Bob's Skates: Project Progress

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- Midterm Progress:
  - Introduction to our project – explaining what we're making and a background of our client
  - Project definition

    - Client needs and prioritization
    - Problem statement
    - Benchmarking and key
    - Concept development and our chosen concept
    - Client meet 1 feedback
    - Prototype 1:
      - Sheet metal prototype and results: (mass, material)
      - 3D-printed prototype results and next steps

Project Background

- Client's daughter 7-year-old daughter that uses orthotics has outgrown her bob skates. Our task is to make a pair of bob skates that fit her and may be adjusted for future use and are able to be used with her orthotics. No bob skates that fit these criteria exist on the market.

Customer Needs

- There is a need for an alternative approach to traditional skates. **(Functional)**
- The skates need to provide extra support for maintaining balance. **(Functional)**
- The skates need to be lightweight. **(Non-Functional)**
- The skates need to be adjustable. **(Functional)**
- There is a need for larger size skates. **(Non-Functional)**
- There is a need for the skates to be appealing and affordable. **(Non-Functional)**

Problem Statement

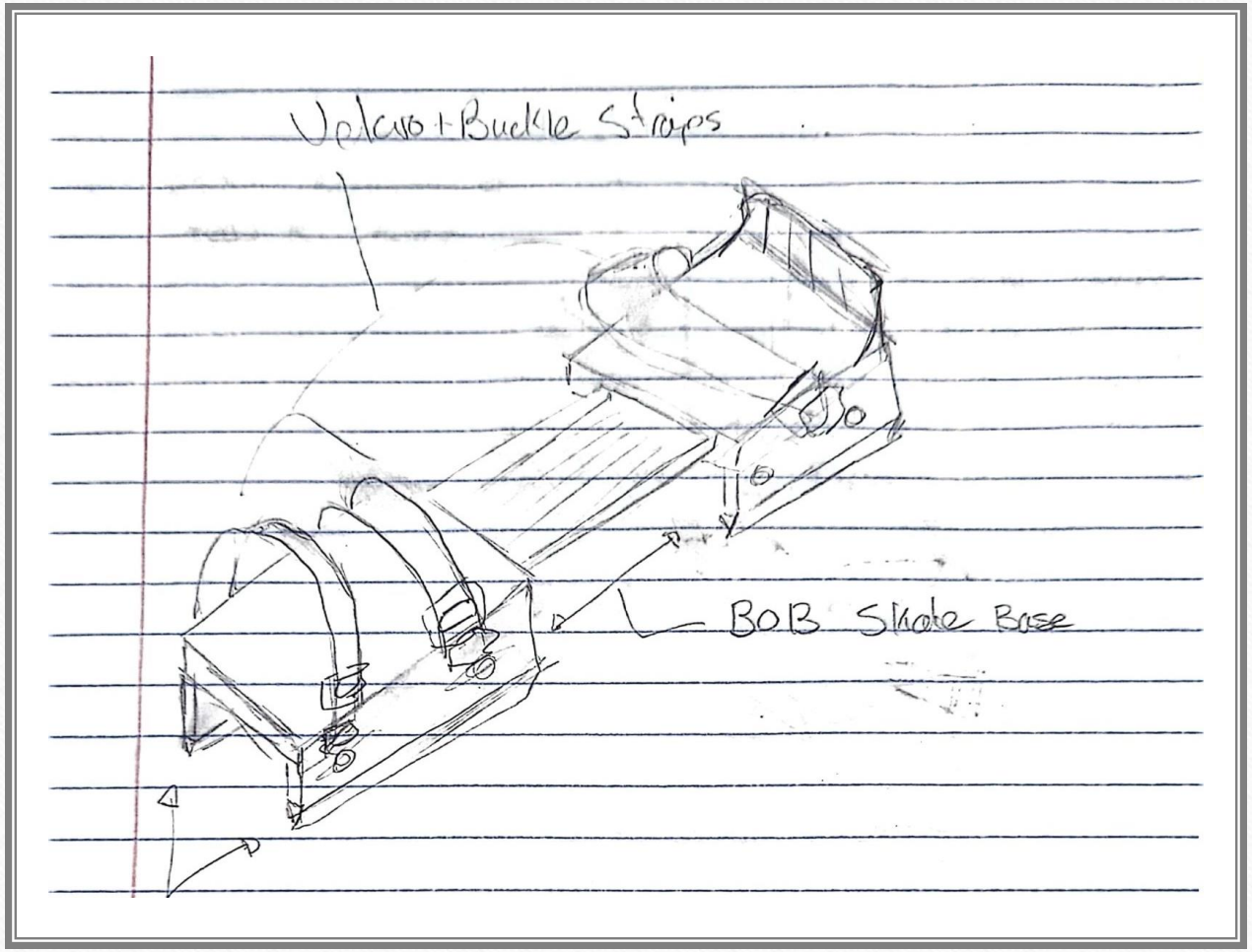
The client's daughter needs skates large enough for her current foot size that are lightweight, provide additional support, are adjustable, and are built to withstand the challenges of winter play.

