GNG 1103 – Engineering Design

Faculty of Engineering

University of Ottawa

Prototype I and Customer Feedback

Group 9

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Abstract

This document focuses on the feedback we were given from our client and the steps we are taking to impact design choices and improve our solution. Prototype 1 testing and test results are included in this document as well as a test plan for prototype 2. An analysis of critical components is also included.

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Client Feedback

- No scraping when inserting with “cheese-grater design”
- Use gravity to collect the sample
- Cable insertion may be difficult with design 1
- The number of cutting locations should be limited to what you need (We have a lot on the sketch), have it out of contact and have a mechanism that extends it to come into contact.
- Liked the simplicity of design 1.
- Liked the sub-system layout.
- A vacuum could work, but it's not necessary. Using mechanical methods to powder samples is difficult to repeat.
- Use gravity to collect burrs
- The sample can be left in the pipe
- Might not need very many cheese grater holes added complexity for no value
- Don't want the cheese grater in contact as it is moving down the pipe
- Design 1 could get jammed
- Stick to sub-systems subsystems are good

Based on our client’s feedback, we have decided to focus on a combination of prototypes 1 and 2. Scott emphasized the simplicity of our first design was good and that breaking down our device into subsystems is an approach we should maintain.

One issue he pointed out with Prototype 2 was that the "cheese-grater" component would scrape the pipe during insertion. In response to this feedback, we decided to discard the cheese-grater idea and instead focus on a single-point blade lever mechanism for our collection subsystem.

He also commented on the idea of using a vacuum to collect the sample while scraping, noting that while it would be possible, it is unnecessary. Additionally, he preferred the sample to consist of "burs" rather than a powder for better repeatability.

Prototype 1 Test Plan

Analysis of Critical Components

Main Lever:

The main lever pivots and comes out through the opening to push up the blade (blade not in this prototype). The main lever should be able to withstand the force of the cable pulling it and the scraper pushing against the top of it.

Stopping Bars:

The lever must be easily manageable, the lever system will contain stopping bars so it doesn't over-rotate and limits the lever's movement. It is important that the stopping bars can withstand the force of the main lever pushing on it due to the tension in the cable.

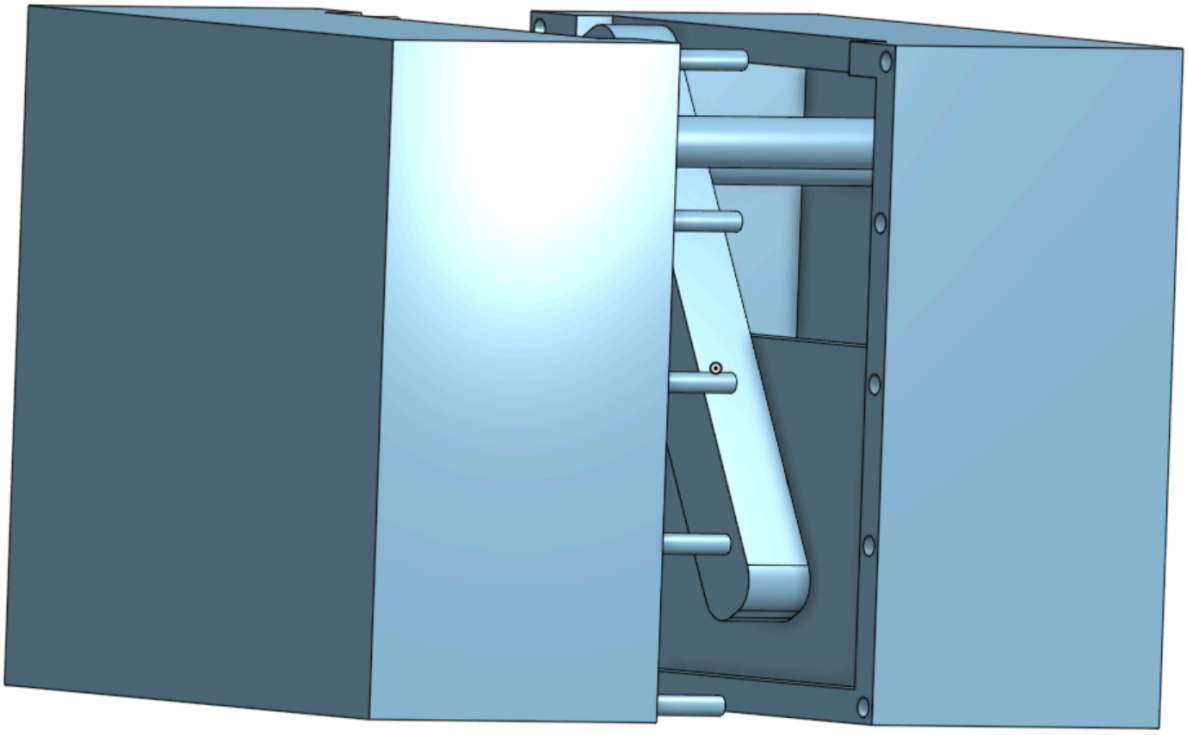
Box Fitment:

