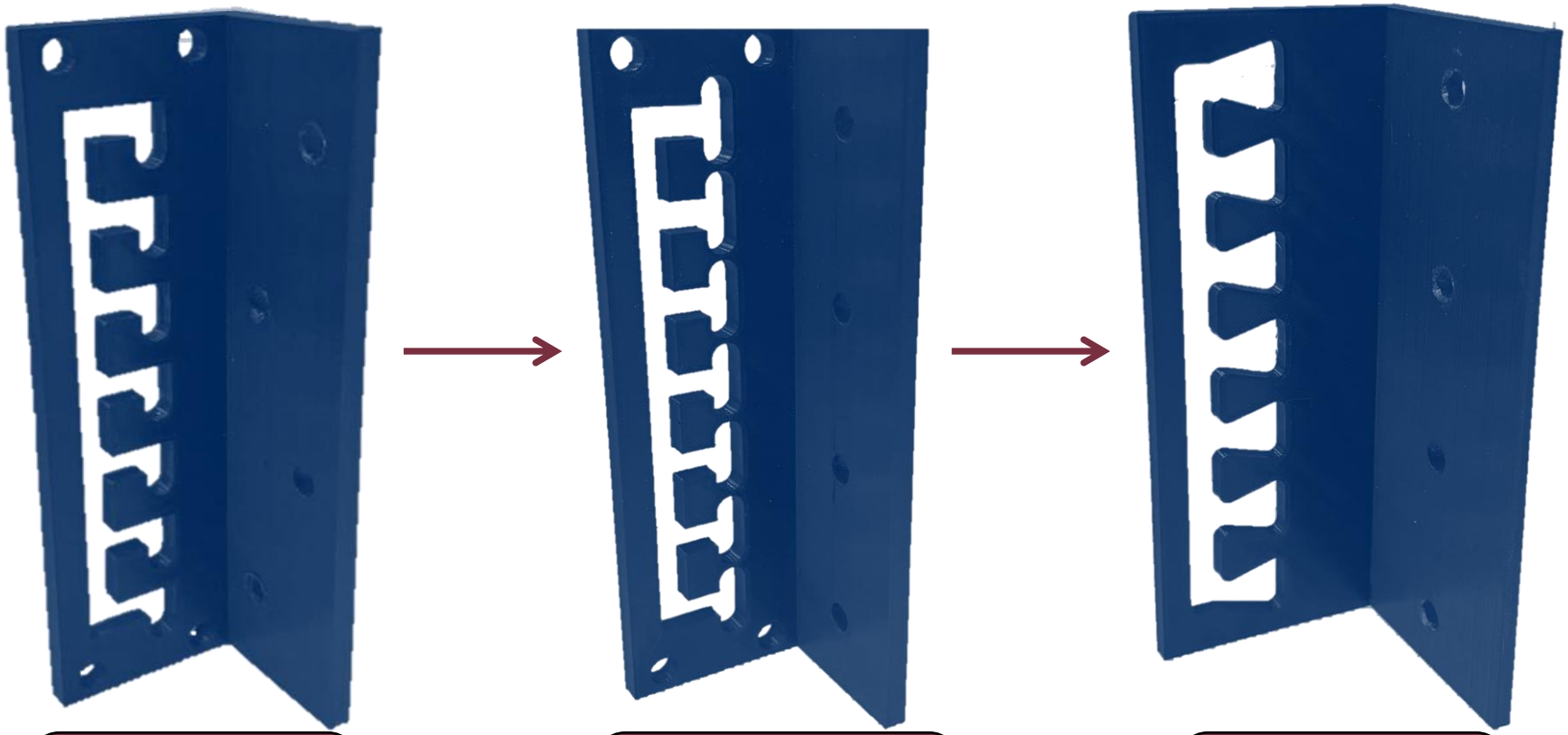
Applications

Left-Hinged Gate



Right-Hinged Gate

Prototyping - Adjustment Plate

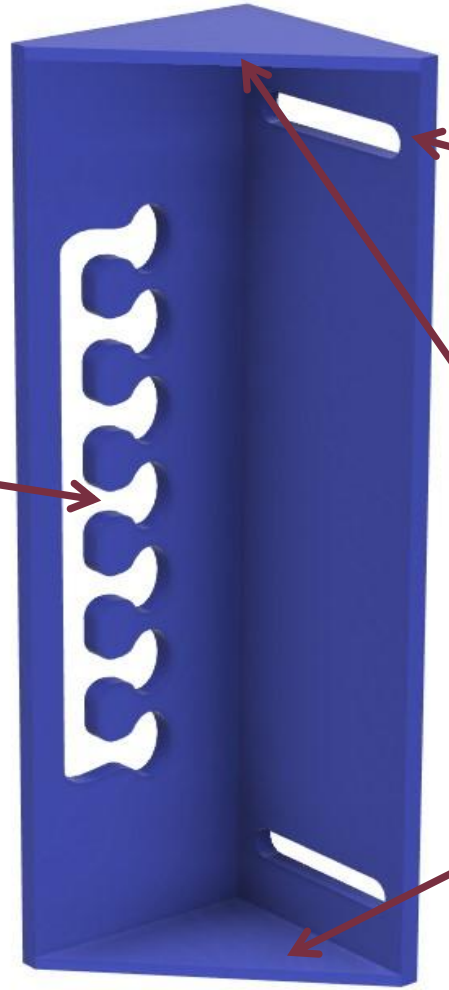


Original Design

Slotted for Left and Right Hinged Gates

Redesigned Slots for Strength

Current Adjustment Plate

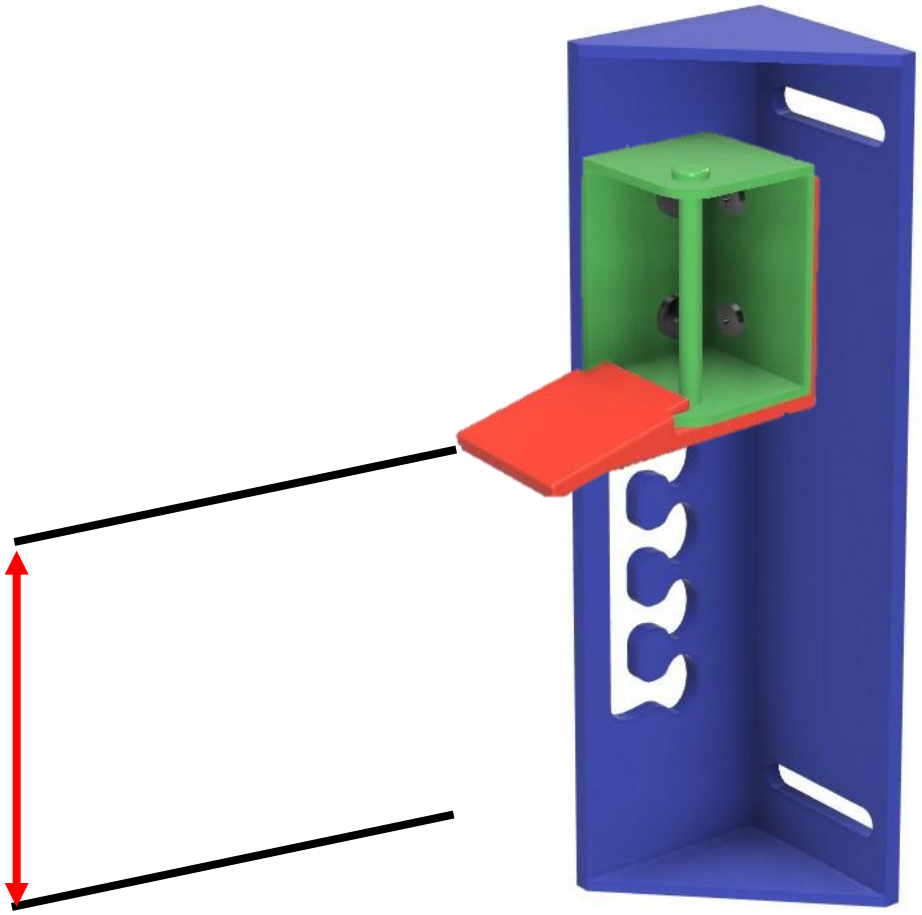


Slotted
Mounting Holes

Elliptical Shape
Slots

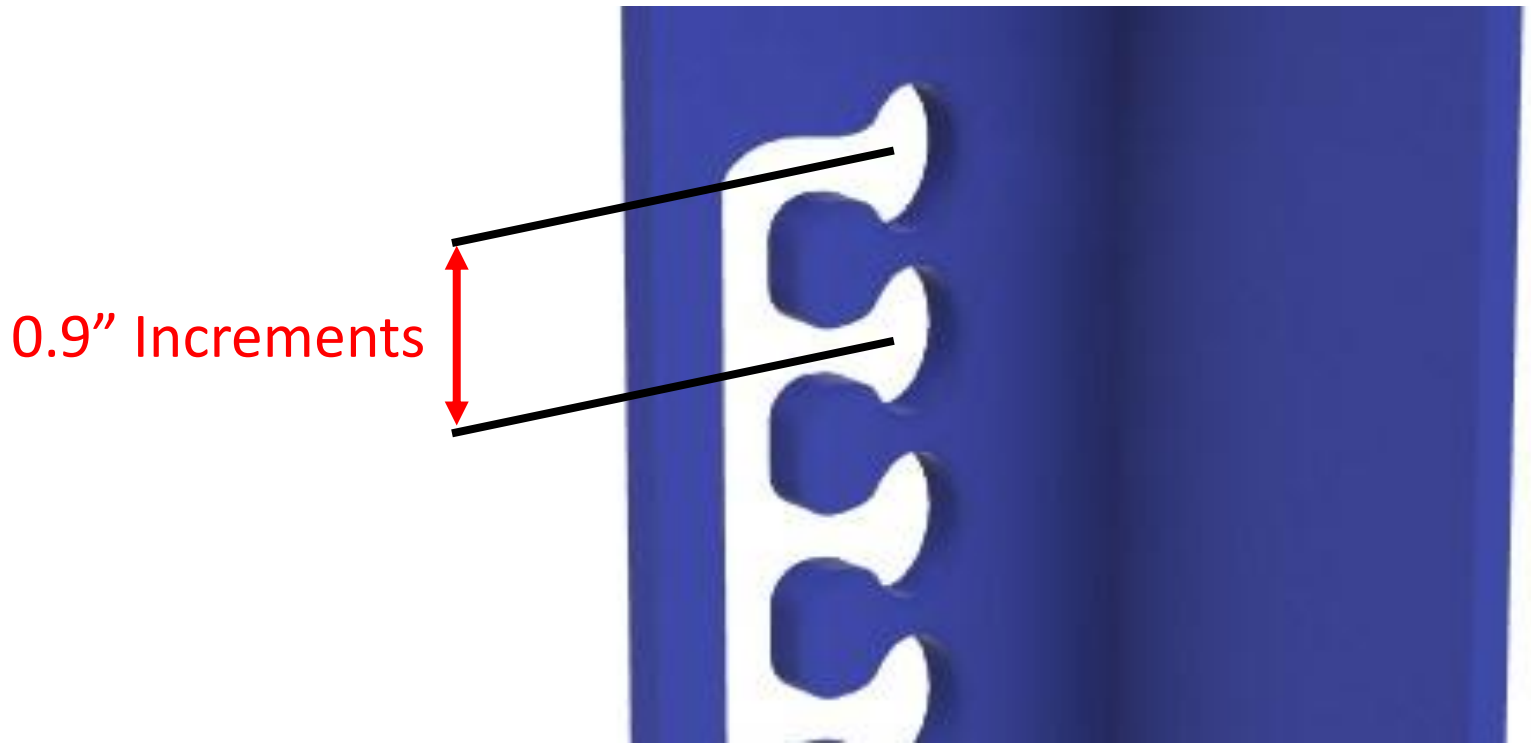
Top and Bottom
Gussets

Current Adjustment Plate



Jacob Brock

Current Adjustment Plate



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Current Adjustment Plate

