Engineering Graphical Design
AERO 2001-L1

Design Report
Egg Mover

Group number:
AERO1-7

Team members:

Sebastien Beauchesne 101183422

Utkarsh Sheel Anand 101191746

Eithin Pero 101203184

Viktor Wozniak 101195414

Date of submission:
12/10/2021

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Introduction

The goal of this design project is to design a free-standing system capable of transferring one large, uncooked chicken egg from inside a 4ft by 4ft square to another 4ft by 4ft square. The two squares are to be 4ft apart from each other with a 3in high, 4ft wide barrier stationed in the middle. The egg must pass over this barrier on its journey, and be precisely, and safely set in as close to the middle of the second square(bulls-eye). The system is to be built with any available material and must include a functional 3D printed component and be powered by a 12V DC power supply. The process should be completed in under 30 seconds.

Our team decided on a claw/cart system for the project design. Using a claw mounted onto a cart that sits on the foundation, it would grab the egg from the starting square. The claw opens and closes and also moves up and down with the help of two separate motors and gear mechanisms. The cart moves to the target square via a nylon rope attached to the cart and motor.

Description of Design

The requirements of this design were that the system:

Can only be supported by the lab floor	Limited by a 12 volt DC power supply
Any structure starting inside the square, must be 12 inches above the 4ft square	Egg must be placed on the ground somewhere in the starting square
Once the process starts, it can only be operated wirelessly or by electrical signals	A minimum of one functional 3D printed part with a maximum volume of material used being 3 in^3
The egg must make contact with the finishing square without breaking	From start to finish the egg should have contact with the finishing square within 30 seconds.

The design constraints imposed by the team are:

The project cost should not exceed $150	Egg should finish within 2 inches of the bulls-eye
Process limited to only 3 mechanical movements	The egg should not be scratched or tossed around during the process
The speed of the whole process should be under 20 seconds	The design should be consistent and ready for many uses
Lightweight operating system with a robust foundation for greater stability	

The Foundation

The foundation of the design consists of a variety of wood such as 2x4 and 2x6 with half inch plywood to create a sturdy and solid foundation. The pieces would be assembled together with screws and 2 pieces of wood strapping would span over the starting square and finishing square about 12.5 in above the squares.

The Cart

For the cart assembly, the platform and the claw arm would be made of leftover plywood from the foundation. The wheels would be made of plastic and rubber as they would be bought online. The axles for the wheels would be made of coat hangers bent and cut to the proper length since the weight of the claw and cart is very small. The DC motor and pulley that would lift the claw up and down would be bought online and would provide more than enough power to lift the claw and egg. A nylon rope attached to the cart would allow for its horizontal motion. The rope would be guided by two pulleys on both ends of the tracks and a DC motor would provide the torque to move the cart assembly in either direction.

The Claw

For the claw, the two buckets would be 3D printed (PTEG) as they have a complicated geometry that is specific to picking up the egg. The claw could not be manufactured any other way and it is critical for the function of the entire design. Additionally, 3-D printing the claw would allow for it to be lightweight, but strong. The small and big gears would be purchased online and be made of a metal alloy as it would prevent fast wear of the gears. For the plates enclosing the claw gears, a simple sheet metal would be used. For the pins that would attach the gear and claw, leftover 3D printed material can be used as the bucket only has a volume of about 2.7in^3.

DC Motors

The three DC motors would be supplied to one power source of 12V which would be sufficient as they will not be running at the highest settings. The wire gauge would be a 22 gauge as the motor does not require great amperage. To control the movement of the DC motors, a Raspberry Pi would be used. With sufficient testing, the assembly could precisely turn the motor for the intended task.

Summary and Recommendations

The team believes that the egg mover design would have solved the design problem quite effectively. The design consists of a rigid base, connected to two tracks extending over the starting square and ending square. Between these two tracks a gap would allow the mechanical claw to pass between and over the 6in height wall. The mechanical claw opens and closes using a DC motor to grab the egg. Another motor mounted on the cart would raise and lower the claw to get over the barrier. The horizontal movement of the cart is achieved by a third motor attached to the foundation that would pull the nylon rope attached to the cart to translate its motion either left or right. The three mechanical motions would be: the claw picking up the egg, the claw being raised, and the cart being travelling across the tracks.

A system within the design that is a potential point of failure is the pulley system controlling the cart's translational movement across the tracks. This pulley system is quite long and the slack of the rope could cause it to tangle with the claw as it moves horizontally. Calculations were performed and it was verified that the motor would indeed have enough torque to move the dead weight of the claw, cart, and egg, but in the real world the system may vary. A proposed solution to this problem would be to mount the motor controlling the horizontal movement of the cart, to the cart itself. The DC motor would be connected through a single gear to one of the axles of the cart to drive the cart's motion.

An improvement that could be implemented into the design would be to make the foundation less "bulky". It was originally designed to have a large weight to be able to support the operating system on top, and not tip over. After designing the claw and cart assemblies, the total weight of the two components was calculated to be less than 1.5 lbs, which is not nearly as much as the group originally thought. Because of the assumption that a heavier cart and claw system would be used, an unnecessary amount of material was used for the foundation, that would unnecessarily increase the cost, and the difficulty of transporting the design.

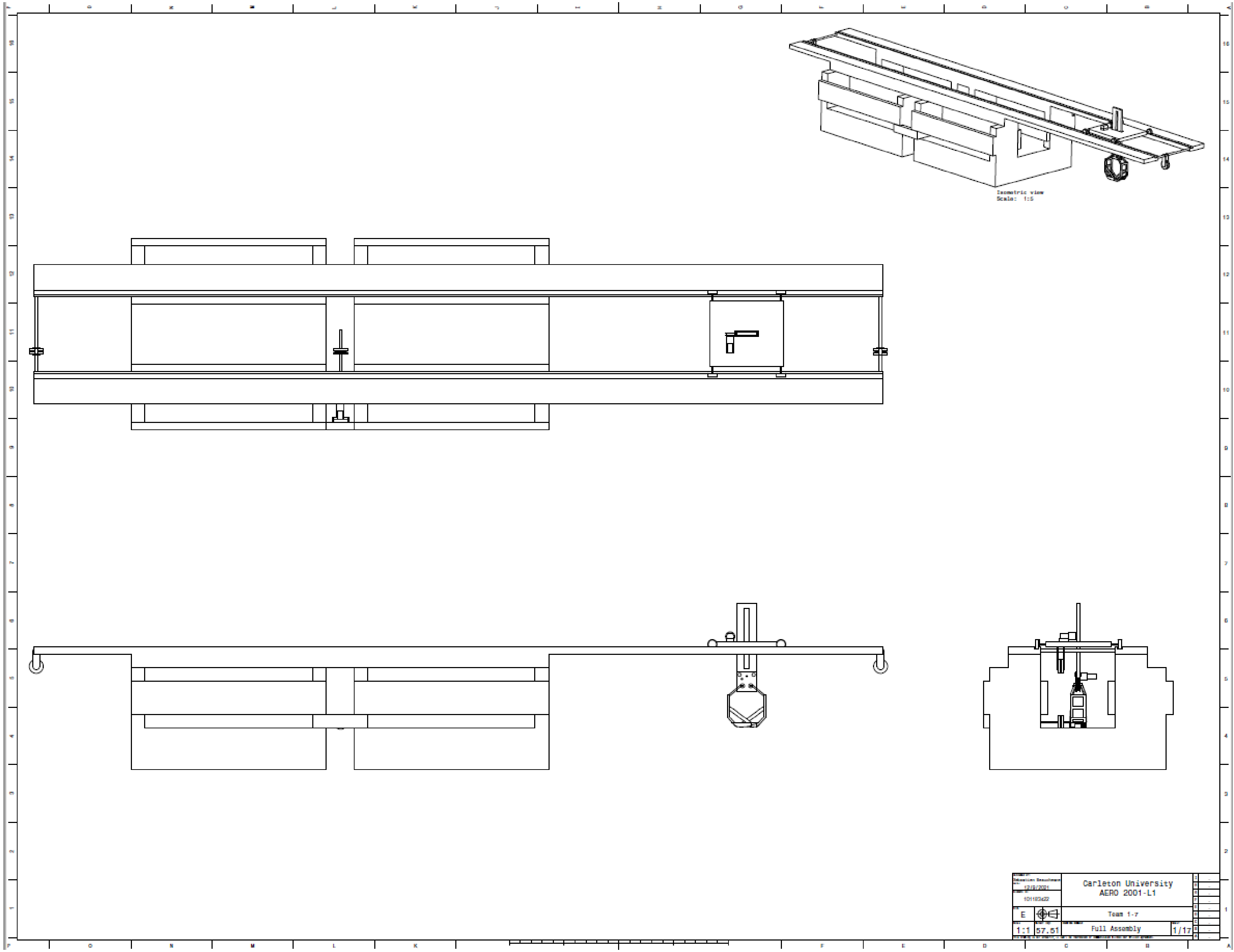
Another suggestion for the process of creating the design would be to experiment more with the electronics that would be used. It was determined that a Raspberry Pi board would be used, but no experiment was conducted to see how the DC motors would act with the pulleys and weights they were supposed to work with. All of this process was done theoretically with calculations of torque, friction, and mass, but as per usual everything does not always work out like expected.