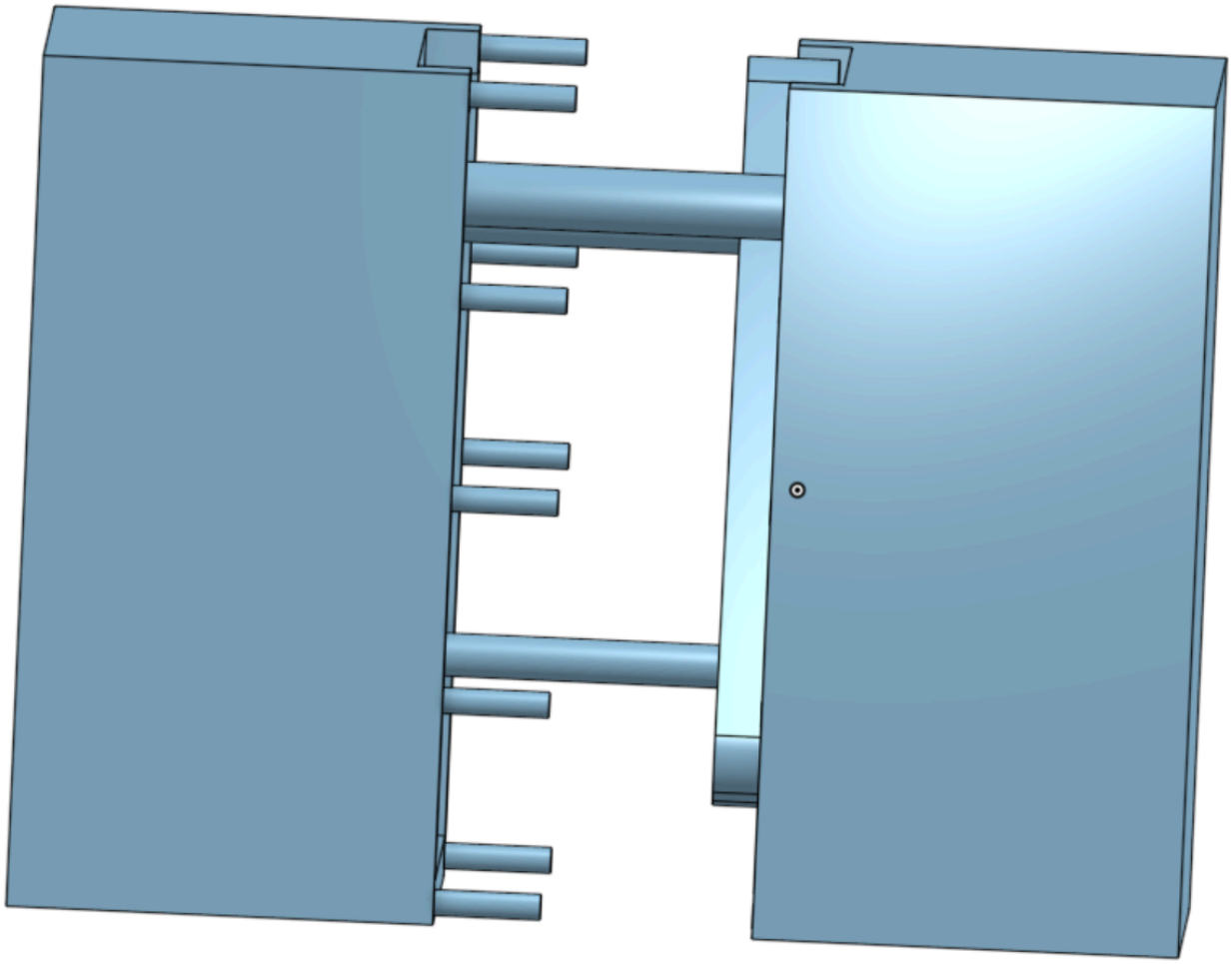
The box must be able to be fitted properly to contain the lever mechanism as well as allow the lever to stick outside of the box. If the lever cannot smoothly stick outside of the box then it would not be able to push our eventual blade up for it to scrape the pipe. In addition, the two halves must fit together.

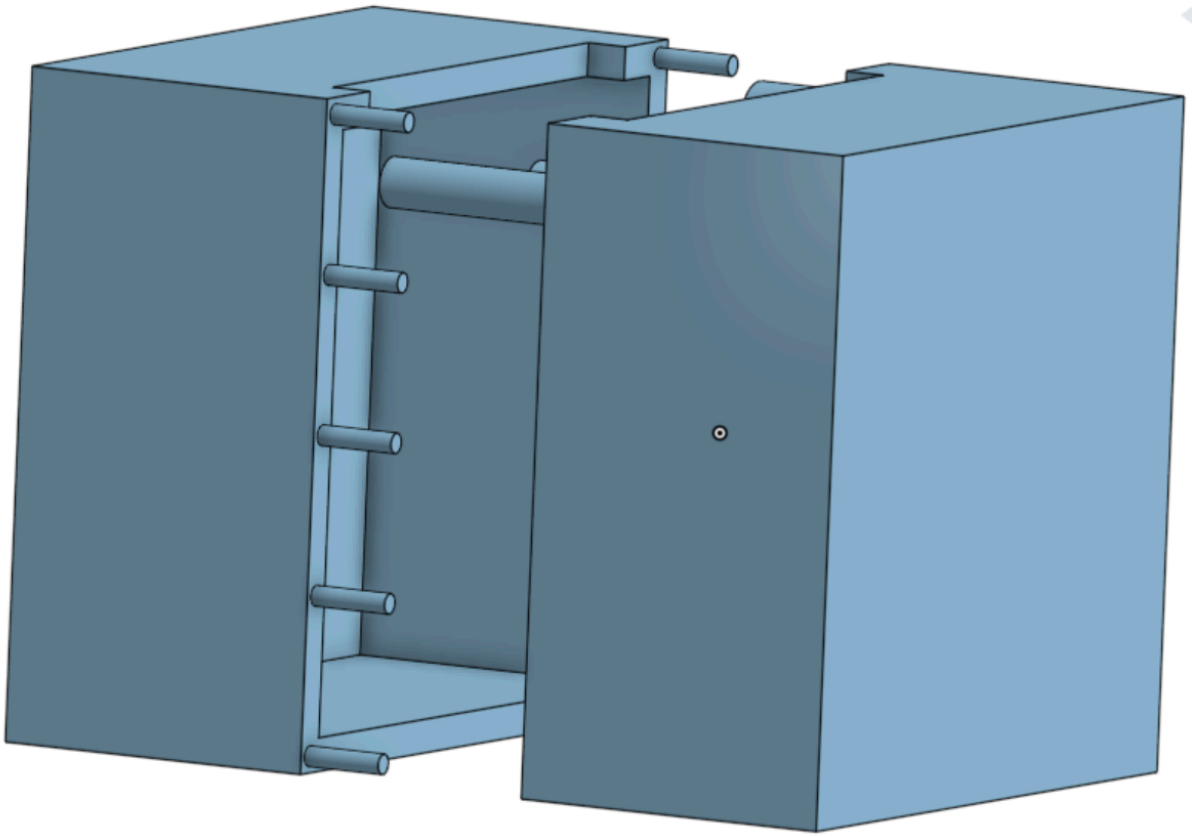
Questions/ideas pointed out by other groups and TAs