Benchmarking

Picture of Product	Amazon Youth Bob Skates	Amazon DUWIN Ice-skates	Amazon Skateez
Size	19.51 x 9.09 x 8.1 cm	25.91 x 1.48 x 38.99 cm	N/A
Weight	526g	1.63kg	209g
Cost	30.99 CAD	66.99 CAD	39.99 CAD
Adjustability	7.5 inches	8.5 inches	N/A
Balance Support	Yes	No	Yes

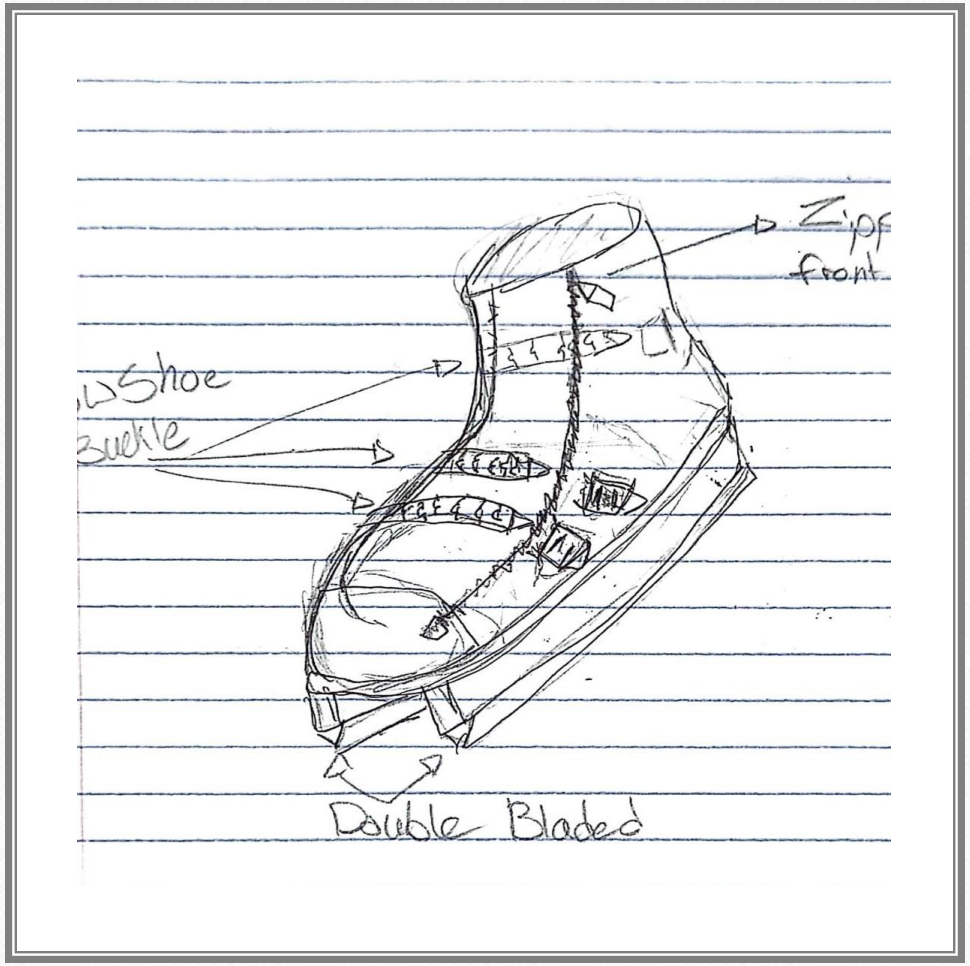
Target Specifications

Metric	Units	Ideal Specification	Acceptable specification
Size	Inches	7.5	>6 inches
Durability	Year	5 years	>2 years
Total Weight	kg	1.1kg	<1.1lb
Cost	CAD	<$75	<$100
Weight Capacity	kg	175lb	120lb
Adjustability	Inches	> 2 inches	2 inches
Balance Support	Yes/No	Yes	Yes