The team believes that the design created is a realistic design that would be an effective solution to the problem, but the team also admits that a more simple design could have also performed similarly. Regardless, the team's focus was primarily on the reliability and precision of the design and not the complexity because enough time was given to do enough research and have enough group discussions to perfect the solution.

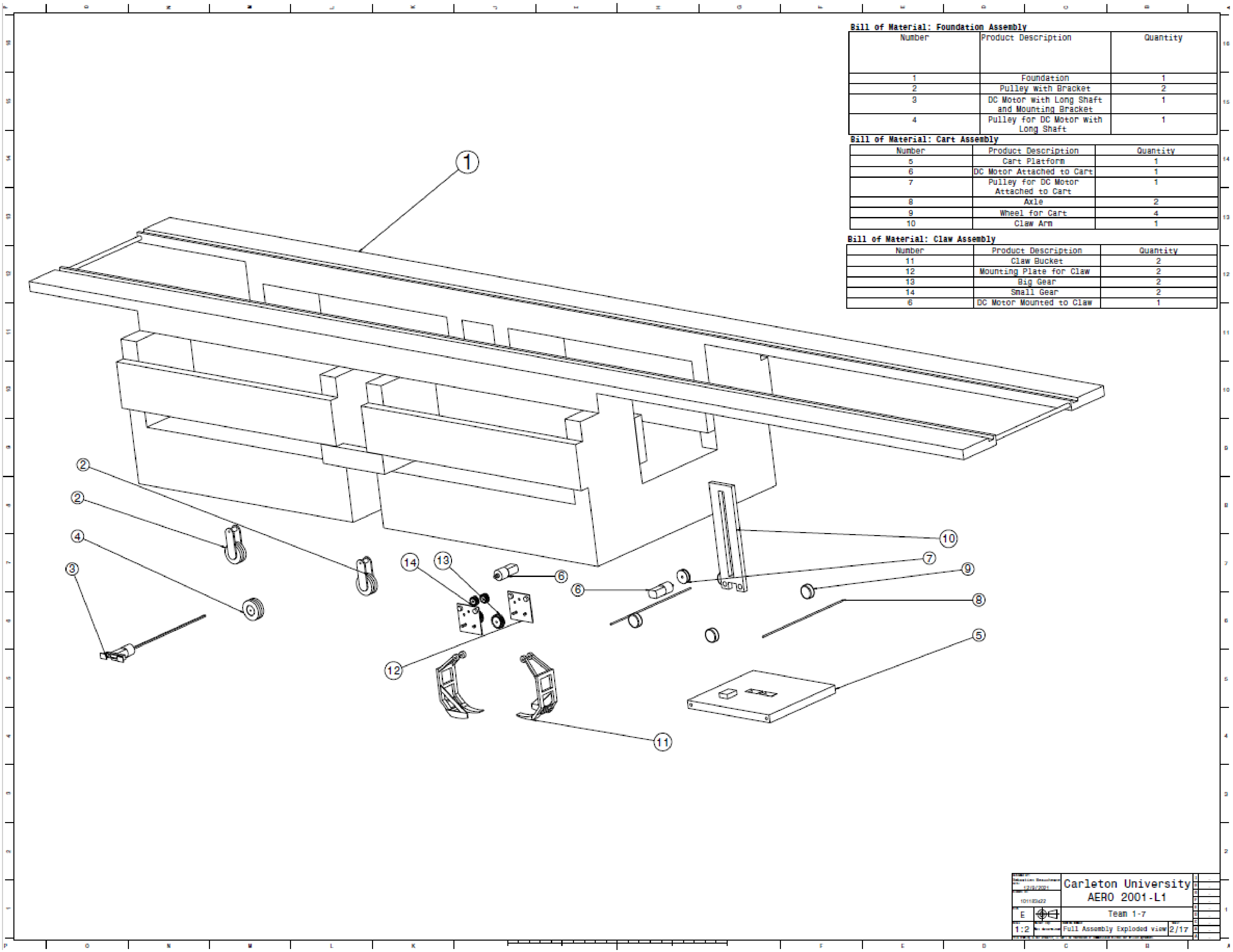
References

[1] R. Miller, “ProjectDescription_egg_mover,” [Online]. Available: https://brightspace.carleton.ca/d2l/le/content/60604/viewContent/2176597/View. [Accessed: 9-Dec-2021].

