Aerobic Workout Device

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Prioritized Needs

- Support the user
- Portable and light
- Controllable
- Self locking feature
- Assist the user in completing symmetrical exercises
- Control and stabilize the shoulder

Hinged Elbow Brace	Slingshot Band	Exoskeleton Arm

Benchmarking

	Hinged Elbow Brace	**Slingshot Band**	**Exoskeleton Arm**
Feature	Elbow Support	Movement Support	Full arm Support
Pros	- Lockout function - ROM dial	- Assist with Symmetrical exercises - Comfortable	- Can do various motions - Various sensors
Cons	- Not good for exercises - No shoulder stability	- Can’t help with ΔL - Long to setup/take off	- Very expensive - Bulky to wear

Target Specification

Functional Requirements

Design Specification	Target Value
Support weight	200 lbs
Stabilize the shoulder	Yes
Controllability during exercise movements	Yes
Allow for symmetrical exercises using proper form	Yes

Constraints

Fits user’s arm	Yes
Support client’s body weight	200 lbs

Non-Functional Requirements

Design Specifications	Target Value
User Friendly and simple setup	1 minute
Maximum Device size/weight (portability)	10 Lbs/1m^3
Manual Lockout feature	Yes
Durability	100 Operational Hours
Aesthetic and minimal design	Yes

Client Feedback

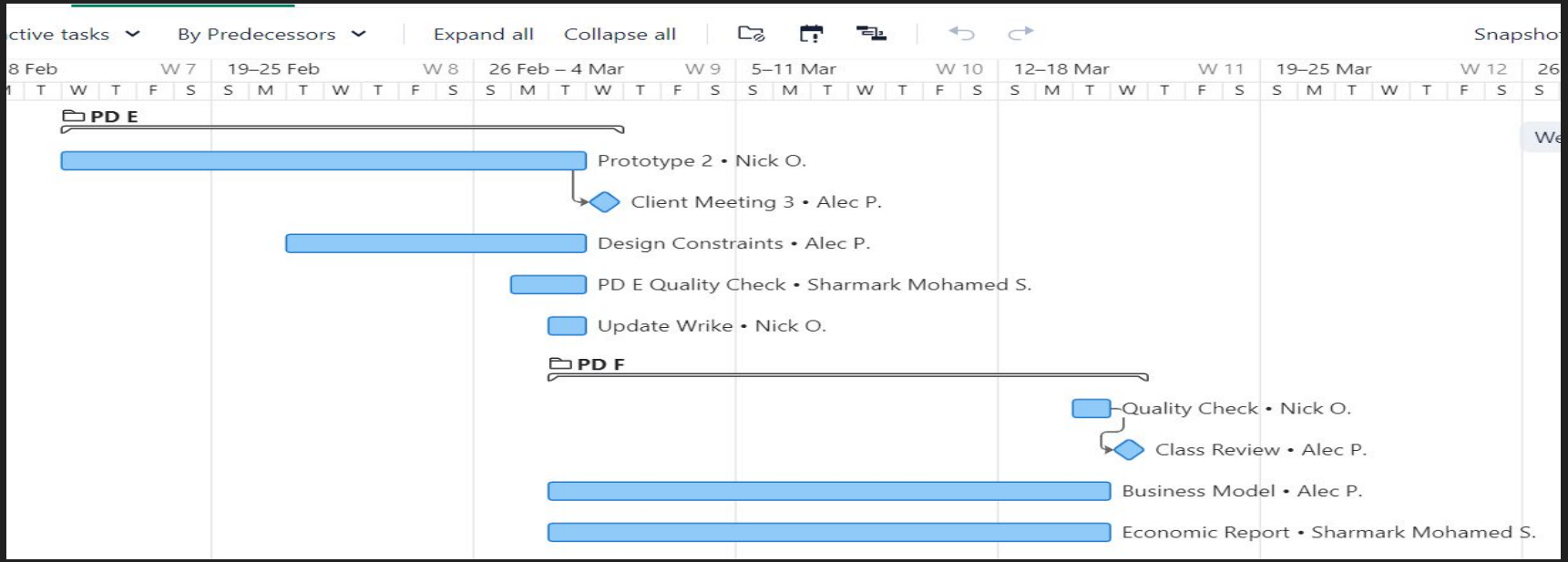
- Assisted in clarifying unmet needs/metrics
    - Setup/response time = new metric
- Emphasizing device's capacity to help with exercising motions.
- Had no personal favourite concept
- TRL rating on concept