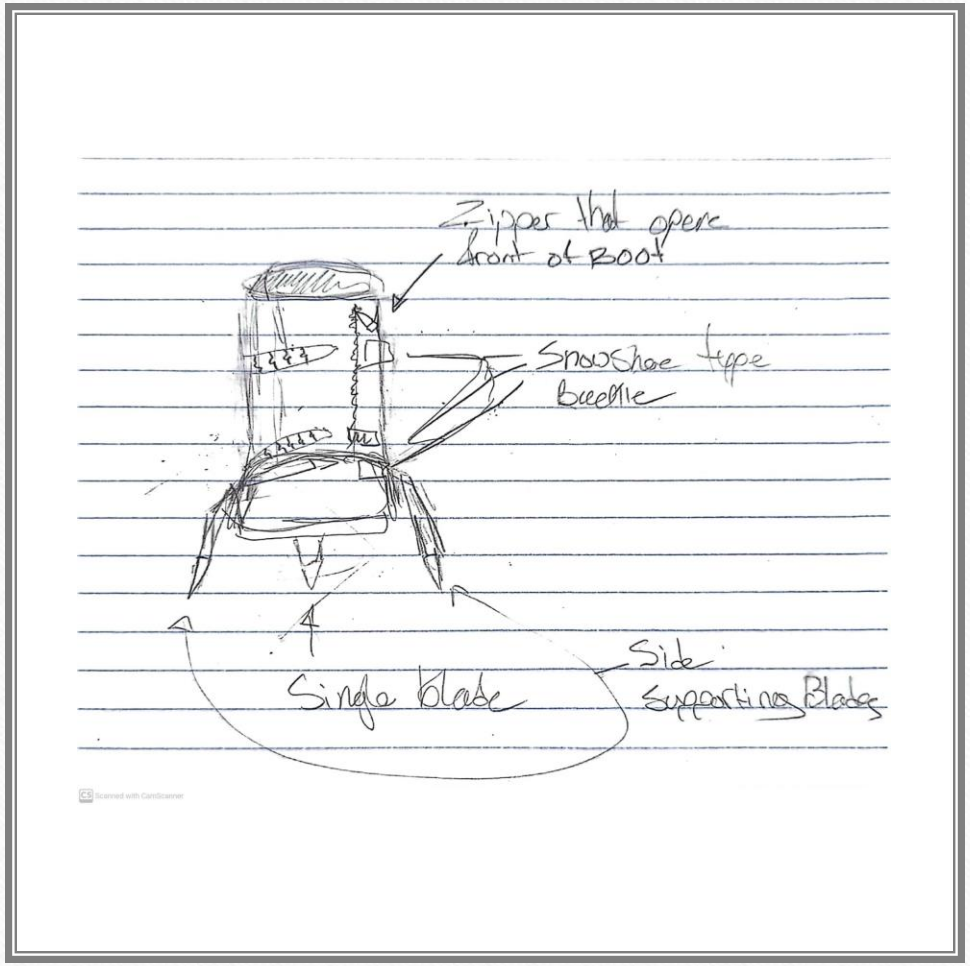
Concept 1

- The assembled system in this drawing is made of three parts which are the Bob skates base, the double blades, and straps using velcro and belt buckles.



Concept 2

- This assembled system depicts a boot using the straps seen on snowshoes as well as the zipper seen on “Billy shoes” so that the front of the shoe can move forward making it easier to put on. The bottom of the Boots has two skate blades for providing support to the wearer.



Concept 3

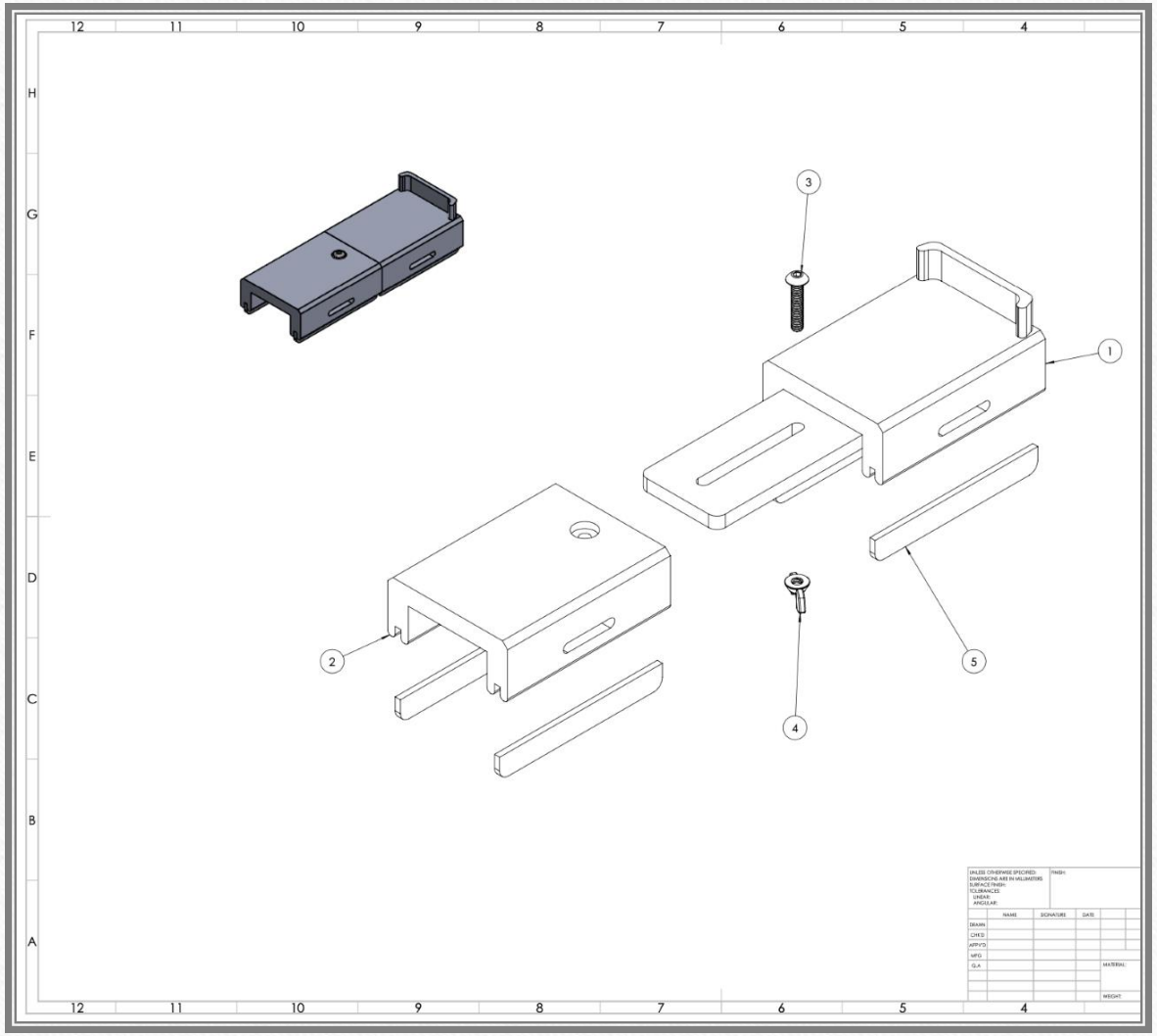
- **The depicted assembled system has a boot with a zipper in the style of "Billy shoes" as well as adjustable snowshoe type buckles. The boot has a single blade under it and has two plastic supporting blades on its sides to provide stability to the wearer.**