3-View Layout
Drawing



Assembly drawing



Bill of Material: Foundation Assembly

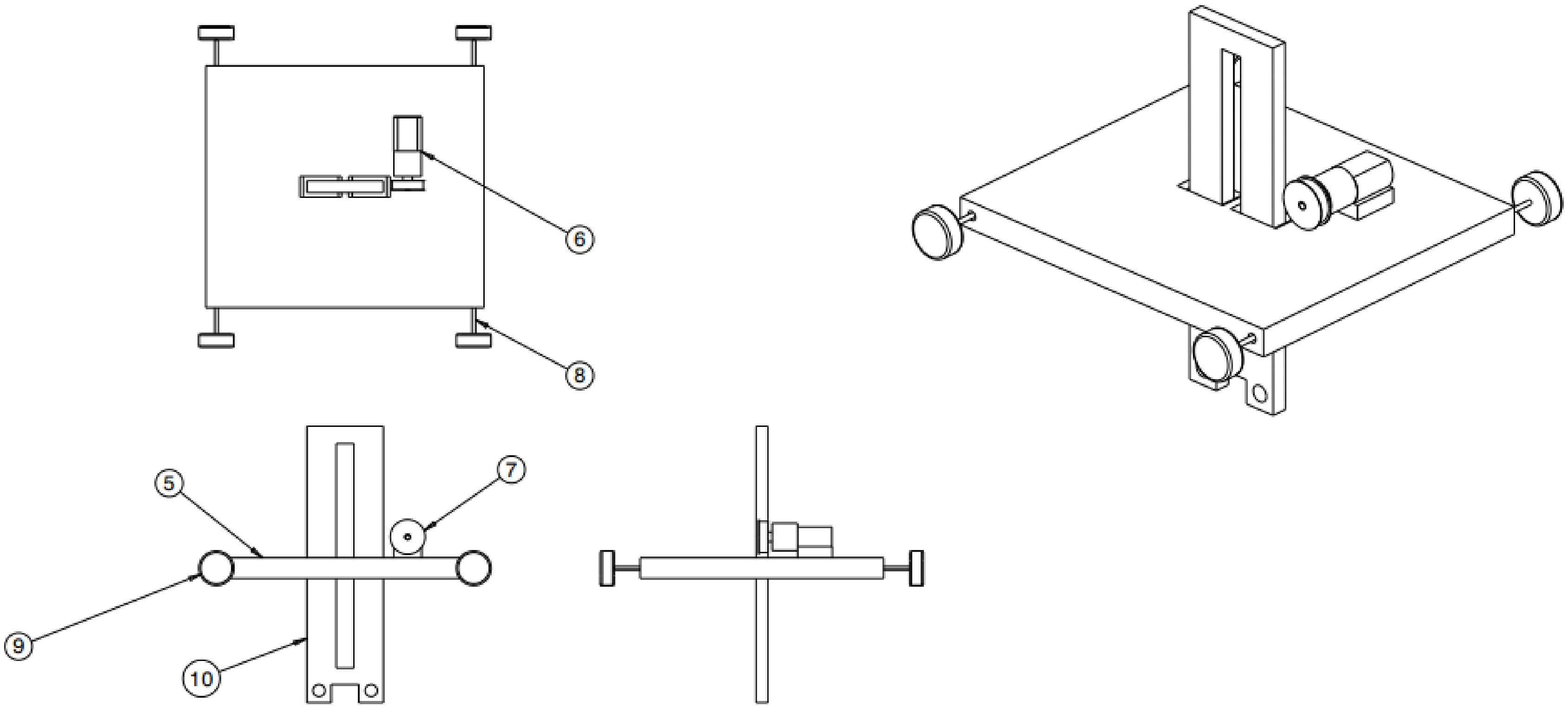
Number	Product Description	Quantity
1	Foundation	1
2	Pulley with Bracket	2
3	DC Motor with Long Shaft and Mounting Bracket	1
4	Pulley for DC Motor with Long Shaft	1

Bill of Material: Cart Assembly

Number	Product Description	Quantity
5	Cart Platform	1
6	DC Motor Attached to Cart	1
7	Pulley for DC Motor Attached to Cart	1
8	Axle	2
9	Wheel for Cart	4
10	Claw Arm	1

Bill of Material: Claw Assembly

Number	Product Description	Quantity
11	Claw Bucket	2
12	Mounting Plate for Claw	2
13	Big Gear	2
14	Small Gear	2
6	DC Motor Mounted to Claw	1



Bill of Material:

Number	Component Description	Quantity
5	Cart Platform	1
6	DC Motor	1
7	Pulley	1
8	Axle	2
9	Wheel	4
10	Claw Arm	1

DESIGNED BY:	Viktor Wozniak
DATE:	2021-12-06
STUDENT ID:	101195414
	CARLETON UNIVERISTY
	AERO 2001 L1
	TEAM 1-7
SIZE	B
SCALE	1:3
WEIGHT (LB)	1.04
DRAWING NUMBER	CART ASSEMBLY
SHEET	12/17

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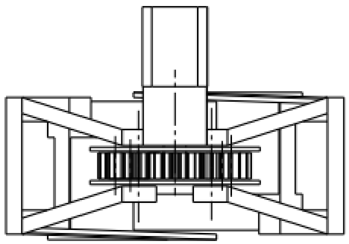
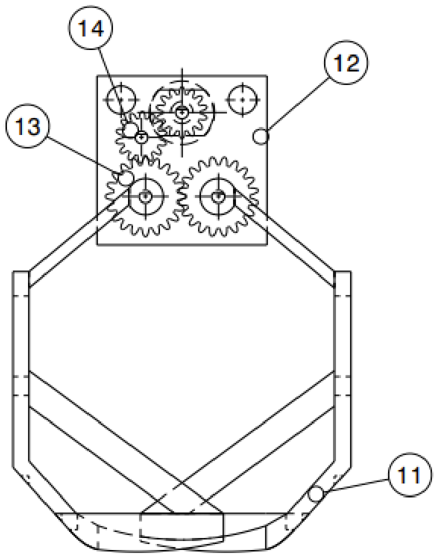
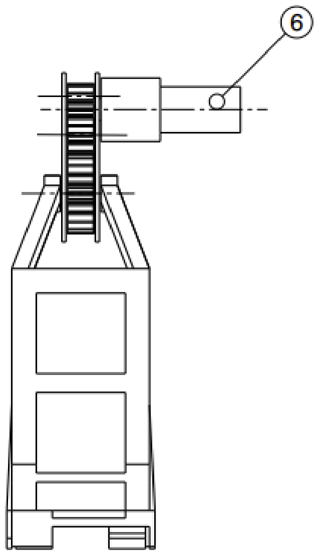
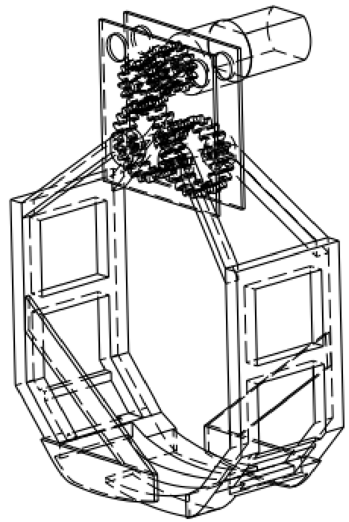






Isometric view
Scale: 2:3



Bill of Material: Mechanical Claw

Number	Component Description	Quantity
11	Claw Bucket	2
12	Mounting Plate	2
13	Big Gear	2
14	Small Gear	2
6	DC Motor	1