Project Plan

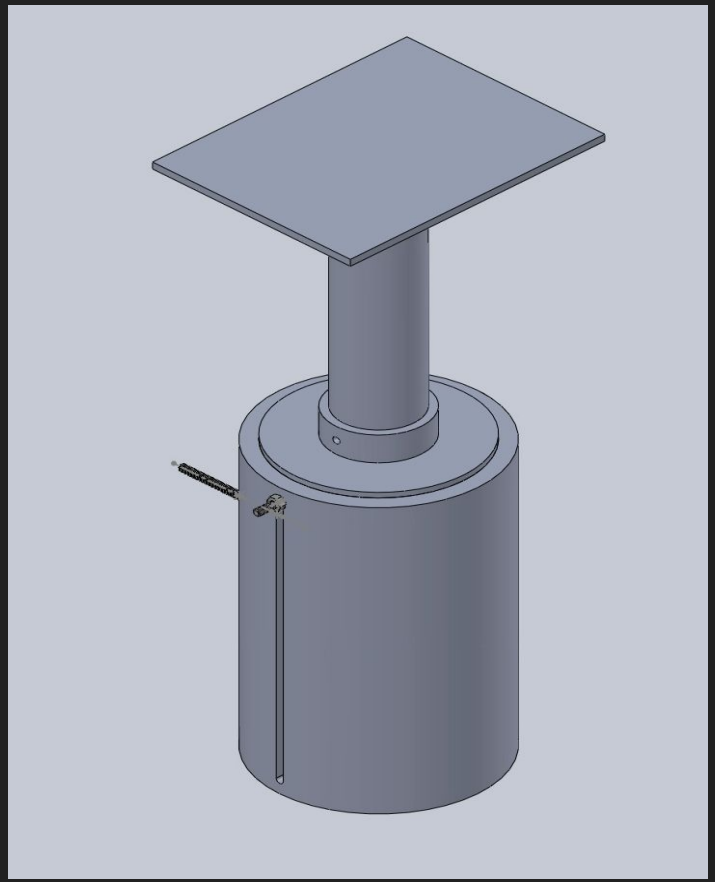
Next steps:

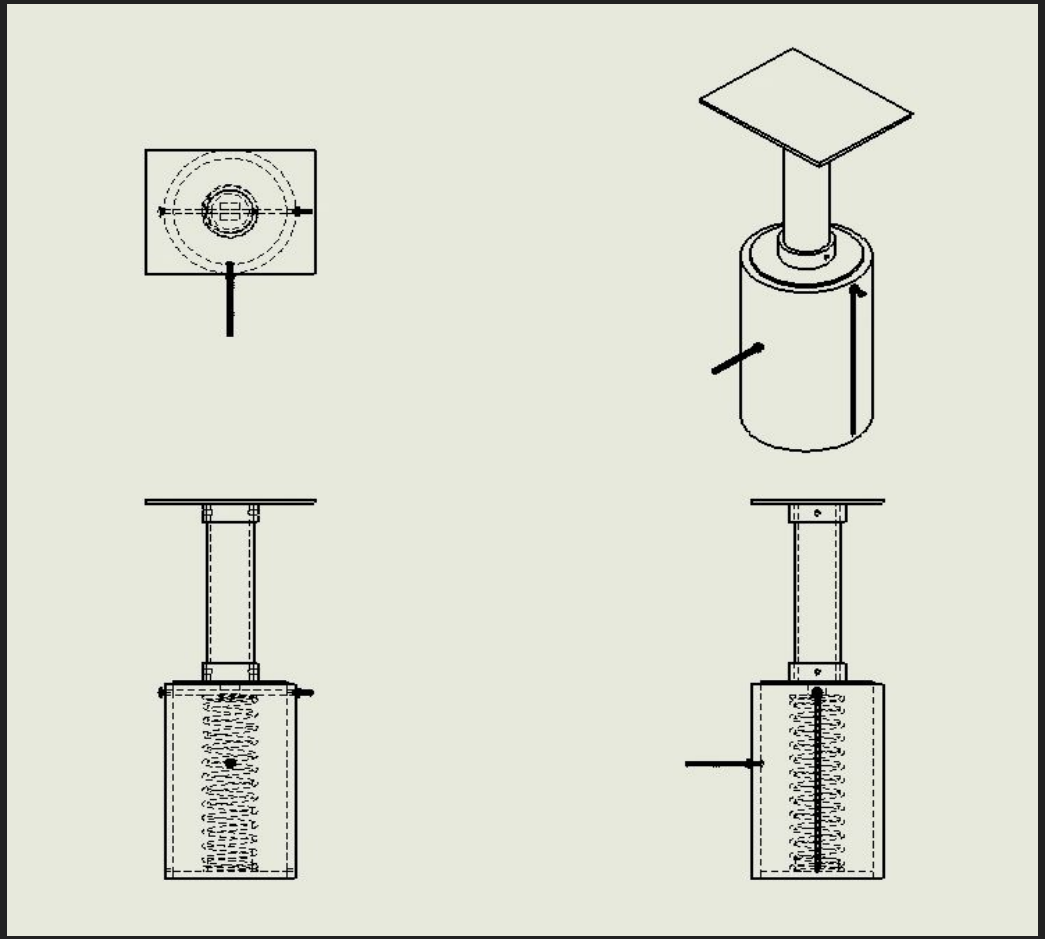
- Work on Prototype 2 : Design Constraints, Building