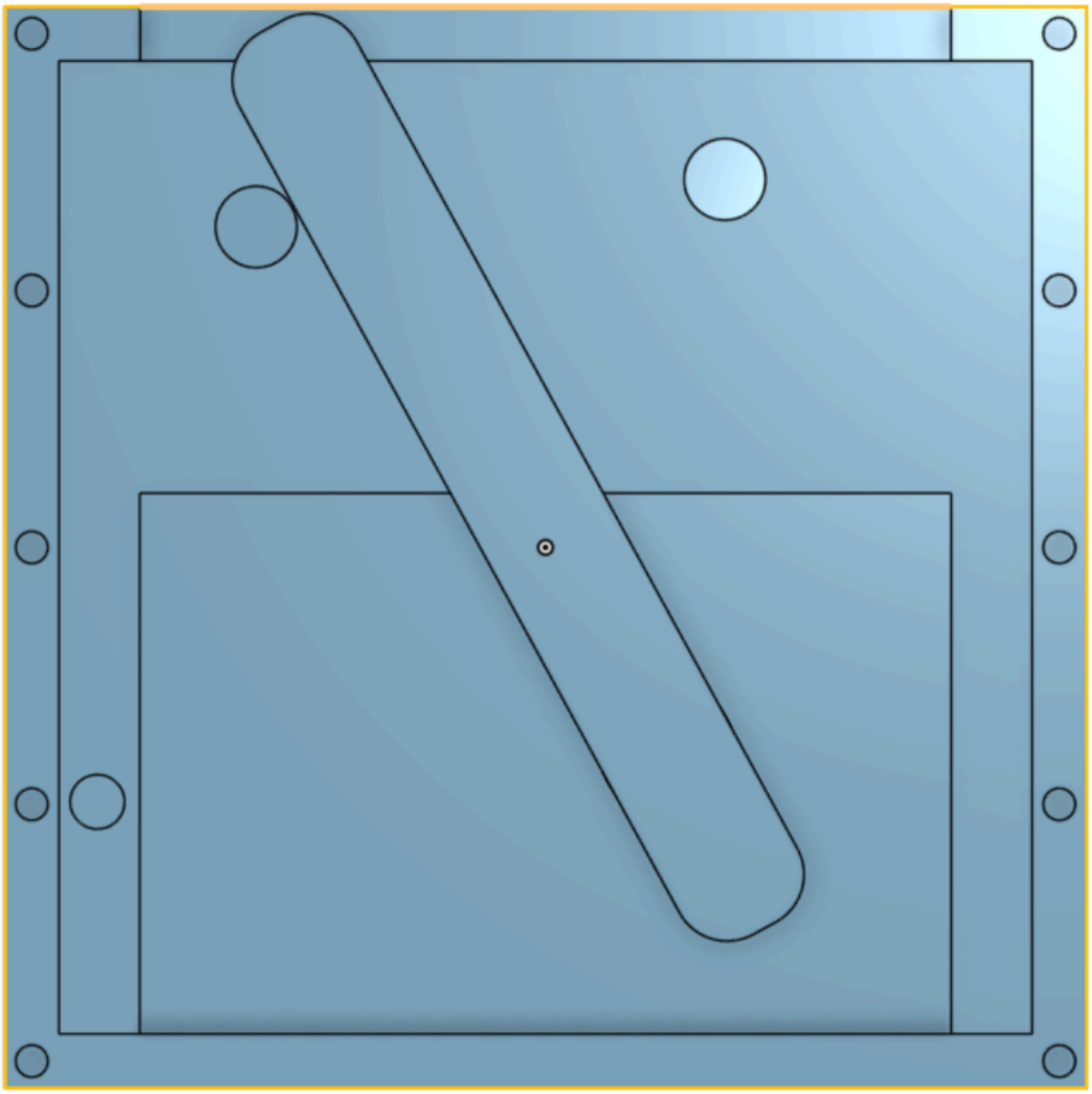
- Adjusting the scraper to be smaller, the TA said to use the tip of something to scrape a really small amount (30mg-80mg) of the sample. If we keep it long then it will be a very small movement to get the 80mgs and that will be hard.
- The vertical setting of the tool could be a concern that needs to be confirmed with testing.
- Suggestion to create a smaller removable container inside the collection chamber of the tool to make the entire tool more reusable