DESIGNED BY: Eithin Pero
DATE: 2021-12-09
STUDENT NUMBER: 101203184

Carleton University
AERO 2001 L1

SIZE: B

Team 1-7

SCALE	WEIGHT (lb)	DRAWING NUMBER	SHEET
1:2	0.26	Claw Assembly	17/17

I	_
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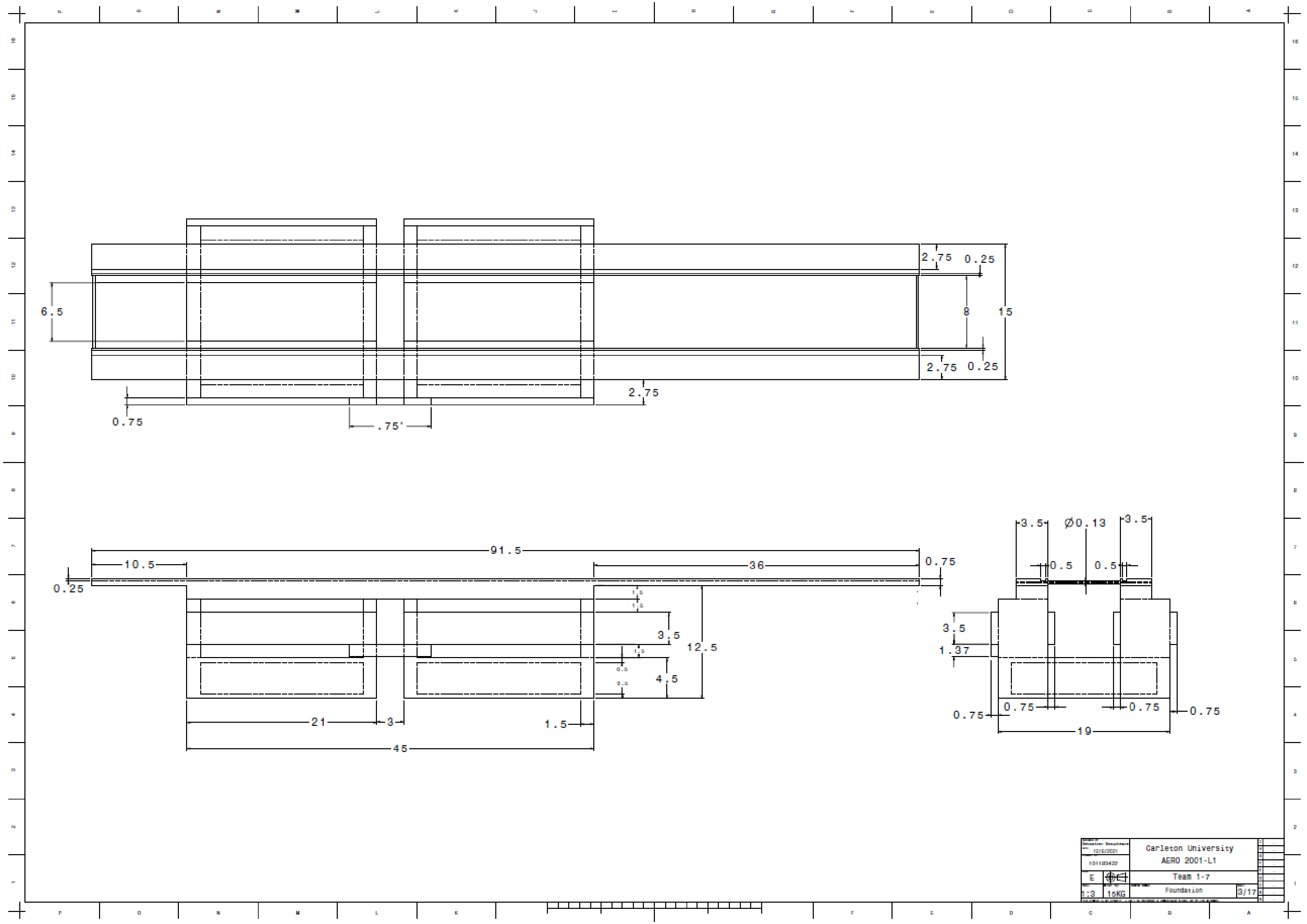
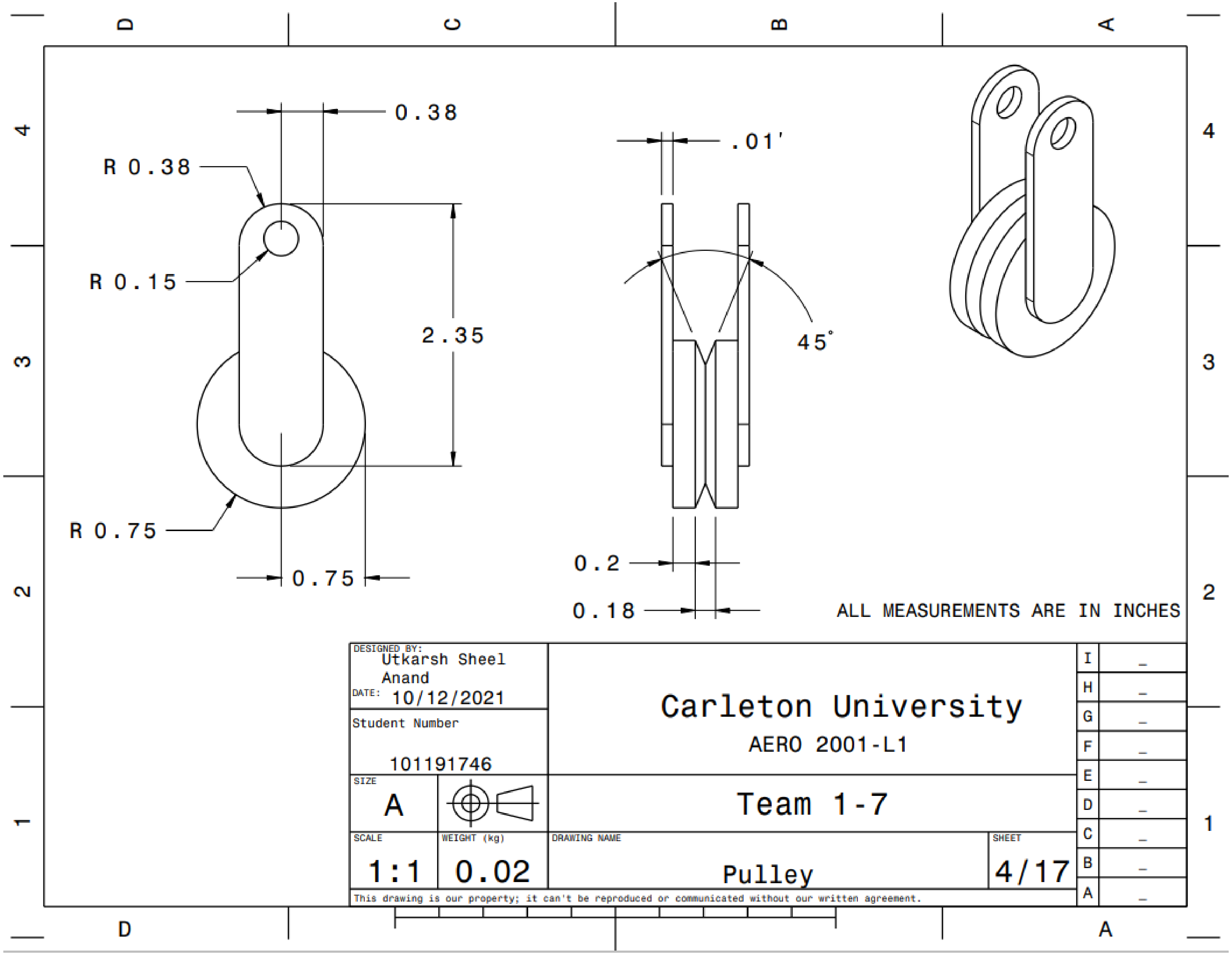
A	_