Organization: Updating timeline/task addition/modification using Wrike every few days

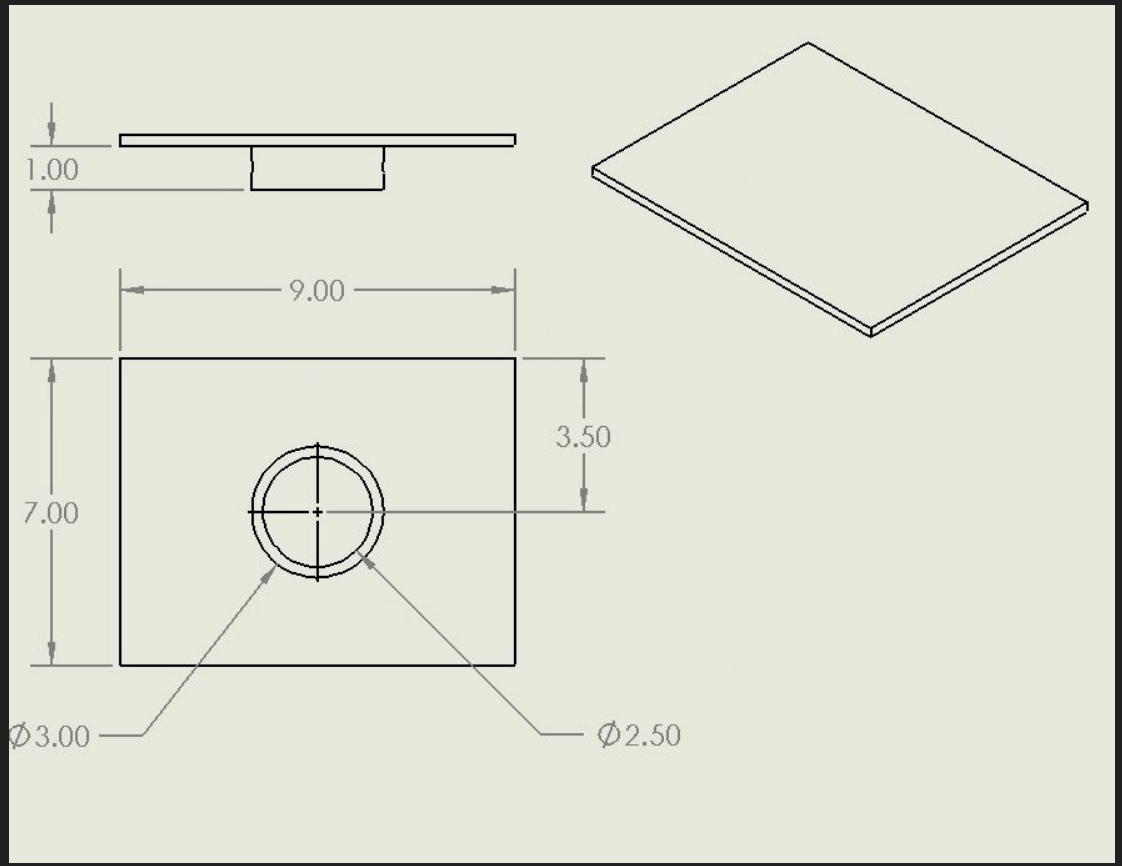


Final Prototype: 3D Model





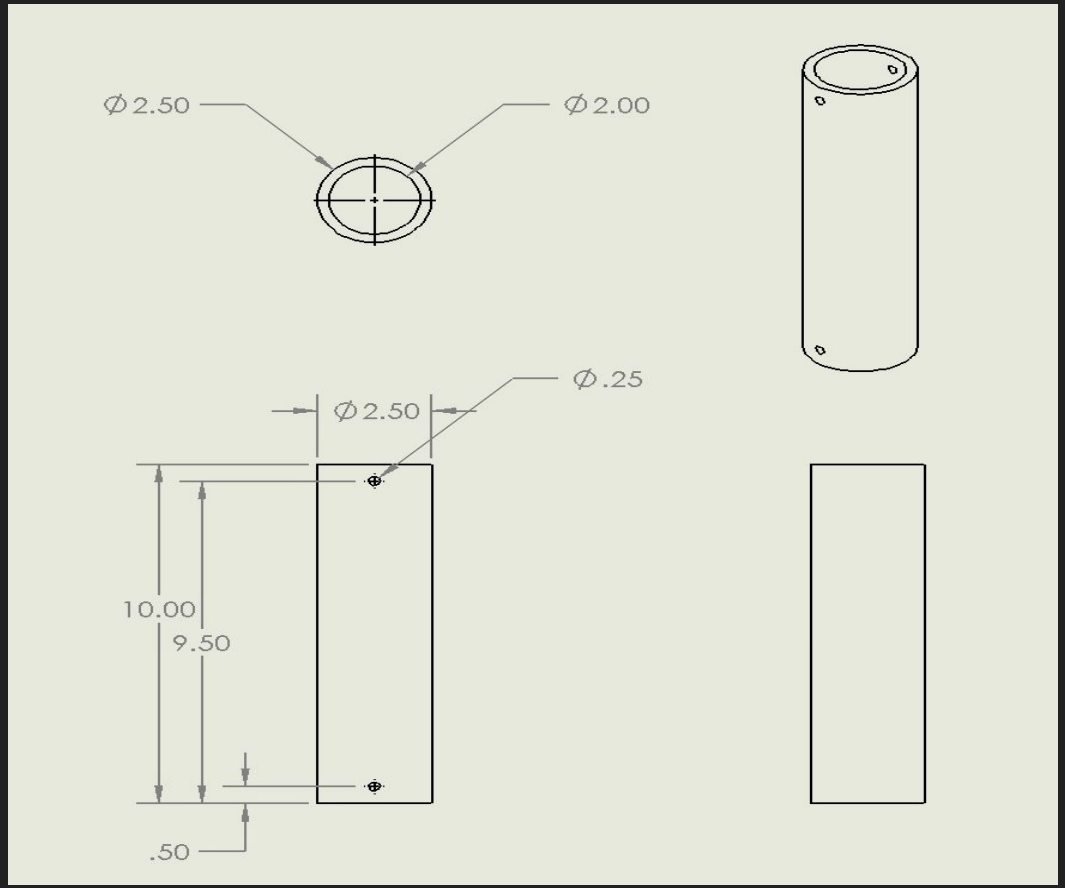