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CAD Assembly

Physical Prototype

- 3D Printed Ramp and Adjustment Plate
- Current Market Reciever and Lock

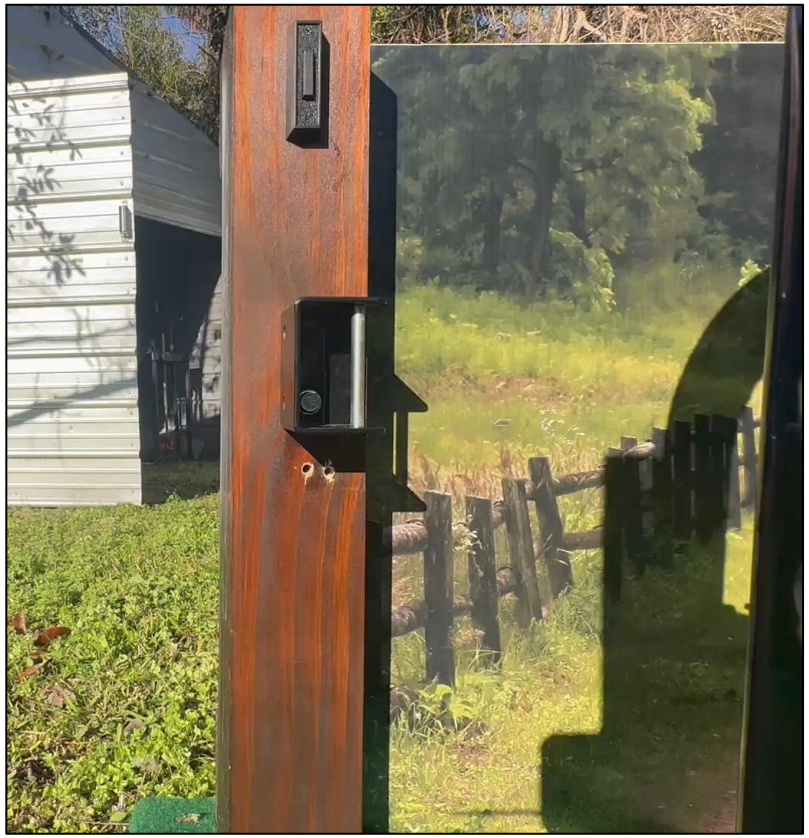
Gate Testing – 3.5 Feet

Scuff Produced on Prototype → Powder Coat Finish to Add Durability

Large Amount of Deflection → Aluminum to Increase Rigidity

Direct Comparison

Before



After

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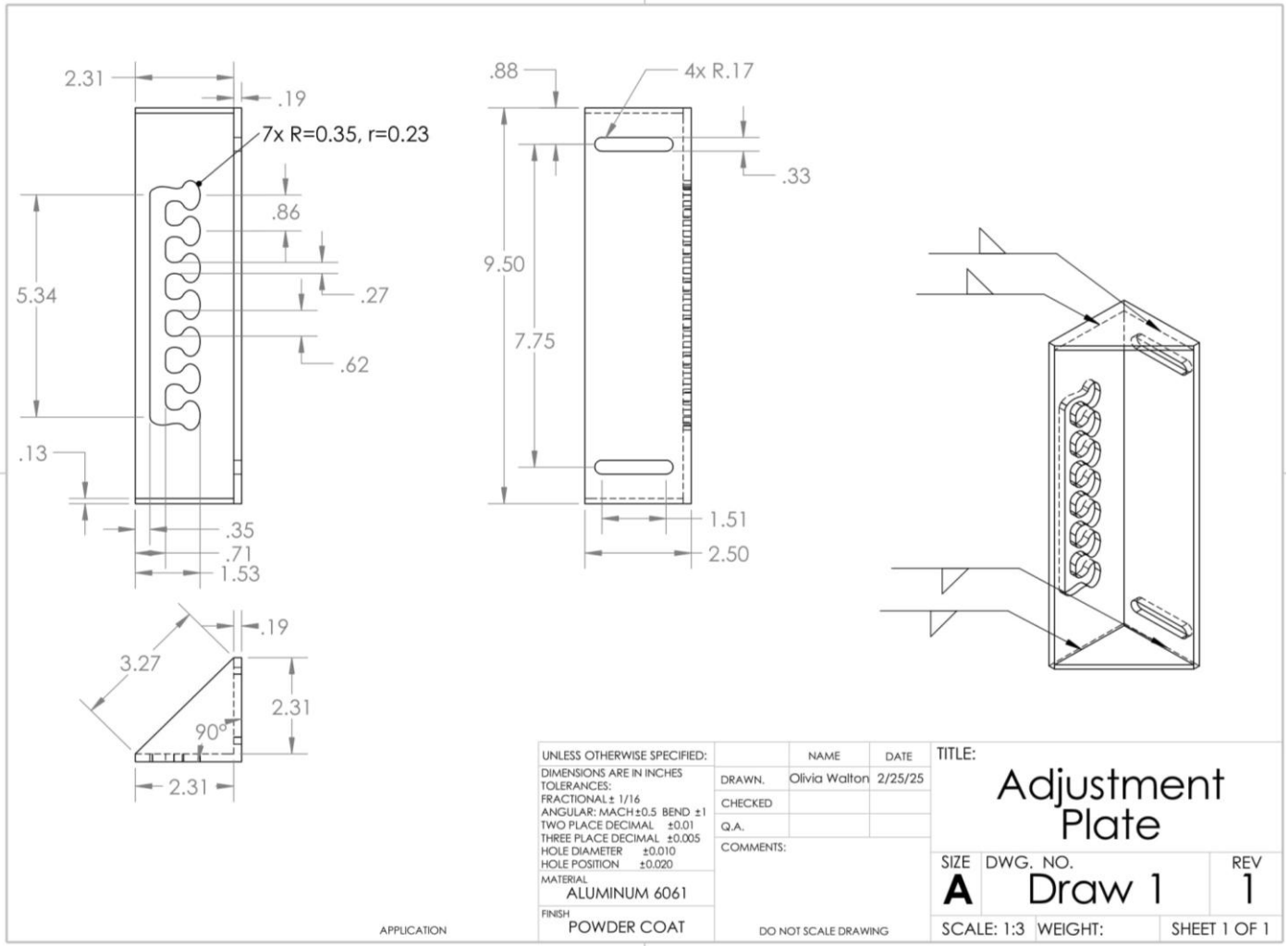
Gate Testing – 16 Feet