Working Drawings




0.38
R 0.38
R 0.15
2.35
R 0.75
0.75
.01'
45°
0.2
0.18
ALL MEASUREMENTS ARE IN INCHES
DESIGNED BY:
Utkarsh Sheel
Anand
DATE: 10/12/2021
Student Number
101191746
Carleton University
AERO 2001-L1
SIZE
A
Team 1-7
SCALE
1:1
WEIGHT (kg)
0.02
DRAWING NAME
Pulley
SHEET
4/17
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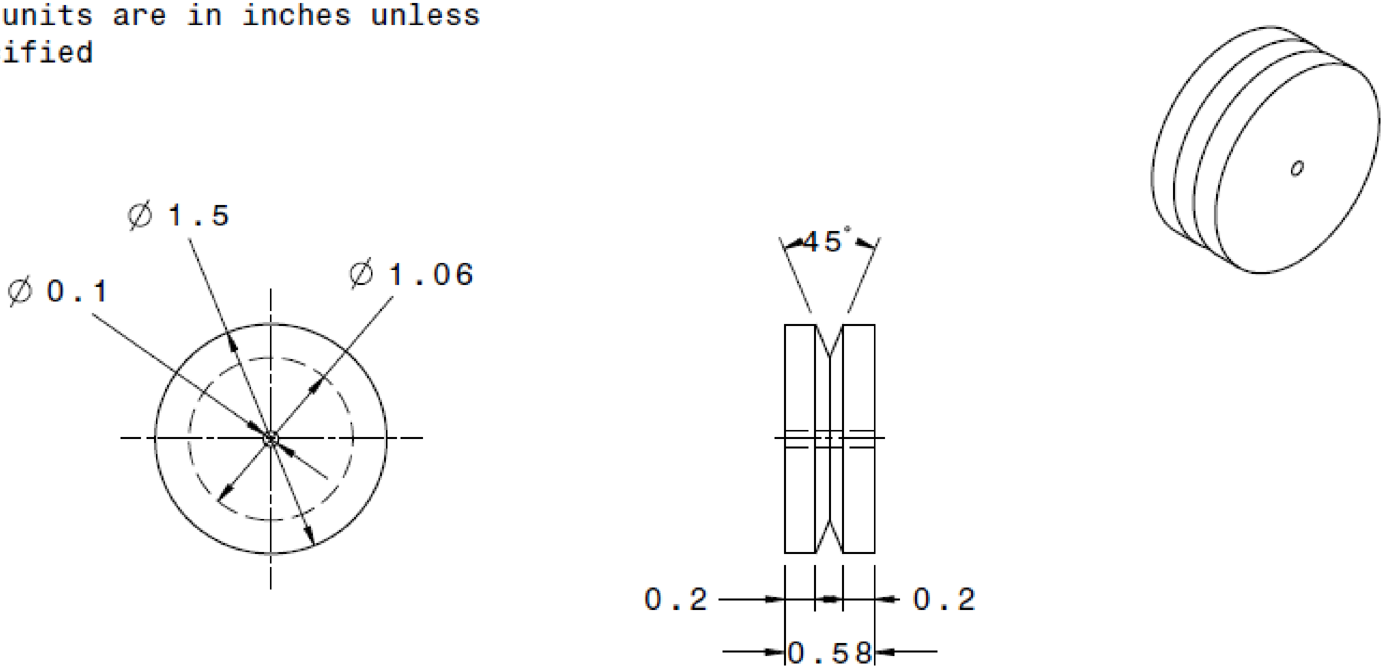
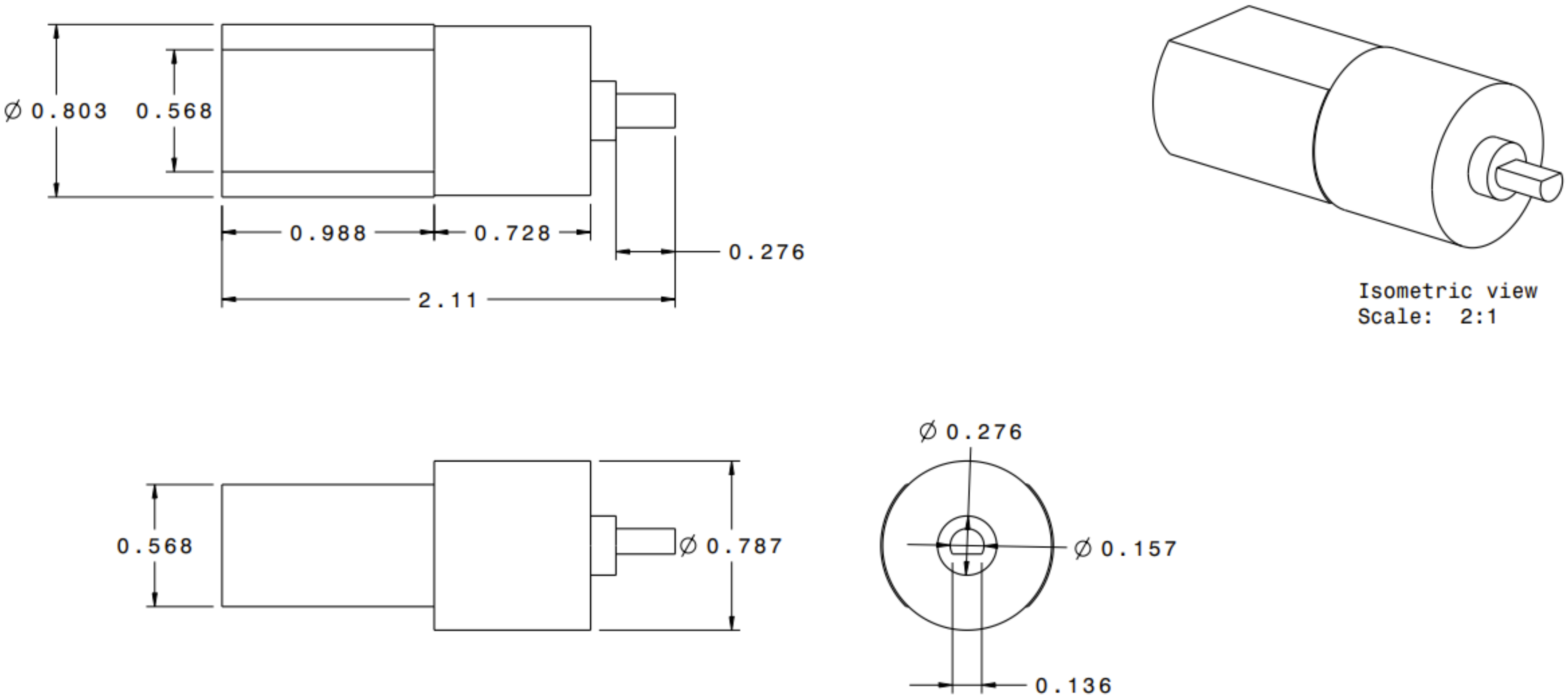
NOTE:
All units are in inches unless specified



DESIGNED BY: Sebastien Beauchesne DATE: 12/10/2021		Carleton University AERO 2001-L1		I _
Student ID: 101183422				H _
				G _
				F _
SIZE A		Team 1-7		E _
				D _
SCALE 1:1	WEIGHT (kg) 0.12	DRAWING NUMBER Pulley for DC Motor with long shaft	SHEET 5/17	C _
				B _
				A _



NOTES:
1. ALL VALUES EXPRESSED IN INCHES
MATERIAL: COMPOSITE (TO BE PURCHASED)