Custom Part 1: Shoulder Platform



Platform = Laser cut

Cylinder Piece = 3D print

Custom Part 2: 2” Pipe



Pipe = Bought from Lowe’s

Holes = Drill/Mill

Custom Part 3: Pipe Fitting-Spring Connector

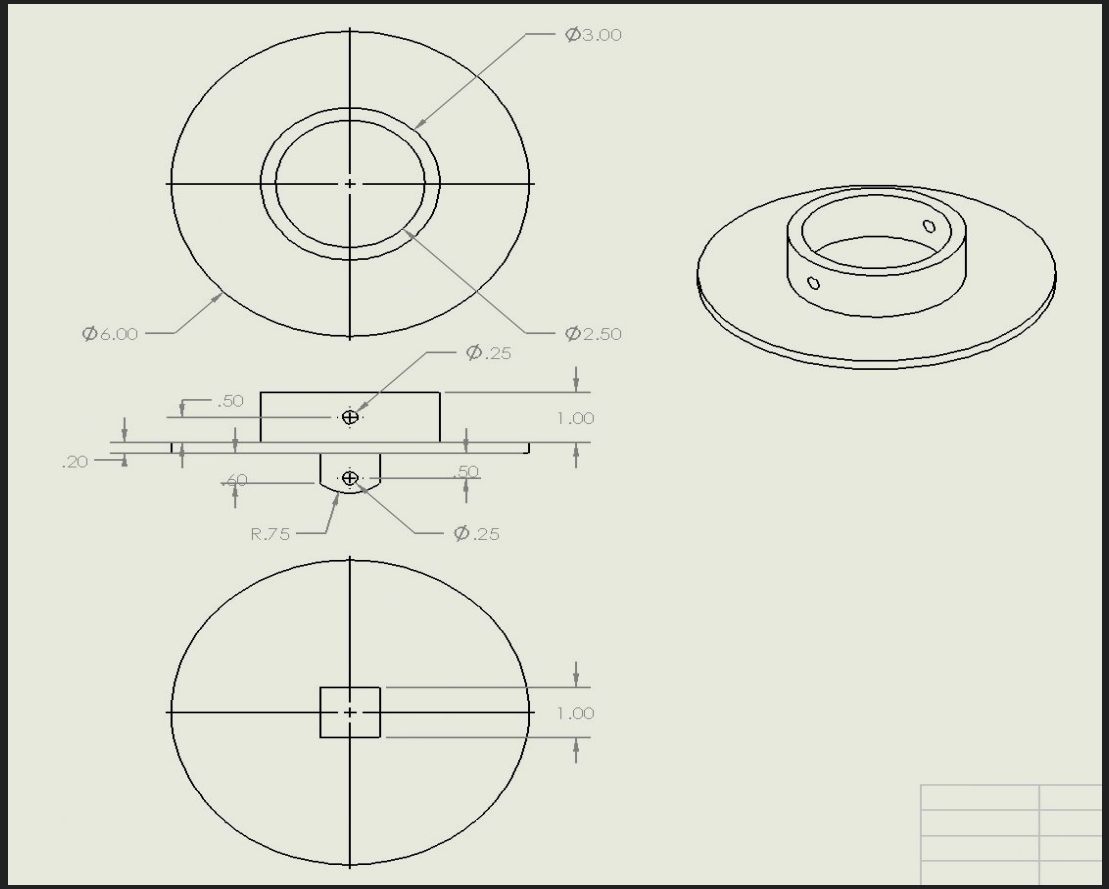


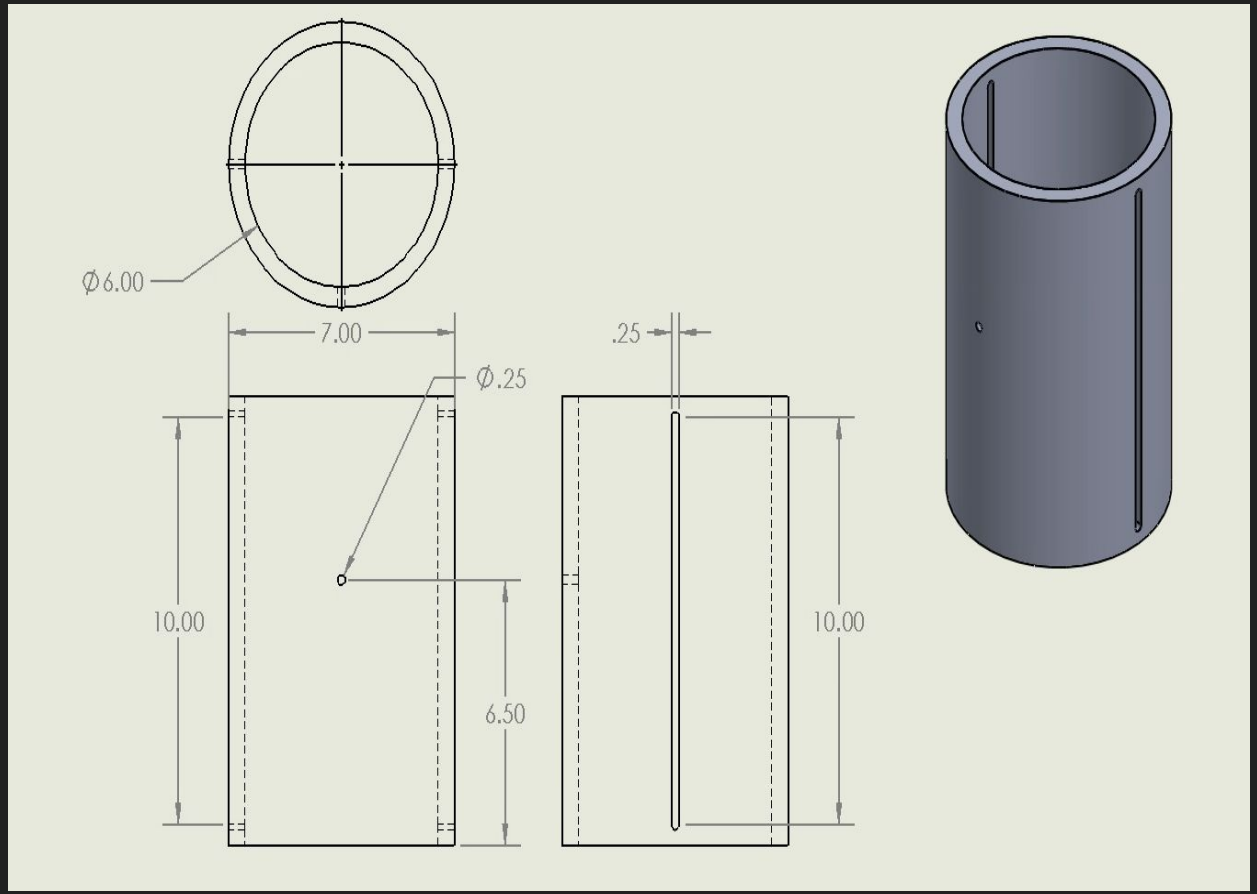
Plate = Laser cut

Piece on top and bottom

=

3D print

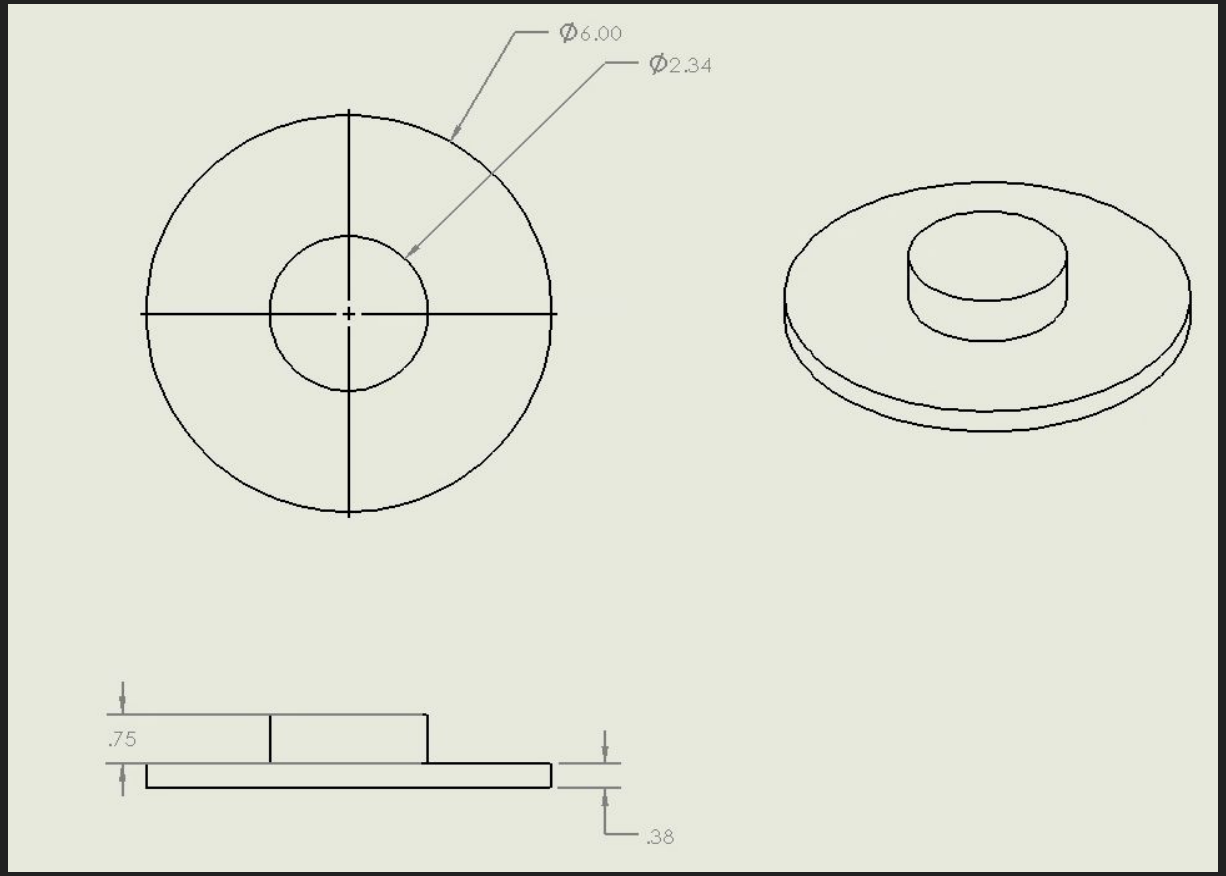
Custom Part 4: 6” Pipe