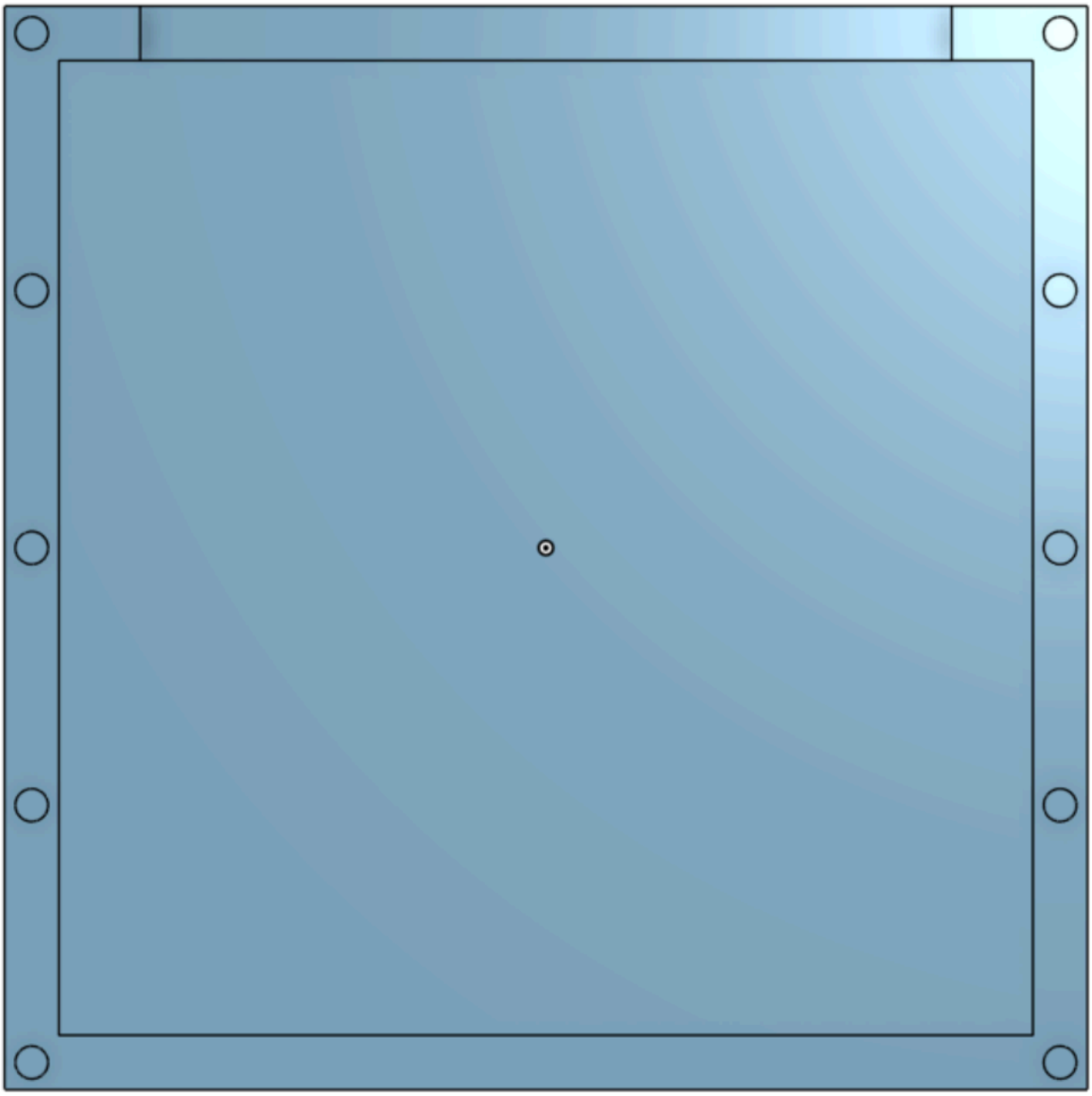
Prototype 1

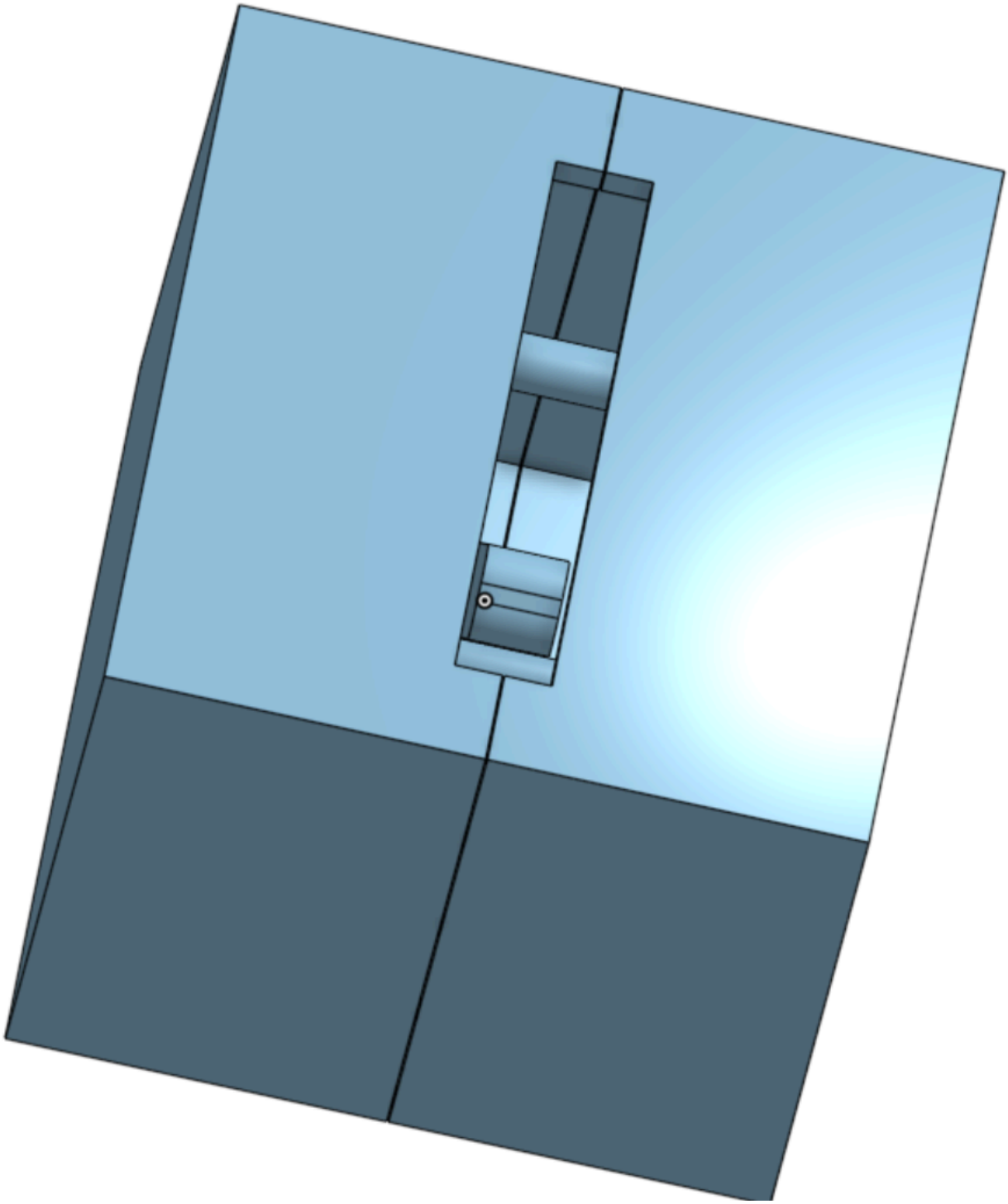


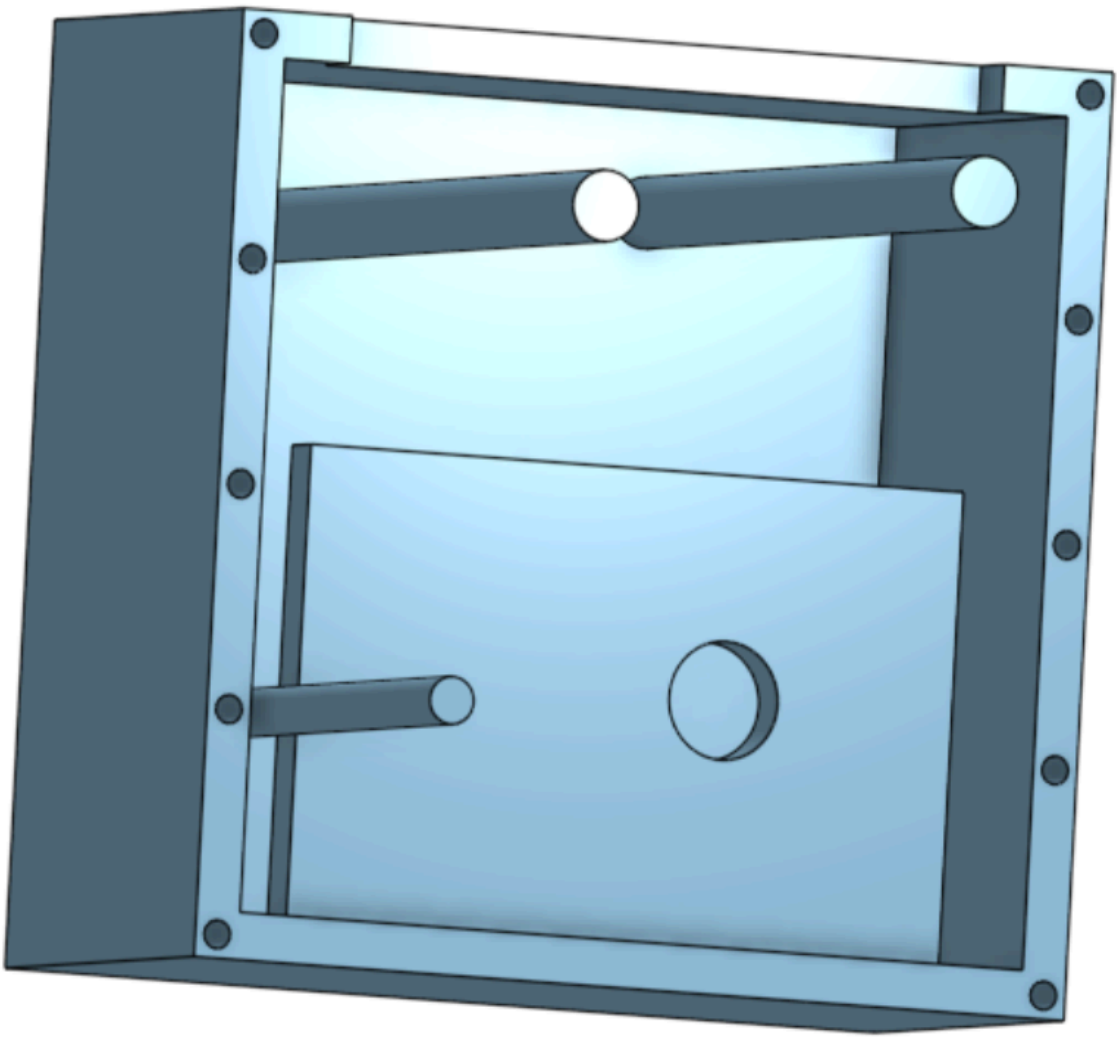


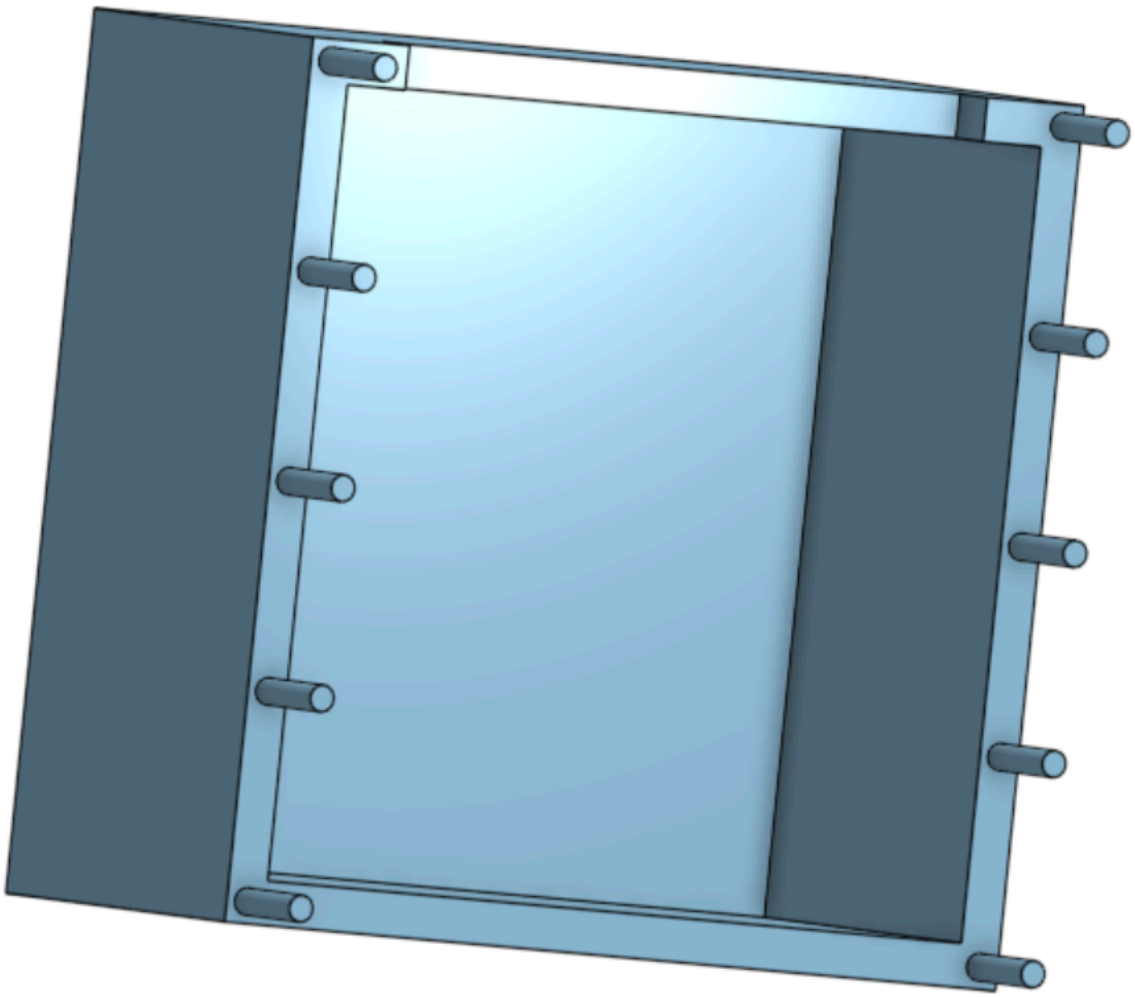


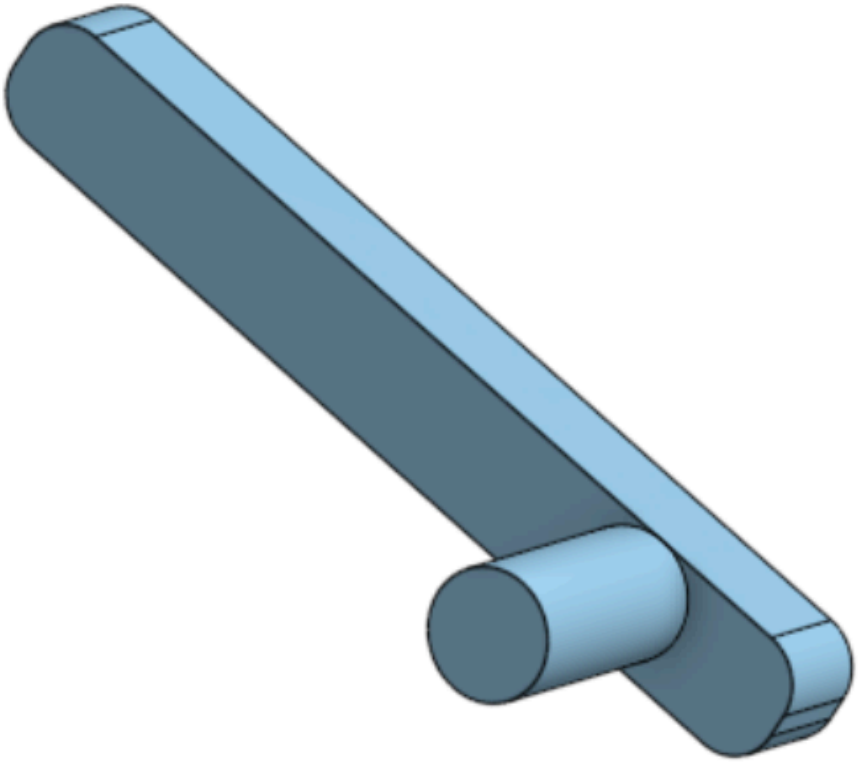


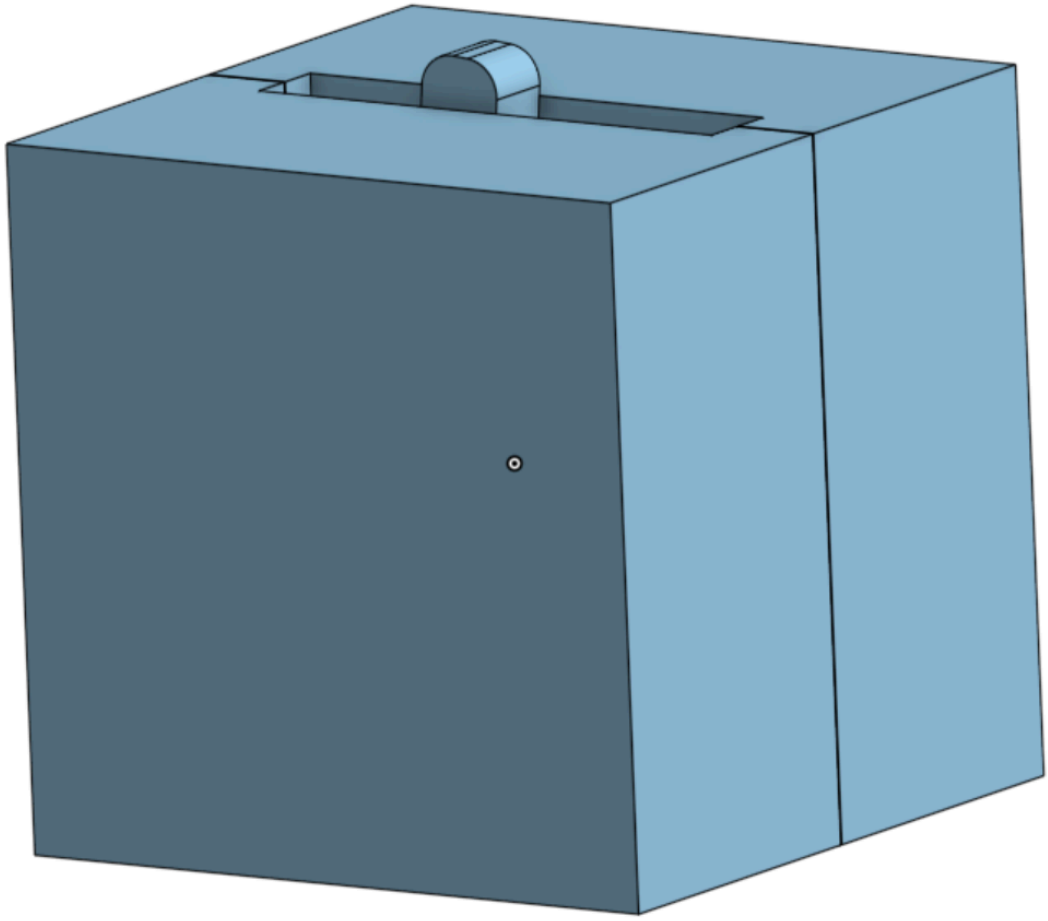


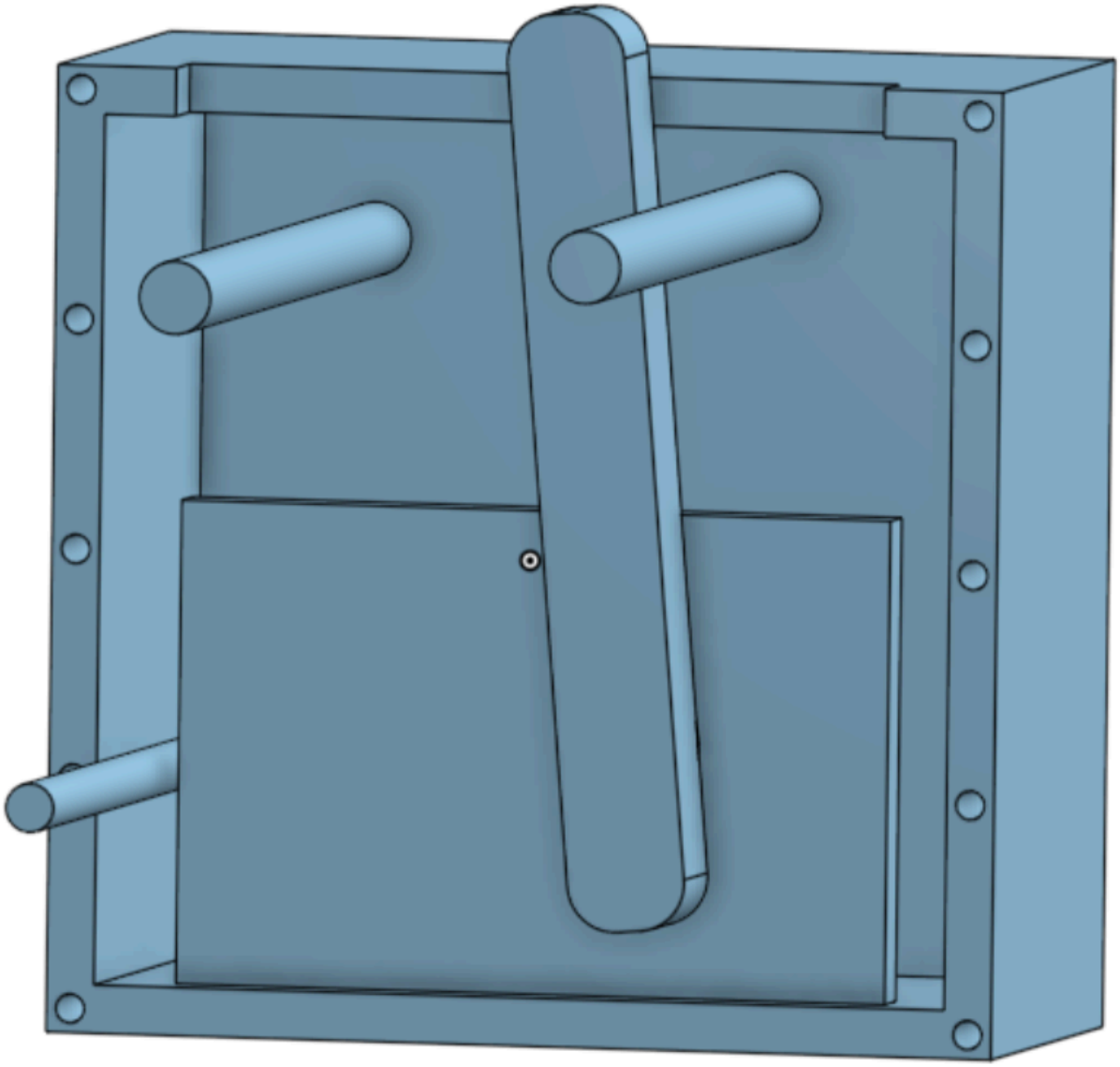












Design Concept:			**Lever/Hinge System**			
Test Number	**Probable critical issue**	**Test Objective (why)**	**Test Description (what)**	**Analysis Method (how and when)**	**Determine Measurables**	**Metrics**
	What assumption are you testing?	*Communication, Performance Measurement, Risk Management, Learning/Understanding*	*What specifically will you test? What is your hypothesis?*	*Specifically how will you test, include things like duration, sequence of test, equipment, pass/fail criteria etc. How will the results be collected?*	*What are you testing with your concept (target measurable attributes)?*	*What metrics will you test? What are the associated units?*
1 (Prototype 1)	Lever system	Performance Measurement & Learning/Understanding	Testing how the lever system will work and giving us a better visualization. See the dimensions of the system	Observing how the cad model behaves; how much the lever protudes through the slot based on the pivot position and where to put the stopping bars.	Length/Width/Height/Volume of lever system	Volume: in^3 Length: in Width: in Height: in