- Successful Guidance Up Ramp
- Similar Scuffing and Deflection Noticed

Gate Testing – 16 Feet

- Forced Bounce to Mimic Extreme Conditions
- Locking Remains Successful

Drawings - Adjustment Plate



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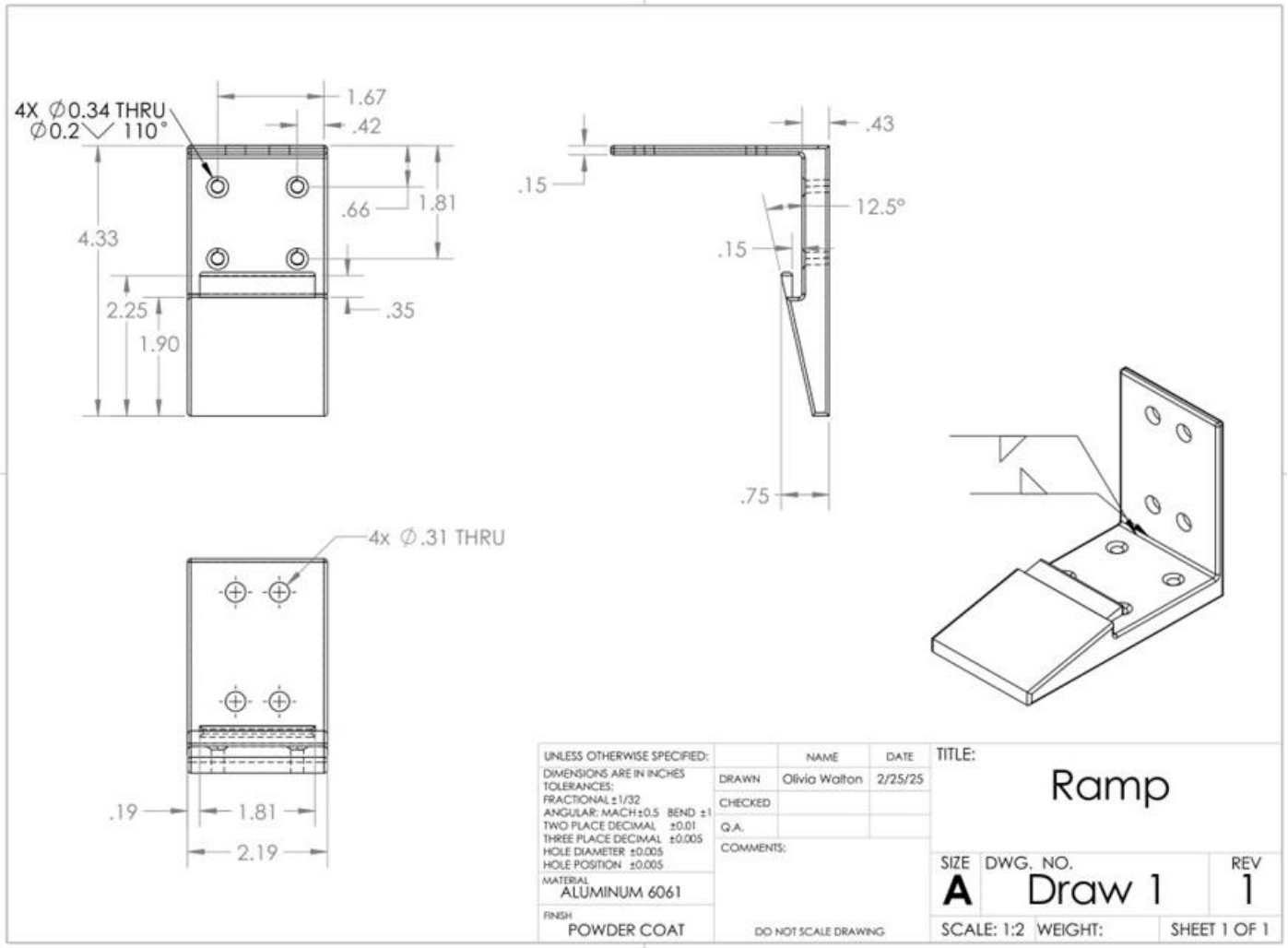
Drawings - Ramp



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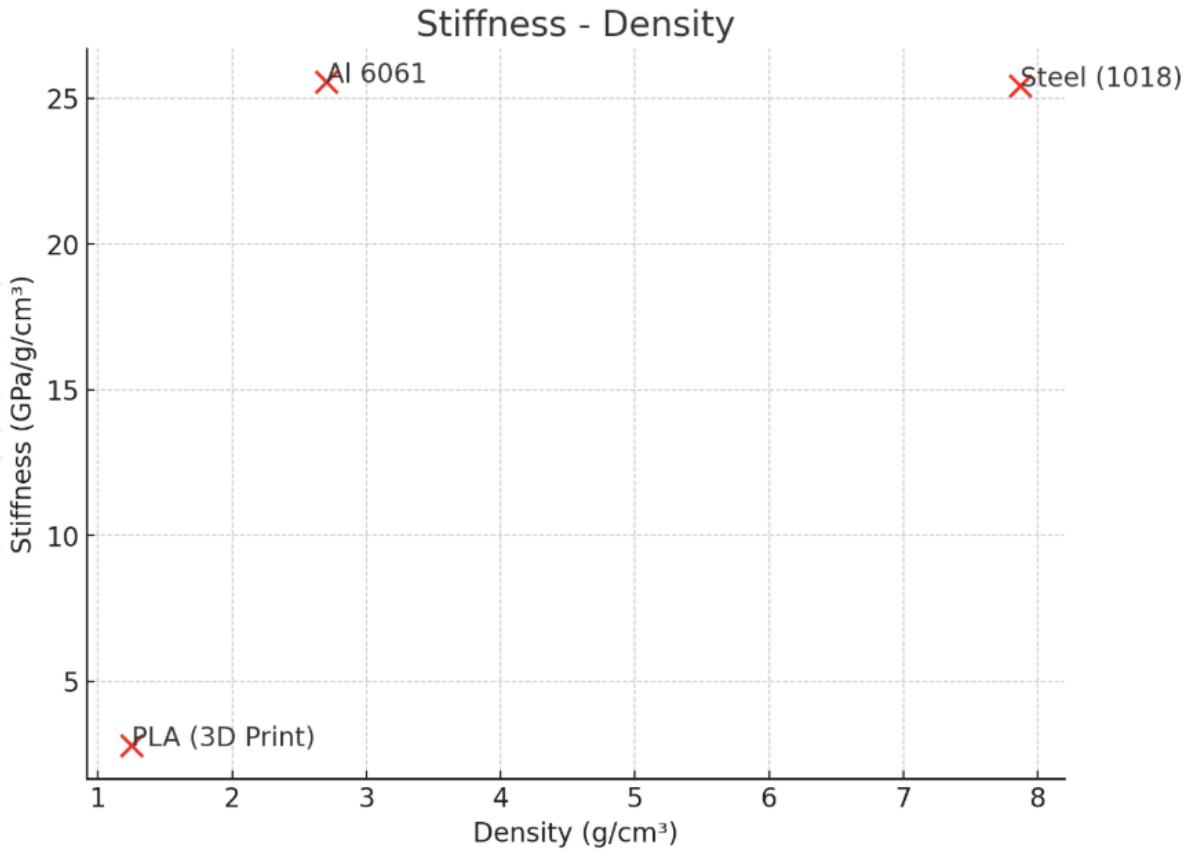
Material Selection

Properties	Aluminum (Al 6061)	Steel (Mild Steel 1018)	3D Printed Plastic (PLA)
Density (g/cm^3)	2.7	7.85	1.0 - 1.4
Yield Strength (MPa)	293 - 300	370 - 440	40 - 60
Ultimate Tensile Strength (MPa)	313 - 320	450 – 500	50 – 70
Elastic Modulus (GPa)	68 – 72	200 – 210	2 – 5
Machinability	Excellent	Good	Poor
Weight	1/3 of Steel	1 (Reference)	1/5 of Steel