Pipe = Owned

Holes/Slot = Drill/Mill

Custom Part 5: Base Plate



Disks = Laser cut

Prototypes

Prototype 1A

Objective: Verify custom pipe fitting size/strength

Fidelity: Medium

Type: Physical/Focused

Method: 3D print (0.4/0.6/0.8mm nozzle)

Assumption: Test model will perfectly fit in the pipe

Prototype 1B

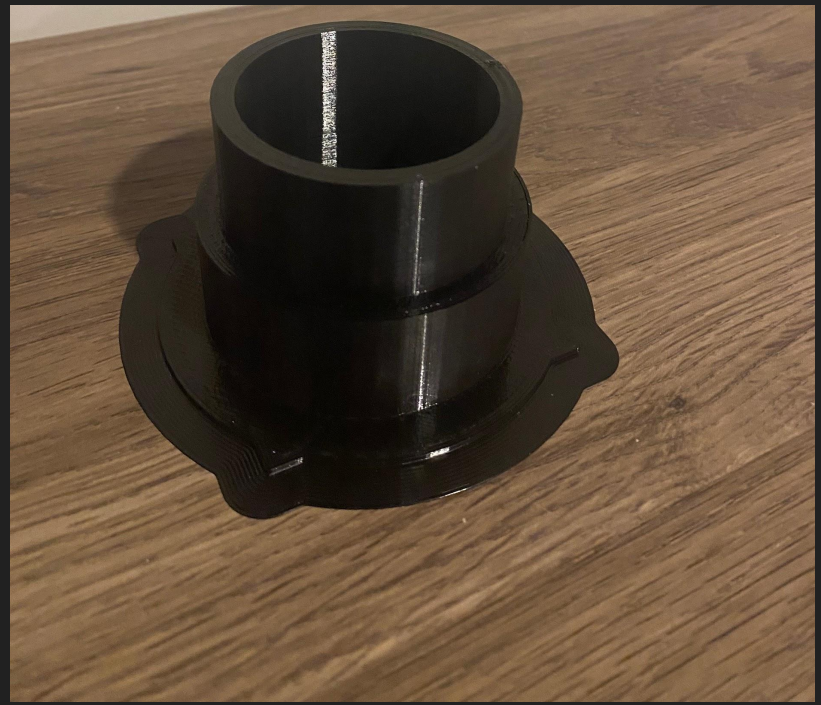
Objective: Test strength of custom spring connector