2 (Prototype 1)	Stopping bars will stop the lever from over-rotating	Performance Measurement & Learning/Understanding	Testing if the stop bars will stop the lever from over-rotating	Seeing how the lever mechanism moves in a CAD environment	Stopping bar positions	Volume: in^3 Length: in Width: in Height: in
3 (Prototype 1)	The box properly fits together and does not clip or interfere with other parts. Contains the lever mechanism	Performance Measurement & Learning/Understanding	Looking at how we can make the prototype so that we can assemble it and them easily	Seeing how we can make our prototype such that we are able to assemble the internal components and then fit to together easily.	How are the two halves fit together	Volume: in^3 Length: in Width: in Height: in

Level and Fidelity of Prototype (what)	Kind of Prototype (what)	Results	Interpretation and Feedback	Notes
HiFi/LoFi Focused, HiFi/LoFi Comprehensive	*Visual, Analytical, Physical*	*Observe and record results.*	*Pass or fail (include reason) and other feedback collected about prototype*	1. Include location of sketch, software libraries, reference materials, etc. 2. Take notes on how you can improve your next prototype 3. Other important things to remember
LoFi Focused	Visual	We were able to determine how the lever will rotate and how much it will protrude from the opening.	Pass because we were able to develop a way for the lever mechnism to rotate and to make the lever protrude from the box to lift the blade	Onshape (CAD) We origially wanted to 3D print the prototype but we underestimated how long it would take and were unfamillair with the makerspace hours. This is definietly something to keep in mind for future prototypes and a final design.
LoFi Focused	Visual	We were able to determine where to put the stopping bars to get the best amount of protrustion and so that the lever does not stick out in the relaxed position.	Pass, We were able to determine where we will put the stopping bars and how they will work in a later more HiFi prototype/final design	Onshape (CAD) We origially wanted to 3D print the prototype but we underestimated how long it would take and were unfamillair with the makerspace hours. This is definietly something to keep in mind for future prototypes and a final design.