Bradley Wiles

Material Selection – Ashby Chart



$$\frac{E}{\rho} = \frac{\text{Elastic Modulus}}{\text{Density}}$$

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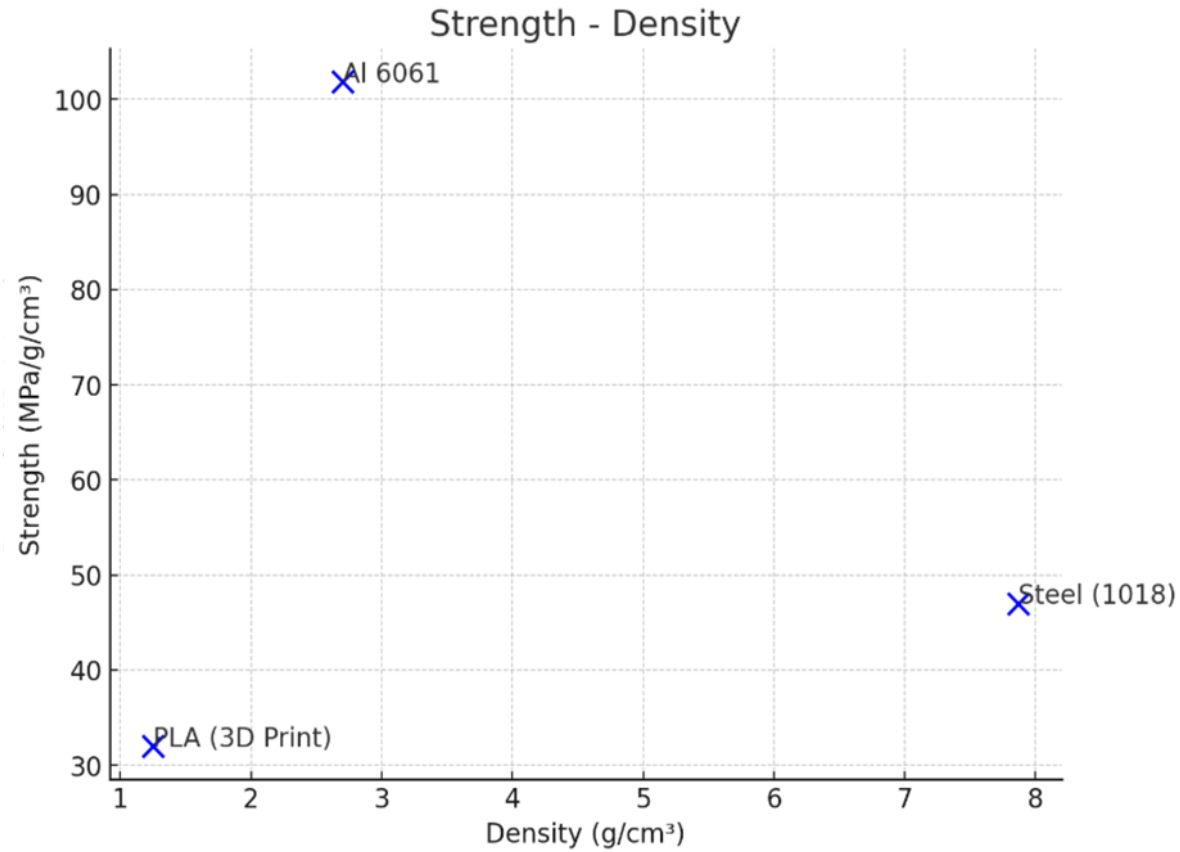
Bradley Wiles

Material Selection – Ashby Chart



$$\frac{\sigma}{\rho} = \frac{\text{Yield Strength}}{\text{Density}}$$

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Material Selection

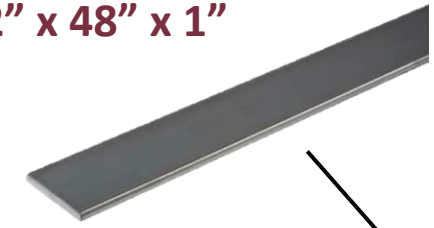
AL 6061

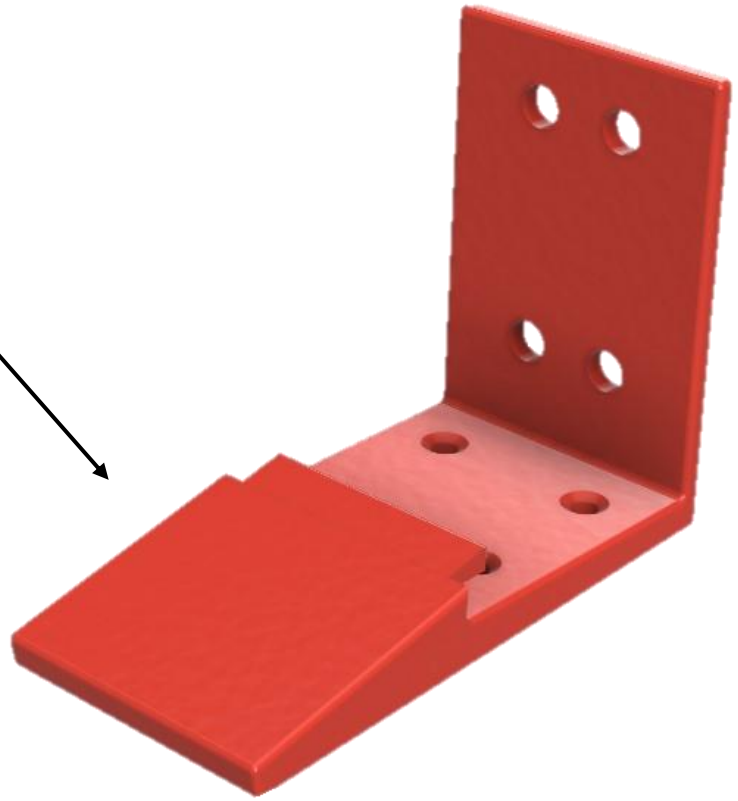
- Current Material Used by Ghost Controls
- Natural Corrosion Resistance
- Lightweight
- Cost Effective
- Environmentally Friendly

Ramp Material

Bar

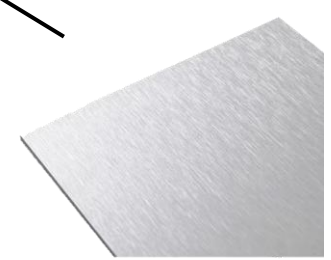
2” x 48” x 1”





Sheet

16” x 16” x 1/8”



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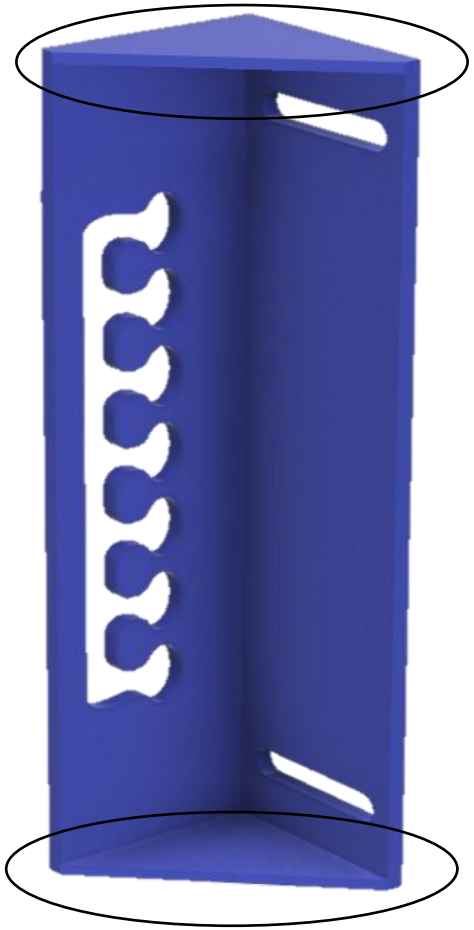
Adjustment Plate Material

Sheet

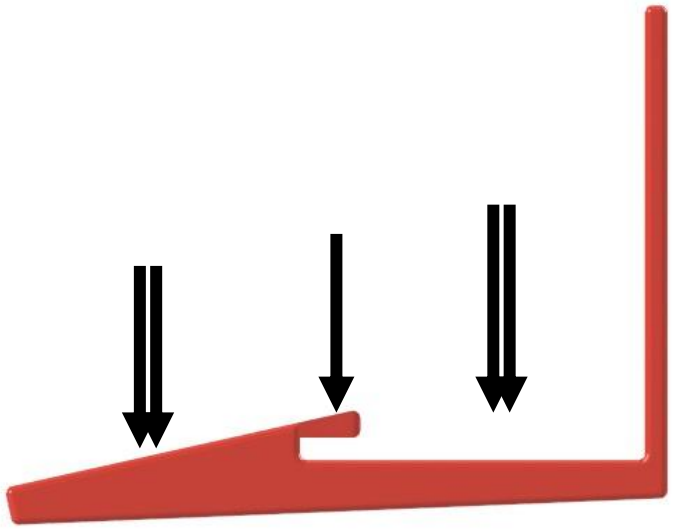
16” x 16” x 1/8”