DESIGNED BY: Eithin Pero
DATE: 2021-12-09
STUDENT NUMBER: 101203184

Carleton University

AERO 2001 L1

SIZE: B

Team 1-7

SCALE: 2:1
WEIGHT (lb): 0.09
DRAWING NUMBER: DC Motor
SHEET: 6/17

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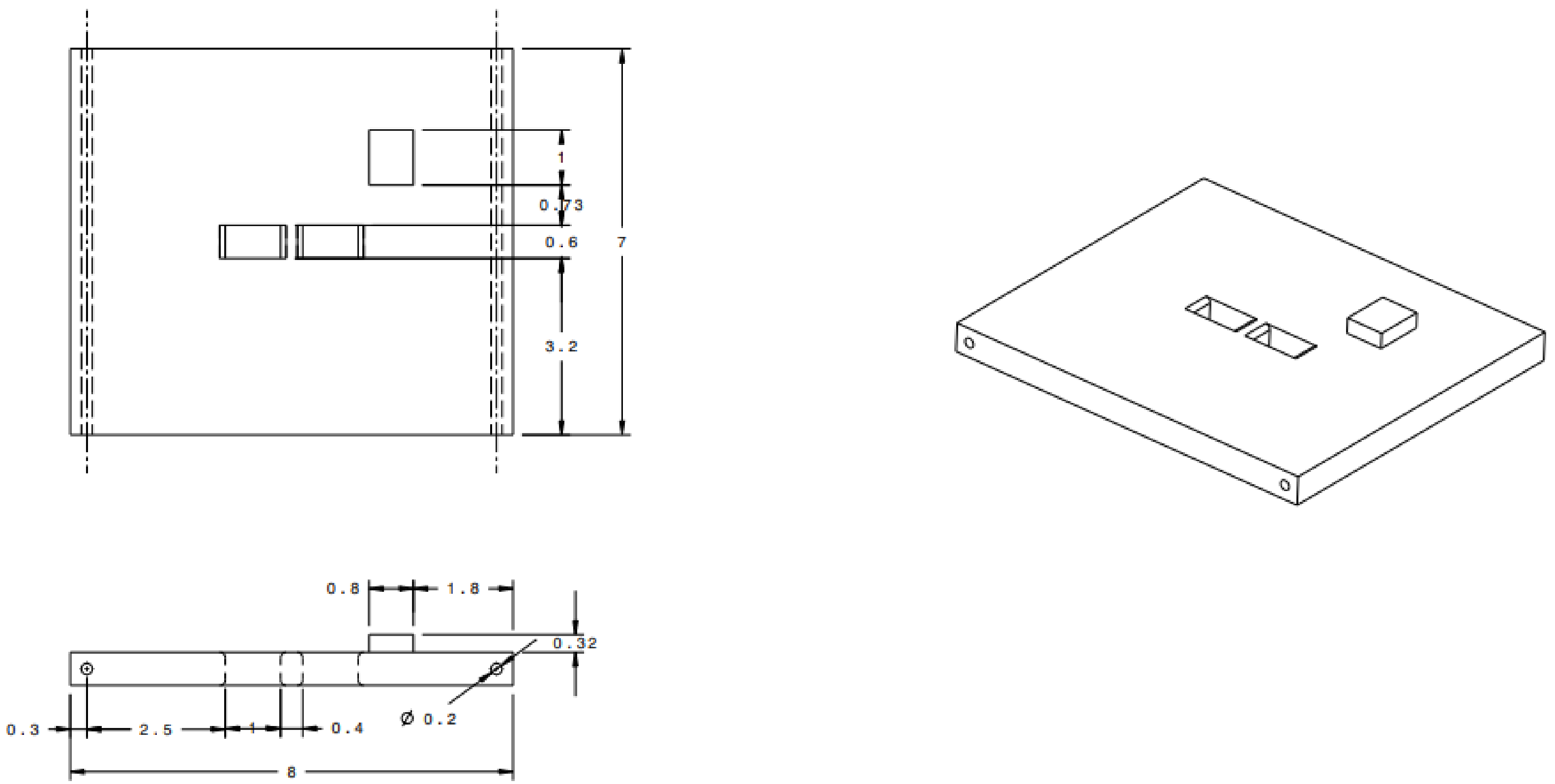
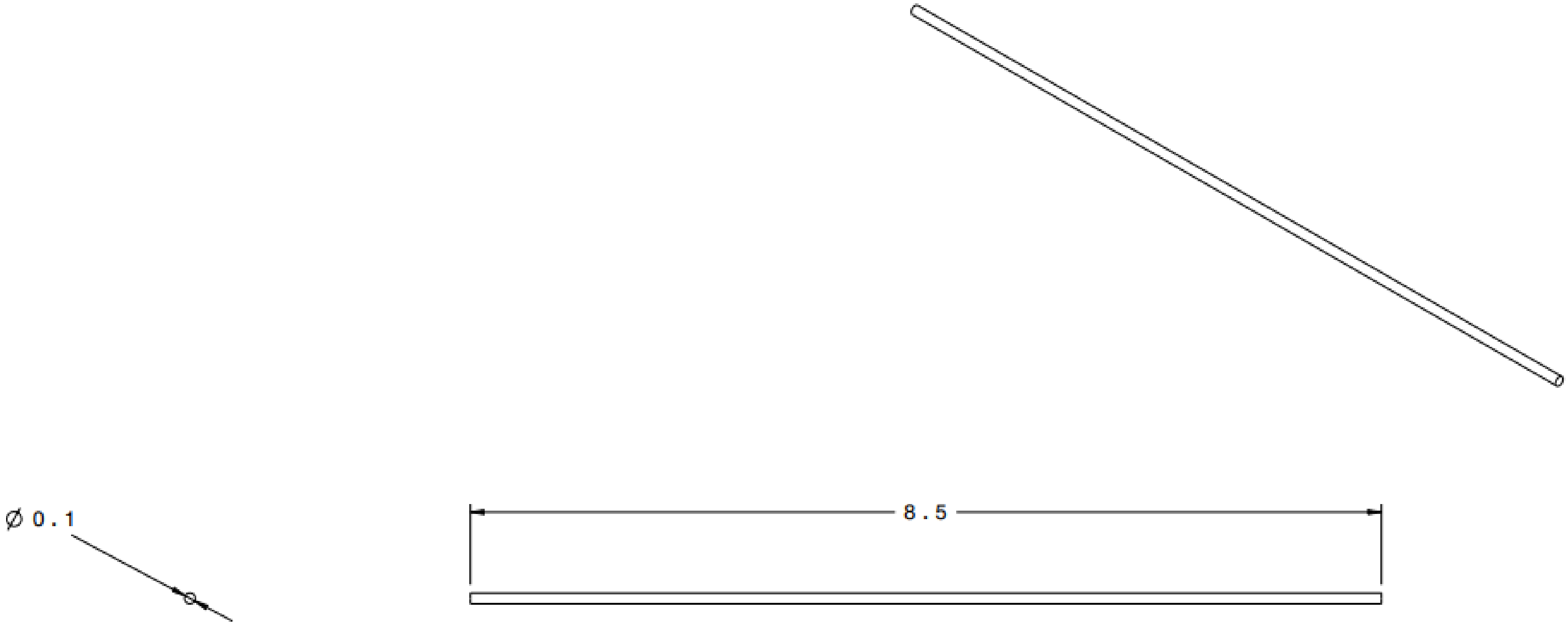


NOTES:

1. ALL UNITS IN INCHES

2. MATERIAL: PINE WOOD

DESIGNED BY: Viktor Wozniak DATE: 2021-12-06	CARLETON UNIVERISTY AERO 2001 L1		
STUDENT ID: 101195414			
SIZE B		TEAM 1-7	
SCALE 1:2	WEIGHT (LB) 0.60	DRAWING NUMBER CART BODY	SHEET 7/17



NOTES:

1. ALL UNITS IN INCHES
2. MATERIAL: STEEL

DESIGNED BY: Viktor Wozniak DATE: 2021-12-06	CARLETON UNIVERISTY AERO 2001 L1	
STUDENT ID: 101195414		
SIZE: B	TEAM 1-7	
SCALE: 1:1 / WEIGHT (LB): 0.01	DRAWING NUMBER: CART AXLE	SHEET: 8/17