Fidelity: Medium

Type: Physical/Focused

Method: Printed on 0.8mm and 200 lb would be applied

Assumption: Test model will support 200 lb weight



Prototype 1C

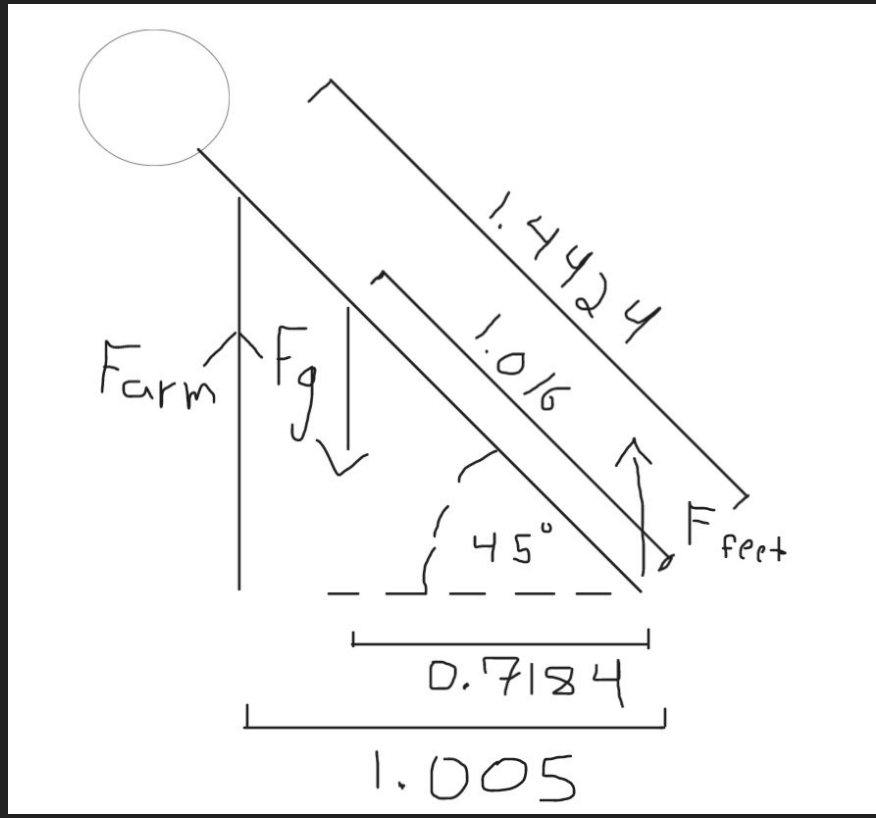
Objective: Prove concept mathematically (Find forces)

Fidelity: Low

Type: Analytical/focused

Method: Using physics to calculate the forces in the system

Assumption: Full body weight is applied on device



Testing Plan - Prototype 1

Test ID	Test Objective	Prototype	Result Recorded	Duration
1	Determine the strength of pipe fitting	Prototype 1a	1. Weight Applied = 200lbs 2. Fracture = no 3. Time of Applied force= 1 minute	Until 200 lb of weight is supported for 1 min
2	Determine the strength of spring connection part	Prototype 1b	1. Weight Applied = 200lbs 2. Fracture = no 3. Time of Applied force = 1 minute	Until 200 lb of weight is supported for 1 min
3	Determine total forces acting on the system and accompanying stresses	Prototype 1c	1. Total Forces 2. Stress Concentrator 3. Stress	Until forces and stresses are determined

Potential Risks/Open Ended Questions

- Stability of each 3D printed/laser cut part
- Delays in shipment of parts
- Limit in the use of CEED equipment
- Proper Connections

Client Meet 3 Objectives

- Client Feedback
- Client’s perspective on chosen spring
- Opinion on parts chosen
- Constructive feedback for project plan