90° Angle Bar

2.5” x 2.5” x 4’ x 1/8”

Manufacturing - Cuts

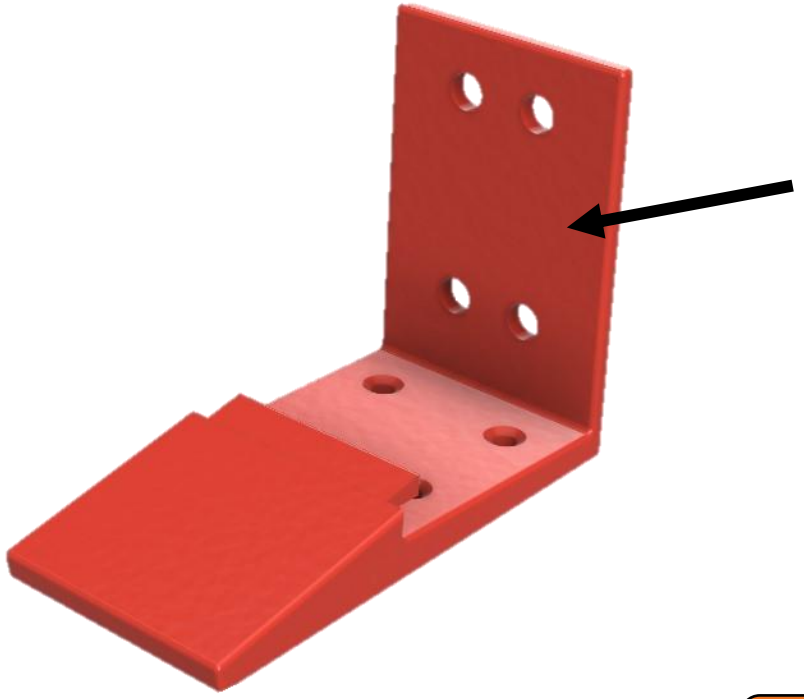


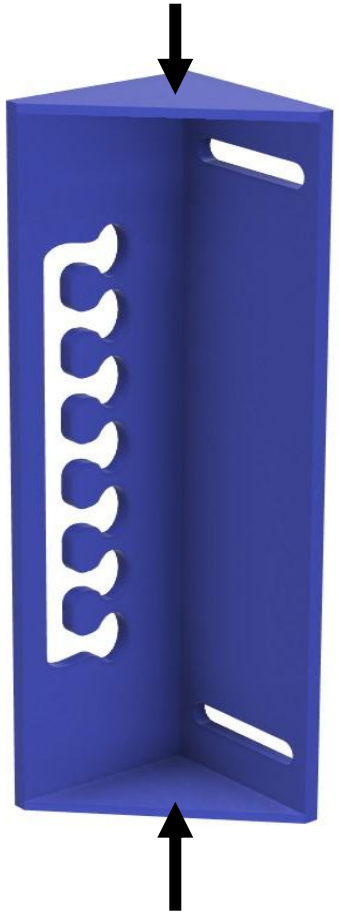
Surface/Rough Cuts: Carbide Bits

Notch: Steel Side Cutter

Facing/Finishing Cuts: Carbide Bits

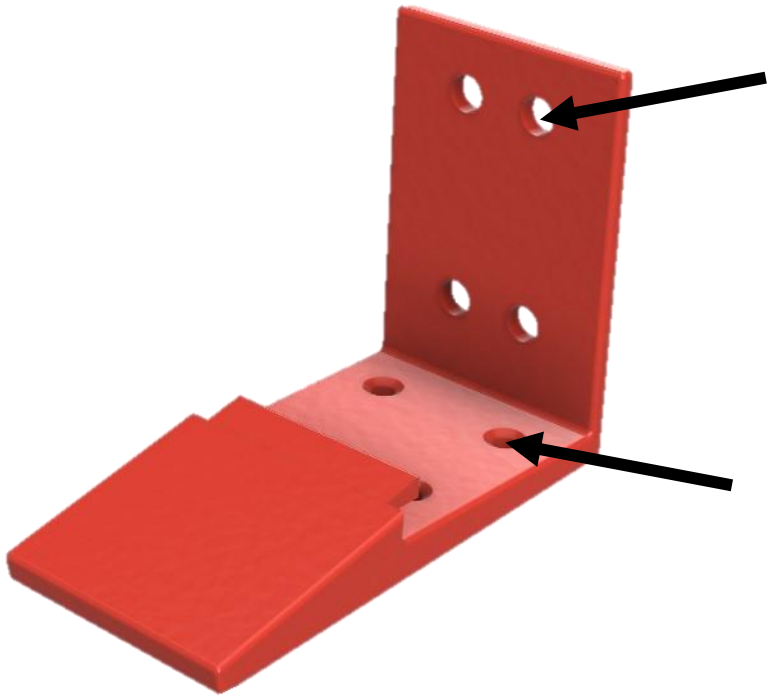
Manufacturing - Cuts



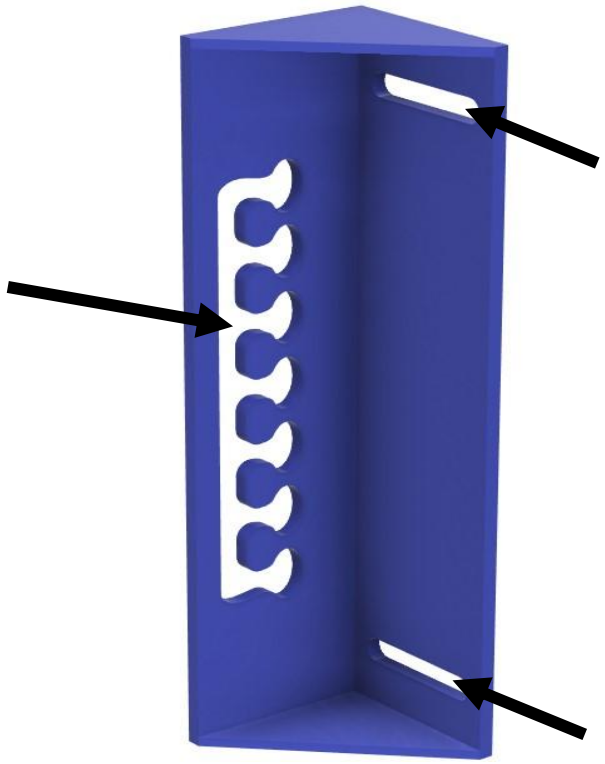


Water Jet

Manufacturing - Holes

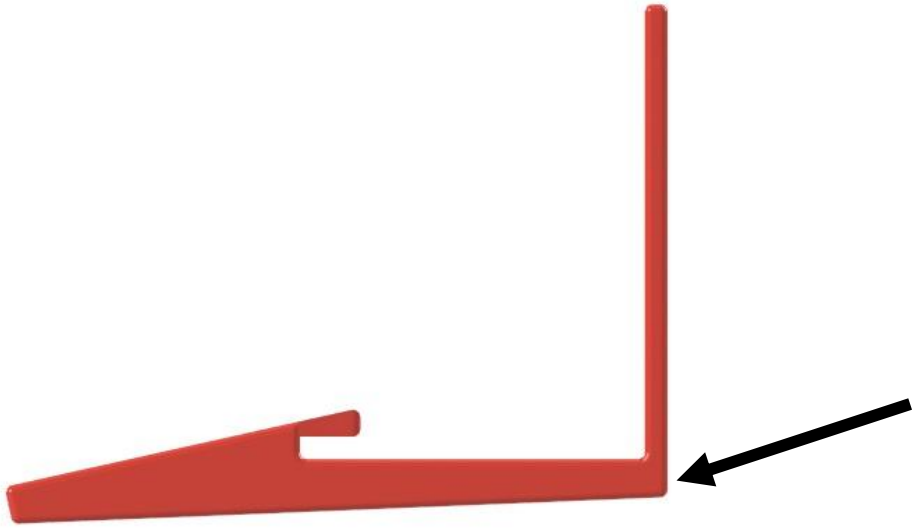


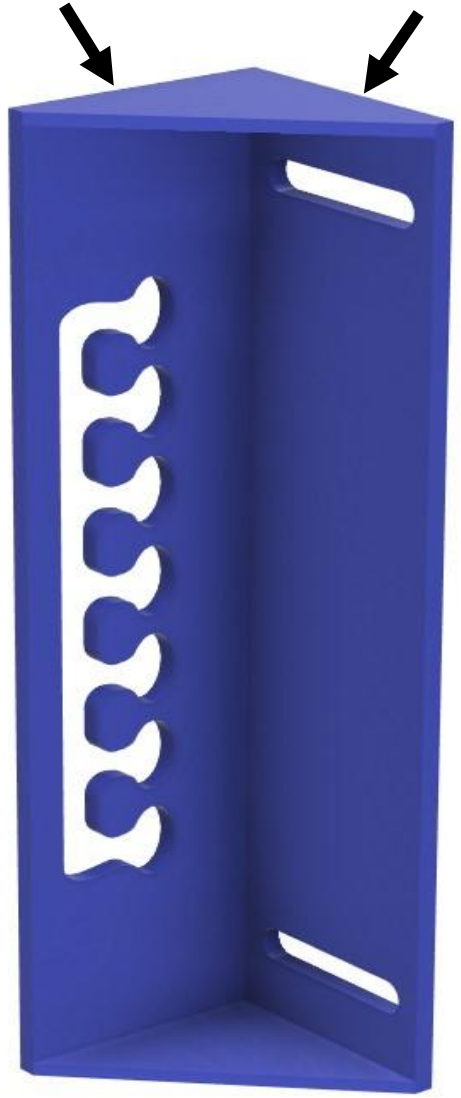
Carbide Bits



Water Jet

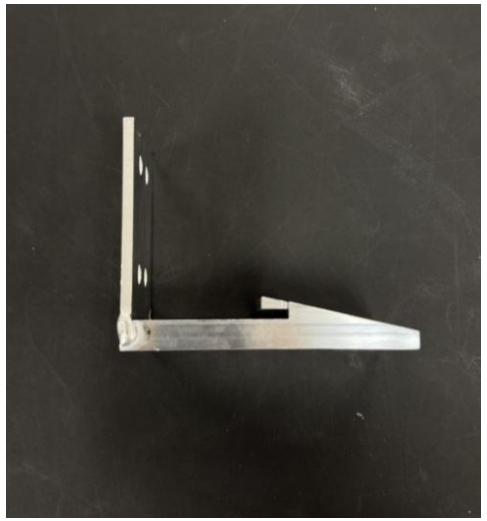