LoFi Focused	Visual	The two halves of the box were able to fit together and it did not interefere with other parts.	Pass if the box can be assbemled easily without having to force it in place or break it.	Onshape (CAD) We origially wanted to 3D print the prototype but we underestimated how long it would take and were unfamillair with the makerspace hours. This is definietly something to keep in mind for future prototypes and a final design.

Design Concept:			**Scraping/collection system**		
Test Number	**Probable critical issue**	**Test Objective (why)**	**Test Description (what)**	**Analysis Method (how and when)**	**Determine Measurables**
	What assumption are you testing?	*Communication, Performance Measurement, Risk Management, Learning/Understanding*	*What specifically will you test? What is your hypothesis?*	*Specifically how will you test, include things like duration, sequence of test, equipment, pass/fail criteria etc. How will the results be collected?*	*What are you testing with your concept (target measurable attributes)?*
1 (Prototype 2)	Collection system will fit into the pipe	Size/Dimensions Measurement	Dimension test. The collection system will fit together and fit into the 4" diameter pipe	Collection system will be built and assembled. Inserted into the pipe.	Length/Width/Height/Volume of collection system
2 (Prototype 2)	Blade will be deployed and can scrape the pipe	Performance Measurement (Deployment mechanism and blade)	Testing if the blade is able to be deployed in the pipe and if it can scrape	Shavings will be collected in the container	Sample size,deployment mechanism and blade behaviour

Metrics	Level and Fidelity of Prototype (what)	Kind of Prototype (what)	Results	Interpretation and Feedback	Notes
What metrics will you test? What are the associated units?	*HiFi/LoFi Focused, HiFi/LoFi Comprehensive*	*Visual, Analytical, Physical*	*Observe and record results.*	*Pass or fail (include reason) and other feedback collected about prototype*	1. Include location of sketch, software libraries, reference materials, etc. 2. Take notes on how you can improve your next prototype 3. Other important things to remember
Volume: in^3"	HiFi Focused	Physical	N/A	Pass if the collection system can be built in a short amount of time and does not require a lot of force, and must fit into the 4" diameter pipe	N/A
Weight of collected sample (mg)	HiFi Focused	Physical	N/A	Pass if the collected sample size is between 30-80 mg, or the sample size is the intended amount of mg	N/A