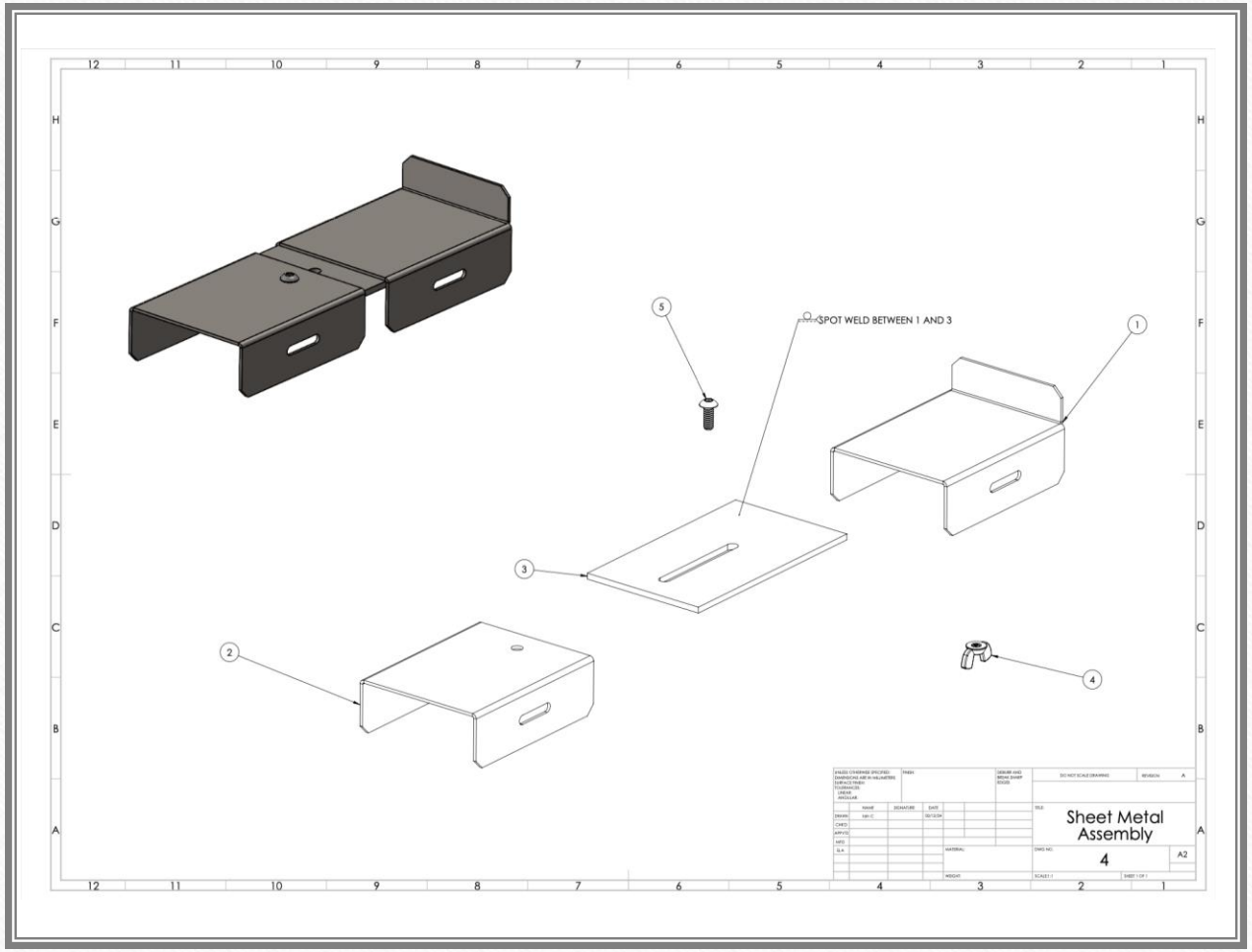
Client Feedback 1

- Concept 1 was the ideal design
- Client highlighted that Adjustability and Weight should be a higher priority
- Client mentioned purple was their daughters favorite color and Clifford the Big Red Dog was their favorite character.