Manufacturing - Welds





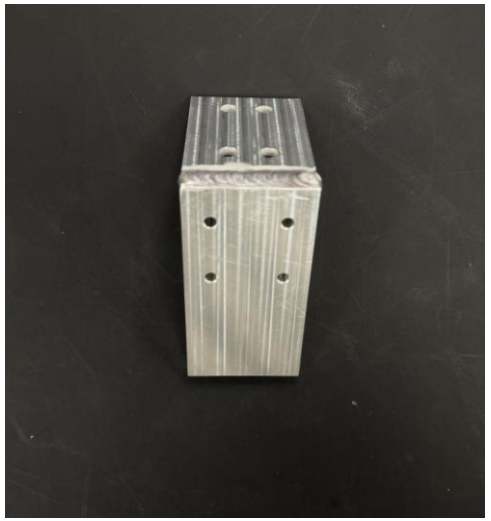
ER 4043 Al Filler

Manufacturing - Ramp



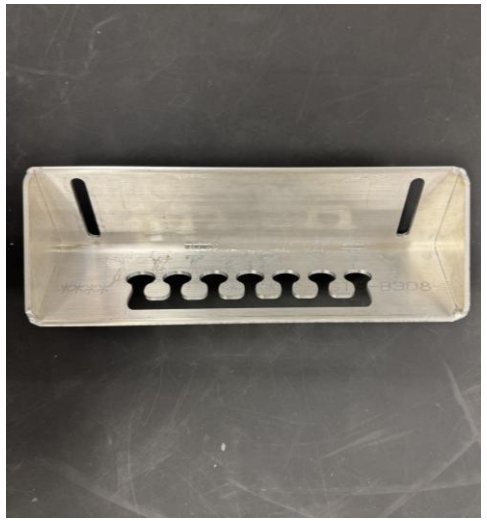
Side

Top



Back

Manufacturing – Adjustment Plate



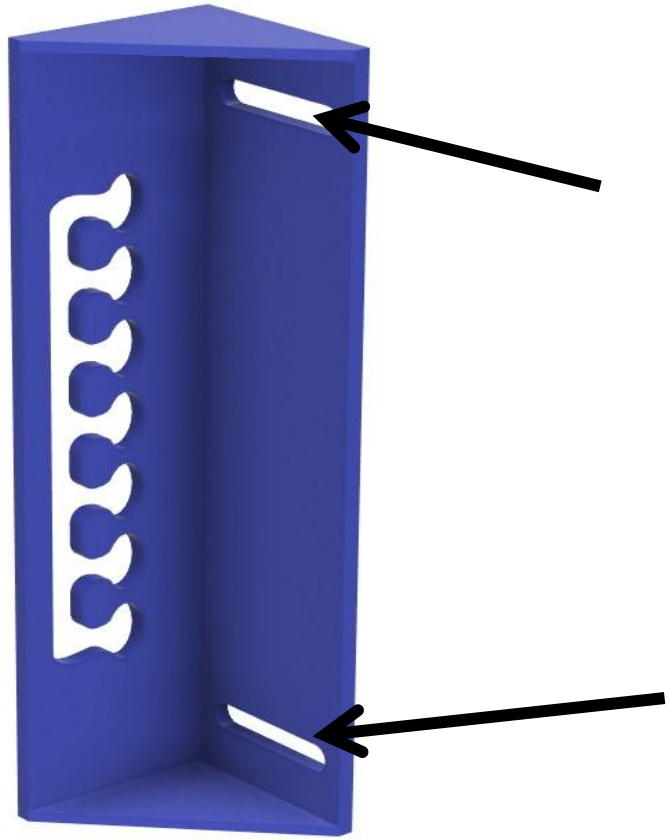
Side

Top

Back

Manufacturing - Hardware

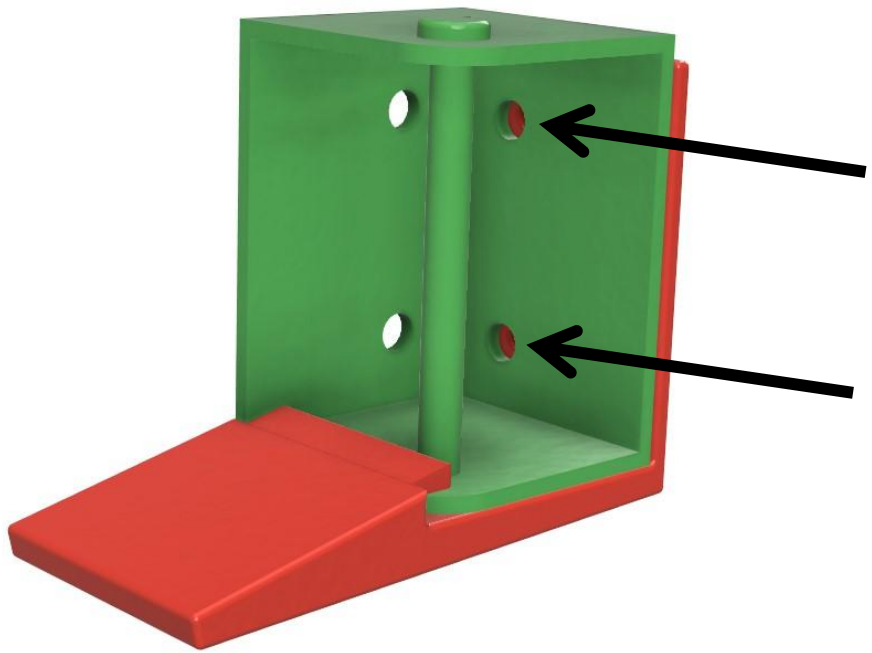
Adjustment Plate to Gate Post



- From Original ZombieLock
- Lag Bolts

Manufacturing - Hardware

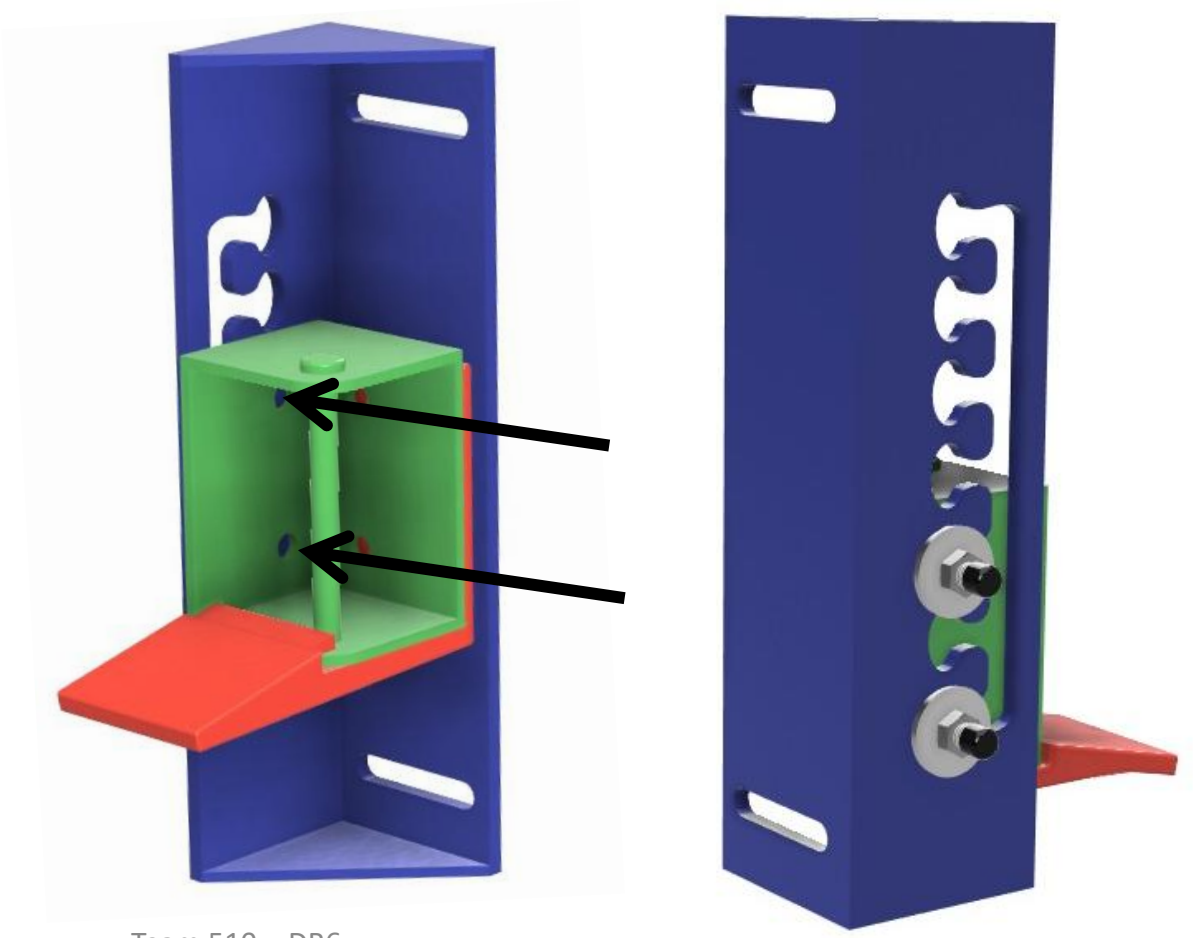
Receiver to Ramp



- 1/4”-20
- 1/2” in length
- Countersunk
- Black

