Morgan State University
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Industrial Engineering

Redesign of the 2020 Morgan State Mining Robot Scooper Mechanism

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BACKGROUND

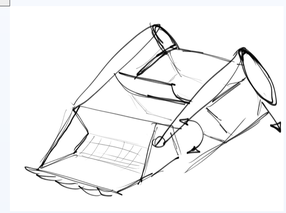
Within a 10-week span of time, the goal of this internship was to create a scooping mechanism that could mine regolith, a fine powdery substance meant to resemble what is found on the moon and potentially other planets. The design had to fulfil the following requirements:

A) Use mostly additive manufacturing
B) Minimize the use of metal attachments
C) Excavate a depth of 20 inches

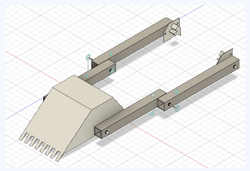
METHODOLOGY

This project followed a basic engineering process.

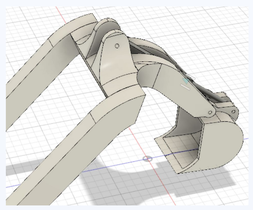
1. Preliminary sketches
2. Prototype
3. Design concept
4. Stress Simulation
5. Design Revisions



Preliminary sketch



Concept design



Final design after revisions

DATA ANALYSIS

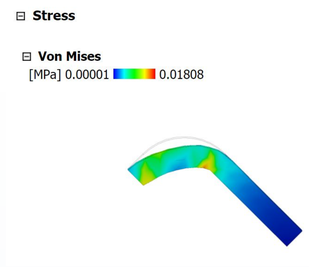


Diagram that shows the weakest parts of the design

Result Summary

Name	Minimum	Maximum
Safety Factor		
Safety Factor (Per Body)	15	15
Stress		
Von Mises	1.193E-05 MPa	0.01808 MPa
1st Principal	-0.006895 MPa	0.005306 MPa
3rd Principal	-0.02035 MPa	0.002091 MPa
Normal XX	-0.01036 MPa	0.002811 MPa
Normal YY	-0.0176 MPa	0.002359 MPa
Normal ZZ	-0.01068 MPa	0.005039 MPa
Shear XY	-0.002031 MPa	0.001781 MPa
Shear YZ	-0.009586 MPa	0.006895 MPa
Shear ZX	-0.001481 MPa	0.001257 MPa
Displacement		
Total	0 mm	0.001027 mm

Table showing the summary for the stress report

Loads

Force1

Type	Force
Magnitude	67 N
X Value	0 N
Y Value	-67 N
Z Value	0 N
X Angle	0 deg
Y Angle	0 deg
Z Angle	0 deg
Force Per Entity	No

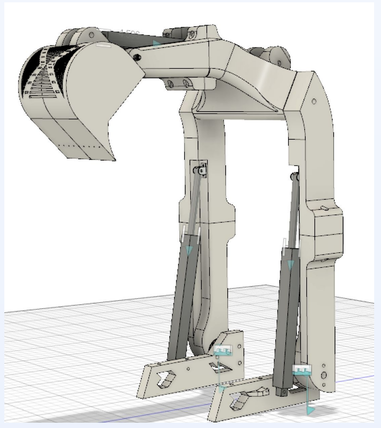
Table detailing the load added in the stress simulation

When deciding how to develop the design, the Fusion 360 stress simulation program and inclusive prototyping using the base design aided improvement decisions.

RESULTS

- Arm with 2 pivot points
- Arch in the middle of the arm that points downwards
- 3 actuators to move the arm
- Perforated scooper

Part of the arm constructed by using additive manufacturing



Final design of the new mining mechanism

CONCLUSION

The final product was developed, analyzed, revised, and finalized into a design that fulfilled each requirement. Data analysis aided in this process by utilizing stress analysis. By using Fusion 360, a functional arm was able to be modeled and 3D printed with the Raise3D printer.