Detailed Design A

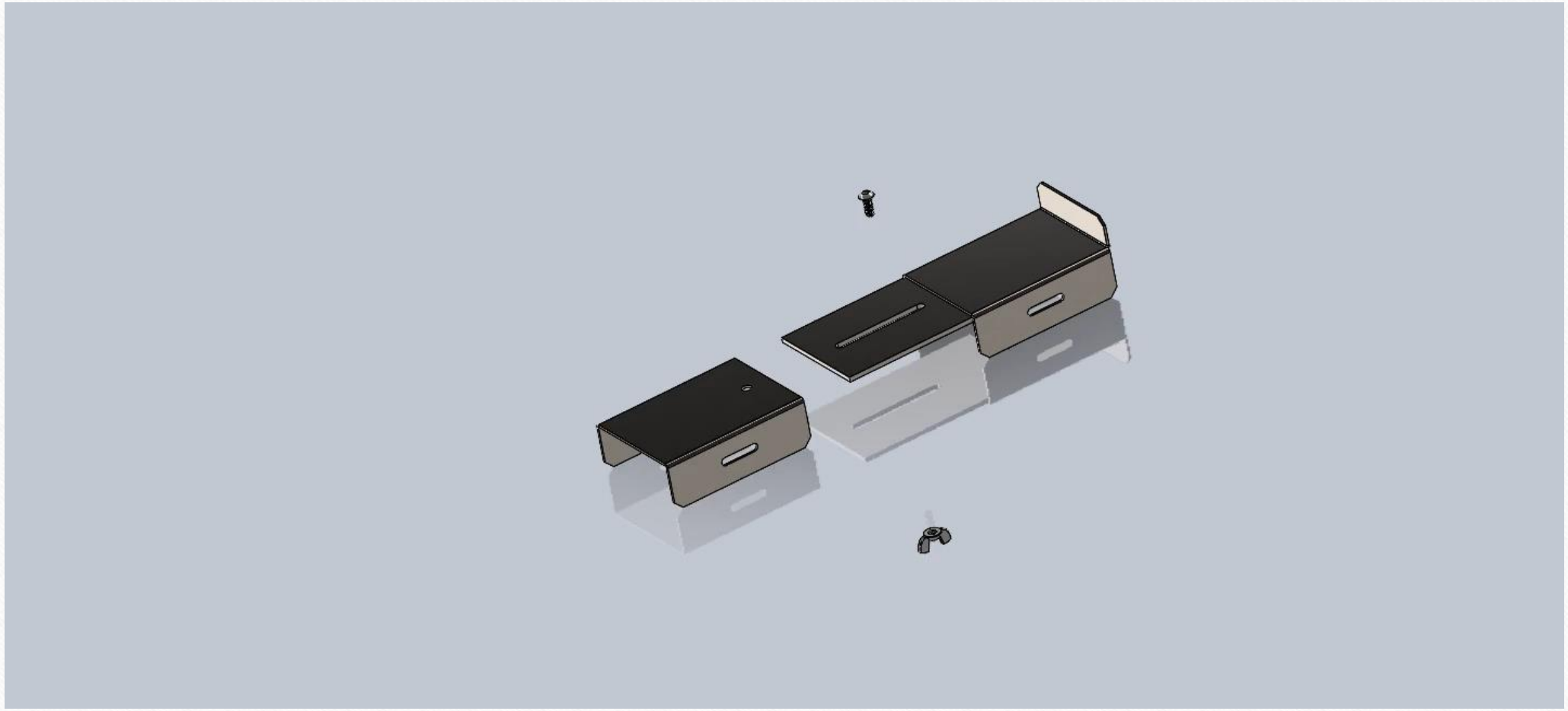
- 3D printed body with steel blades





Detailed Design B

- Sheet Metal Skates



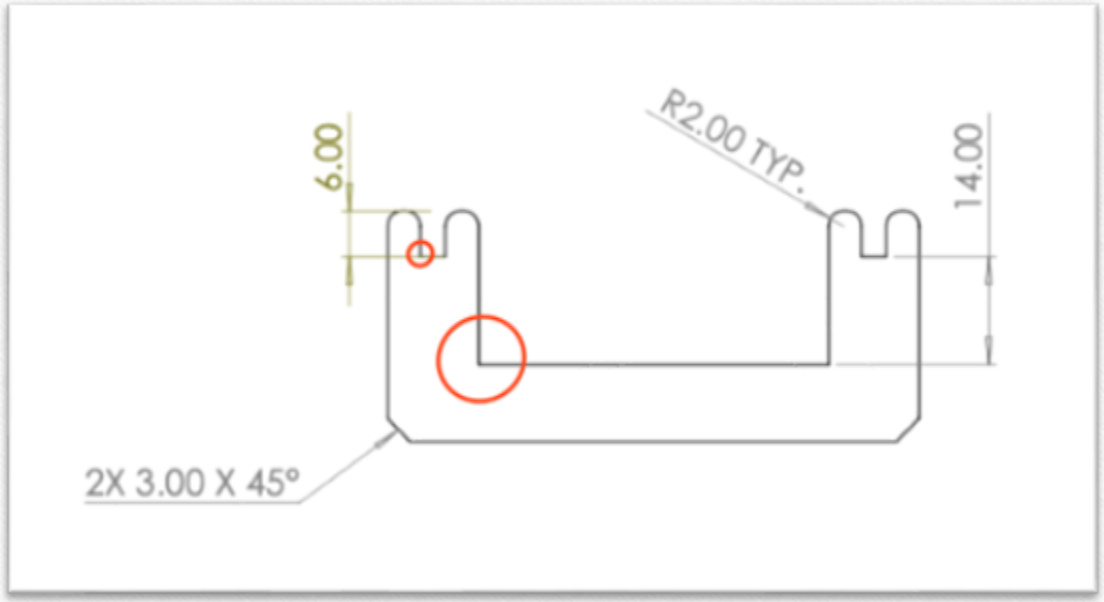
Prototype 1

Prototype 1A

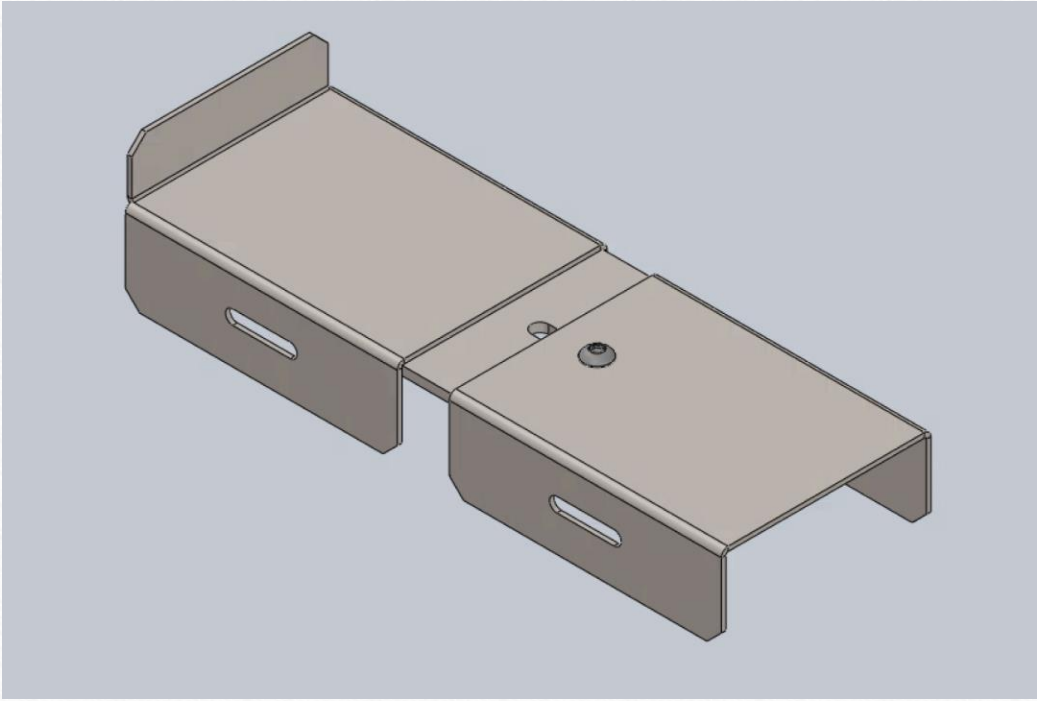
What	How	Result
Material (brittle?, Lightweight?)	Just general feeling around of the object.	The PLA was not as brittle as we thought it would be and the part was very light weight.
Can it withhold 175lbs?	We had a group members that weighed around 175~lbs stand on the part.	Heard cracking within the part. may need to increase infill to make stronger.
Can we print the size needed? And is it printable?	Attempt printing at makerspace	We were able to print the part with no issue at makerspace.