Manufacturing - Hardware

Receiver and Ramp to Plate

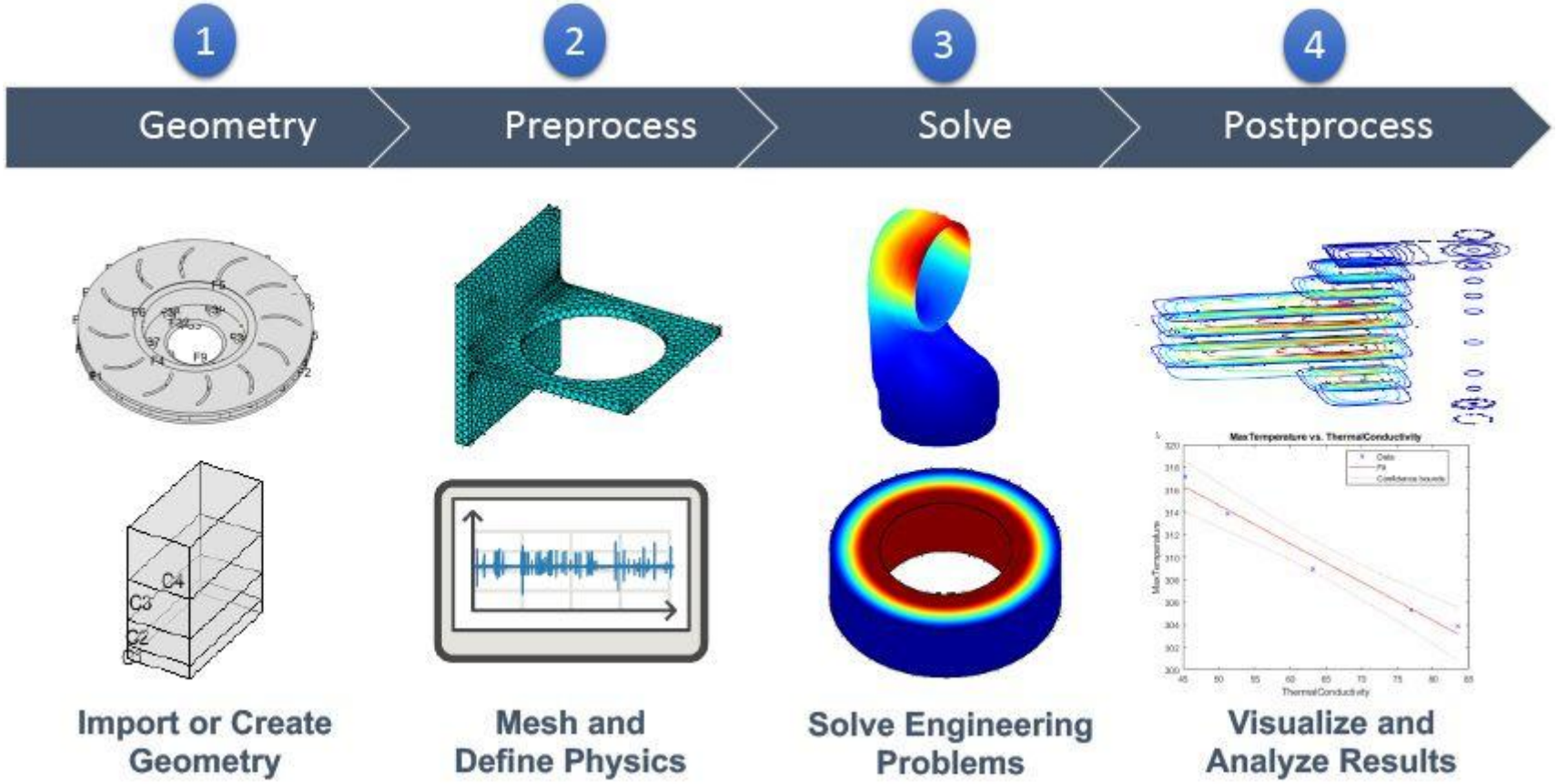


- Size 3/8”-16
- 1 inch in length
- Black
- Rubber end caps

Manufacturing – Powder Coating

- Increased Durability
- Improved Corrosion Resistance
- Aesthetic Appeal with Other Ghost Controls Products
- Increased Heat Resistance

Finite Element Analysis



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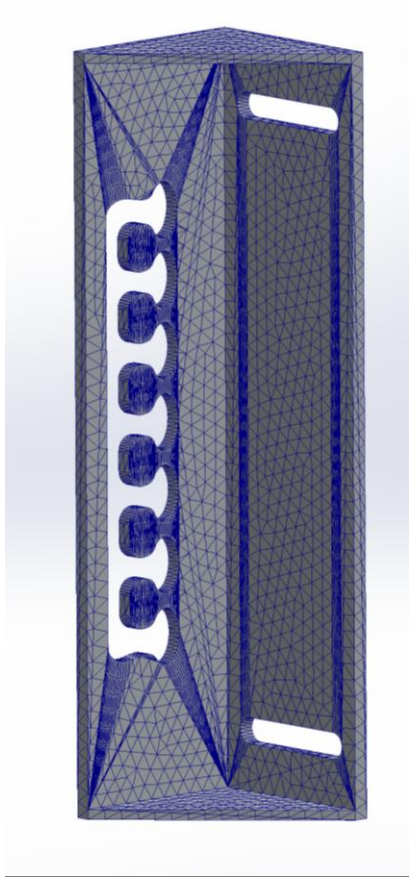
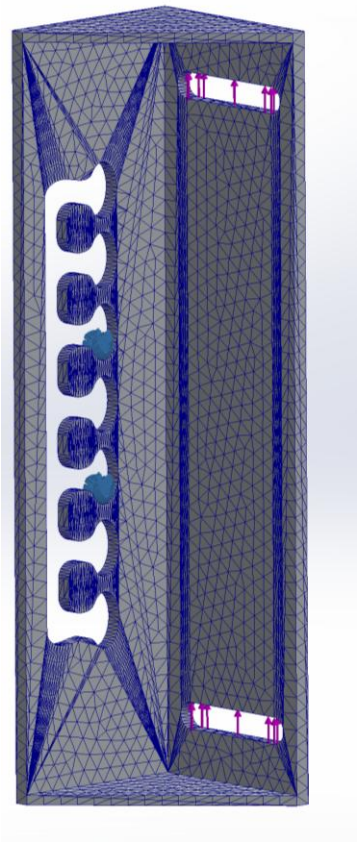
Dior Reece

FEA – Adjustment Plate



(1)