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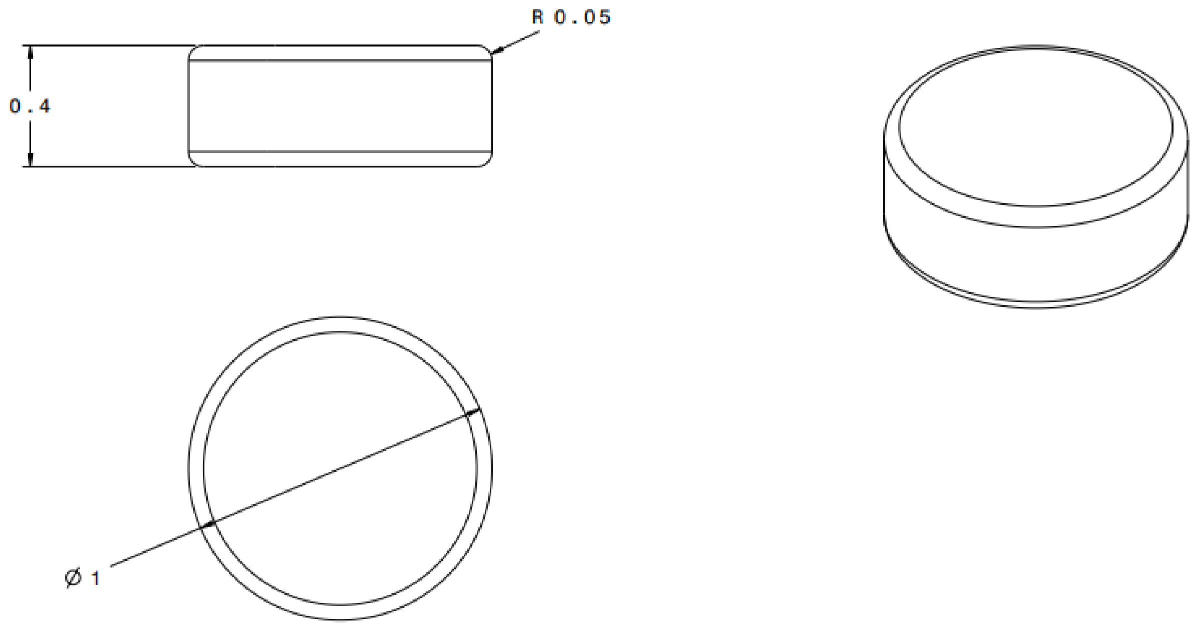
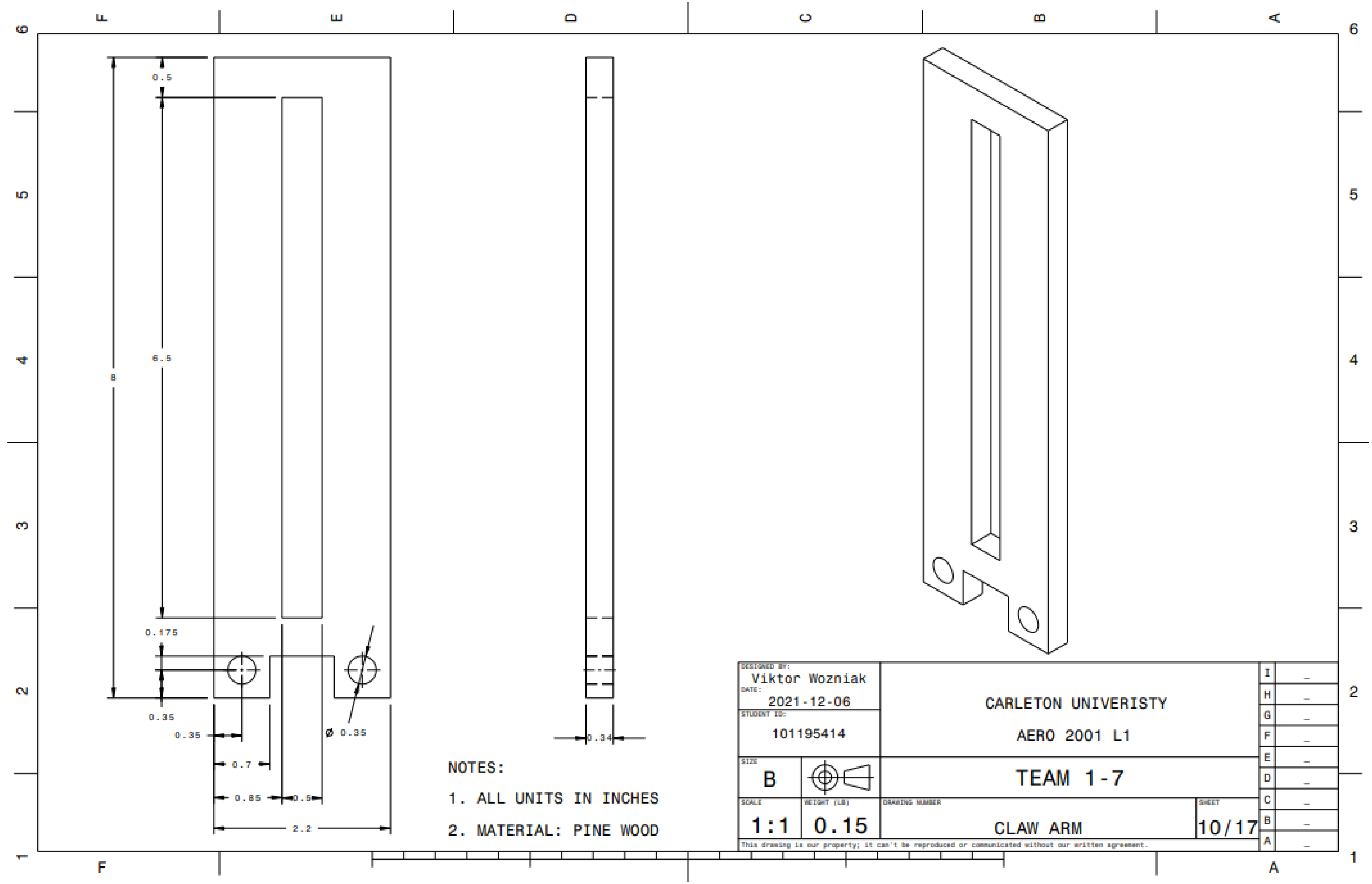


NOTES:

1. ALL UNITS IN INCHES
2. MATERIAL: PLASTIC & RUBBER

DESIGNED BY: Viktor Wozniak DATE: 2021-12-06		CARLETON UNIVERISTY	
STUDENT ID: 101195414		AERO 2001 L1	
SIZE B		TEAM 1-7	
SCALE 3:1	WEIGHT (LB) 0.03	DRAWING NUMBER CART WHEEL	SHEET 9/17



NOTES:

1. ALL UNITS IN INCHES

2. MATERIAL: PINE WOOD

DESIGNED BY: Viktor Wozniak	CARLETON UNIVERISTY		
DATE: 2021-12-06			
STUDENT ID: 101195414	AERO 2001 L1		
SIZE: B		TEAM 1-7	
SCALE: 1:1	WEIGHT (LB): 0.15	DRAWING NUMBER: CLAW ARM	SHEET: 10/17