Prototype 1A Feedback

- There are points of stress on the rigid corners of our initial design. Adding chamfers would fix this.



Prototype 1B

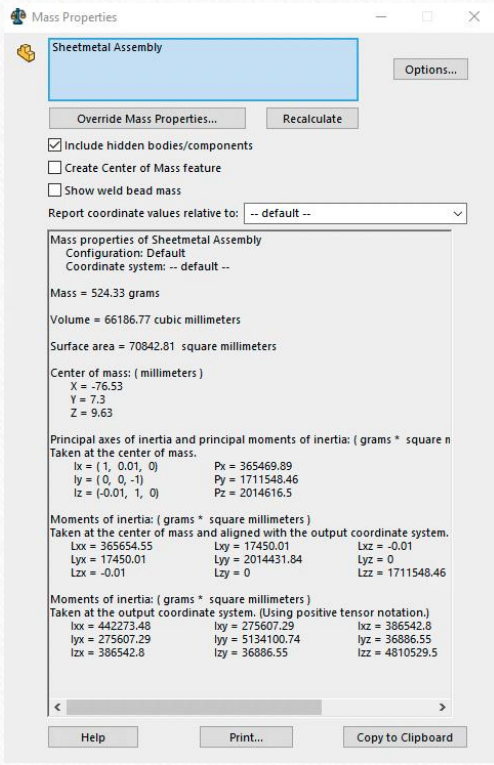


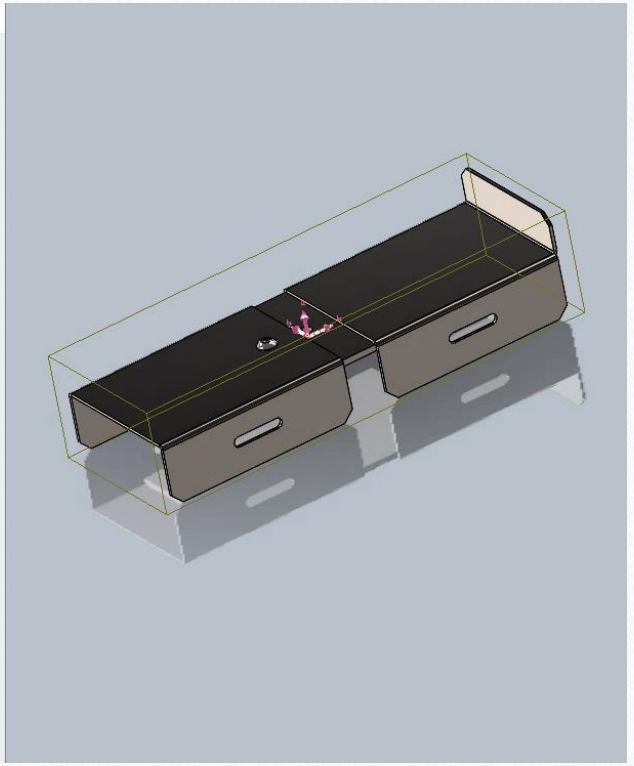
Prototype Testing

Sheet metal mass analysis

- Material comparison
  - SS vs cold rolled
- Varying thicknesses
  - 0.12in vs 0.0625in

- Cold rolled 0.0625in is lighter (and cheaper)
- Must verify mechanical properties