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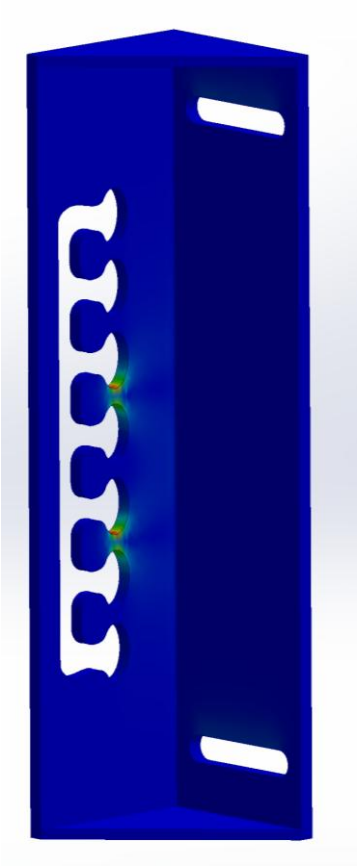

(3)

1. Mesh Quality Plot
2. Mesh with Added Forces
   - 300 lbf
3. von Mises Stress

   Max Stress: 1.203 psi

   Min Stress: 6.893e-16 psi

   Yield Strength: 3.999e04 psi

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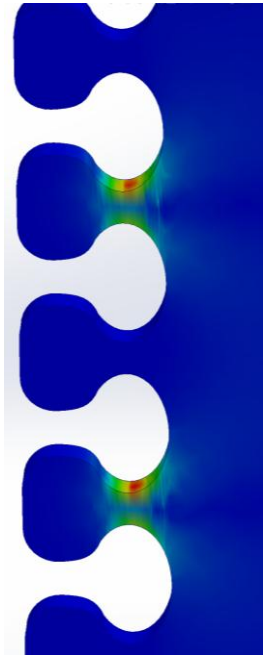
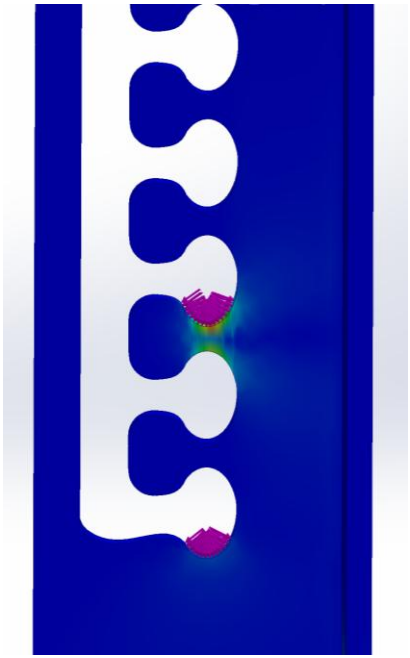
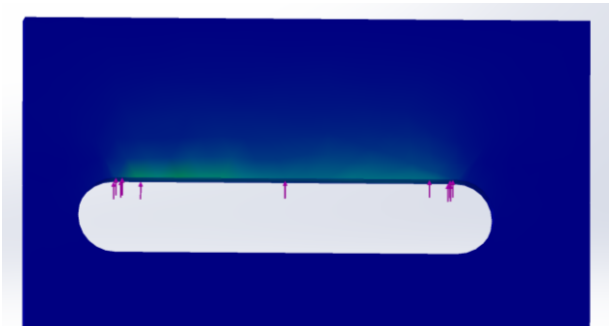
FEA – Adjustment Plate Results

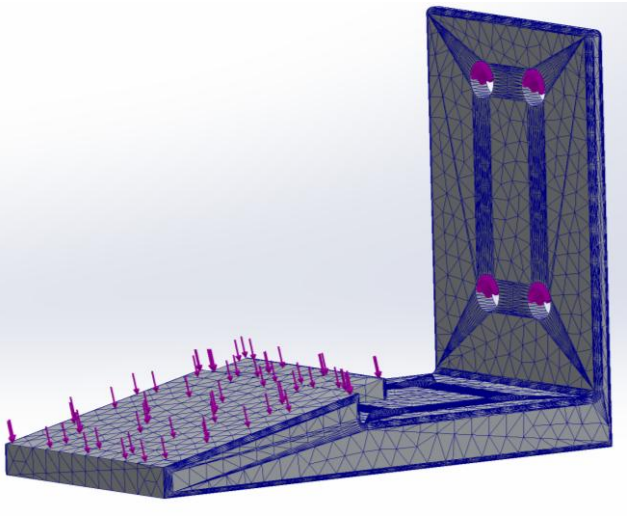




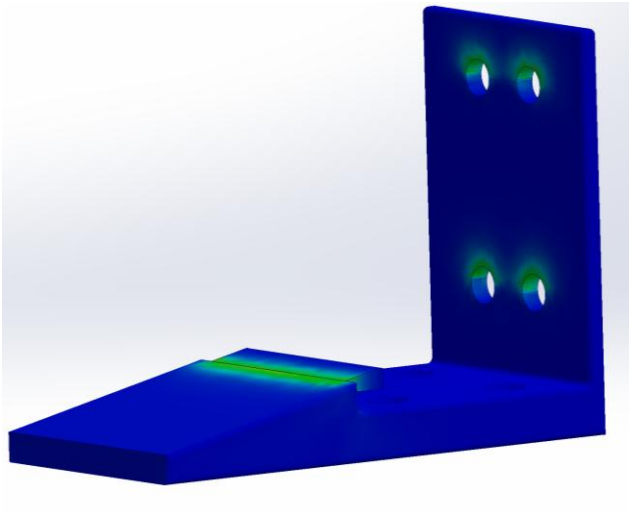


- Max stress is in the center of an elliptical tab
- Similar results except for last slot
- Stress around slotted mounting holes is small compared to elliptical tabs

FEA – Ramp



(1)



(2)

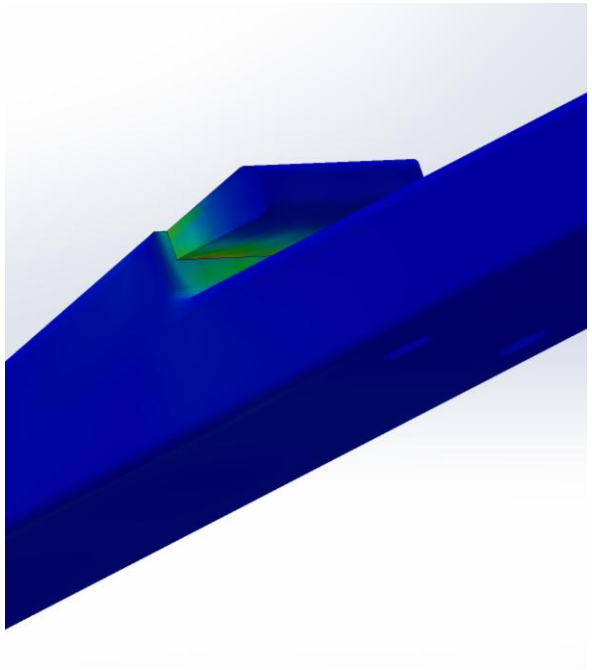
1. Mesh with Added Forces
   - 300 lbf
2. von Mises Stress

   Max Stress: 4.266 psi

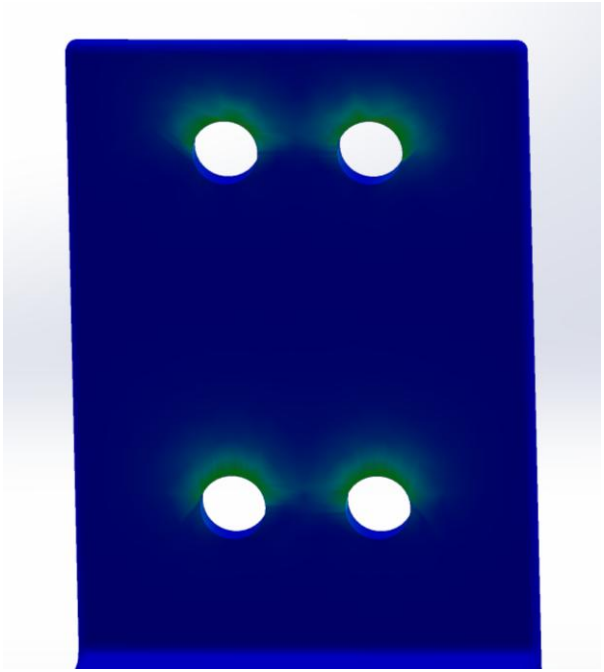
   Min Stress: 5.269e-13 psi

   Yield Strength: 3.999e03 psi

FEA – Ramp Results



(1)



(2)

1. Max stress is under stress support lip
   - Deals the most with the weight of the gate
   - Extra support will be given from receiver
2. Stress around mounting holes

Future Work

- FEA and Material Testing
- Material Machining & Powdercoating
- Hardware Purchasing
- Assemble First Metal Prototype
- Test Product on Gates

GHOST® CONTROLS

Questions?

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