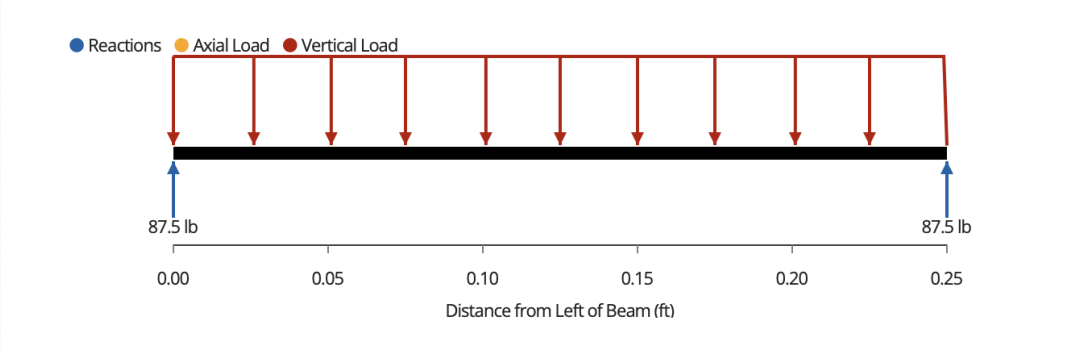


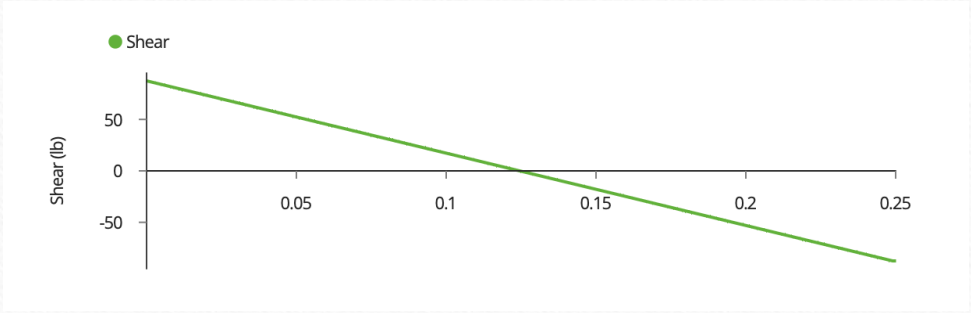


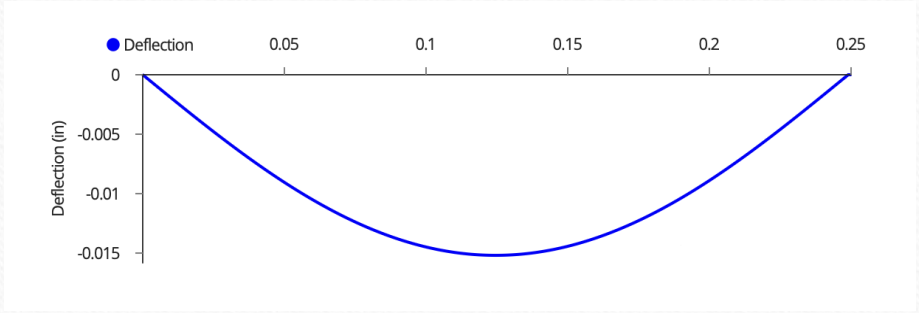
Prototype Testing

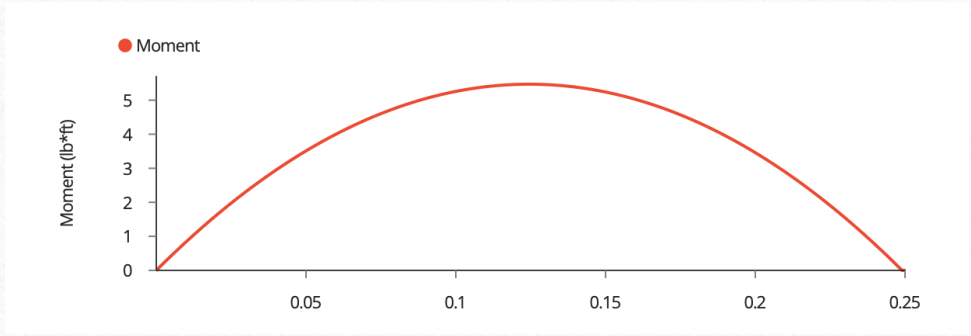
Sheet metal simple load analysis for cold rolled steel

- To test if the weight of 175lb applied to the system will cause failure
- Treat our design as a simply supported beam









Summary

Moment Demand	$M^* = 5.47\ \text{lb} \cdot \text{ft}$
Shear Demand	$V^* = 87.5\ \text{lb}$
Deflection	$\delta = -0.0152\ \text{in}$

- The max bending stress is -13 ksi
- The max shear stress is negligible

Ultimate tensile strength is 60 ksi for cold rolled steel

Max stress < Ultimate strength - **failure will not occur**

AISI 1020 Cold Rolled Steel is Sufficient

- Verified with Alex

Testing Summary

Metric	Units	Ideal Specification	3D Printed	Sheet Metal
Size	inch	7.5 inches	7.5 inches	7.5 inches
Durability	Years	5 years	NA	NA
Total Weight	lbs	<1 lb	NA	1.1 lbs
Cost	CAD	<$75	Free	Free
Weight capacity	lbs	175 lbs	<175 lbs	>175 lbs
Adjustability	inches	> 2 inches	2.2 in	2.2 in
Balance Support	Yes/No	Yes	Yes	Yes

Project Plan

- Deciding to stick to one manufacturing method
  - Focus all teammates time and energy to maximize the best results
  - Alex mentioned that we may need to send our design to be machined elsewhere
  - Client prefers 3D print approach
- 3D Printing Approach is the most ideal
  - Next Steps:
    - Print full prototype with higher infill (excluding the blades and straps)
    - Improve the CAD geometry for better load bearing
    - Test material with more desirable mechanical properties
- Next Client Meet
  - Gather feedback on prototype progress