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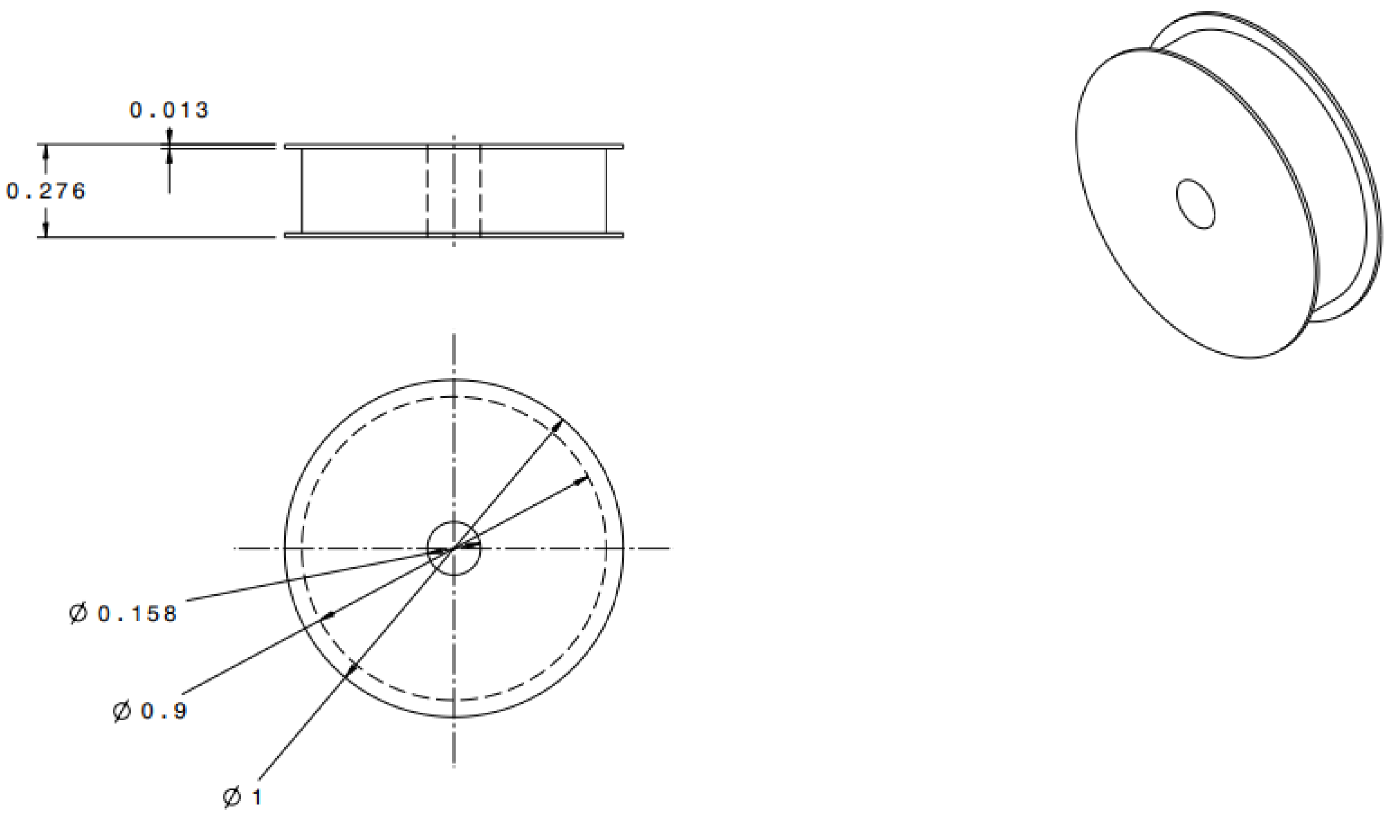

NOTES:

1. ALL UNITS IN INCHES
2. MATERIAL: STEEL

DESIGNED BY: Viktor Wozniak DATE: 2021-12-06 STUDENT ID: 101195414	CARLETON UNIVERISTY AERO 2001 L1		
SIZE: B		TEAM 1-7	
SCALE: 3:1	WEIGHT (LB): 0.06	DRAWING NUMBER: PULLEY FOR CLAW ARM	SHEET: 11/17

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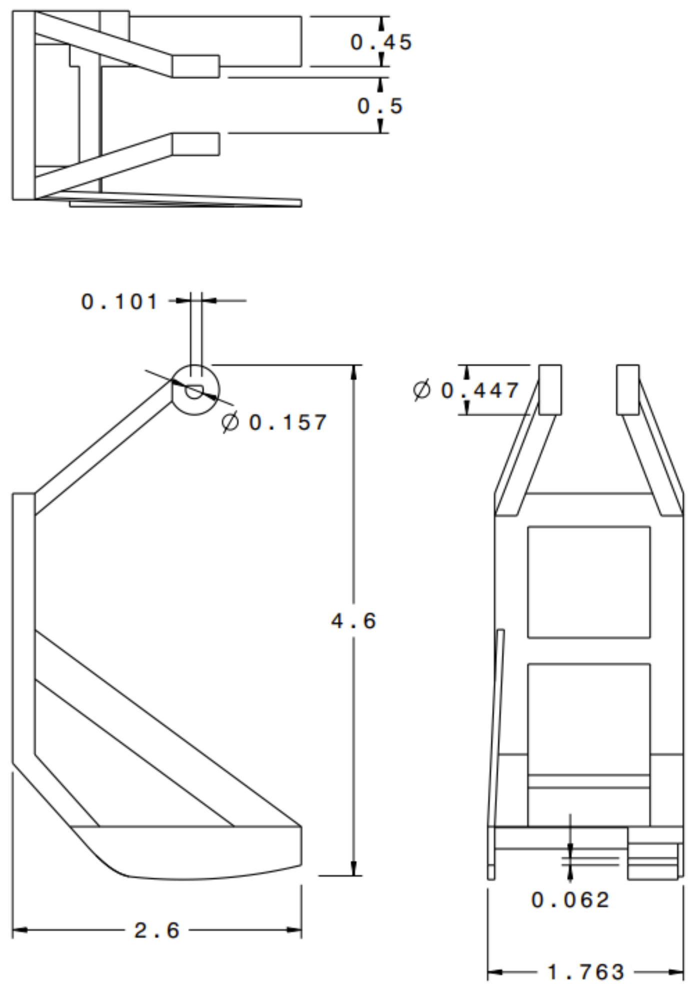

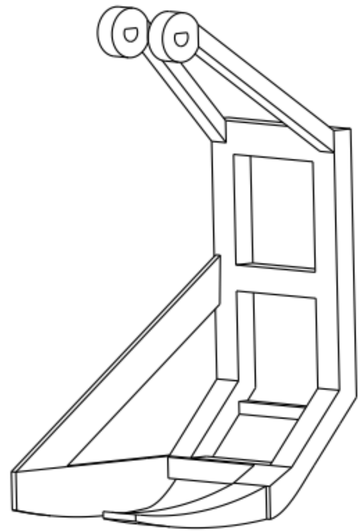

Isometric view
Scale: 1:1

NOTES:
1. WORKING DRAWING FOR ILLUSTRATIVE PURPOSES ONLY, PART TO BE 3D PRINTED
2. ALL VALUES EXPRESSED IN INCHES
MATERIAL: PTEG FILAMENT

DESIGNED BY: Eithin Pero
DATE: 2021-12-09
STUDENT NUMBER: 101203184

Carleton University

AERO 2001 L1

SIZE: B

Team 1-7

SCALE	WEIGHT (lb)	DRAWING NUMBER	SHEET
1:1	0.1	Claw Bucket	13/17

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C	_
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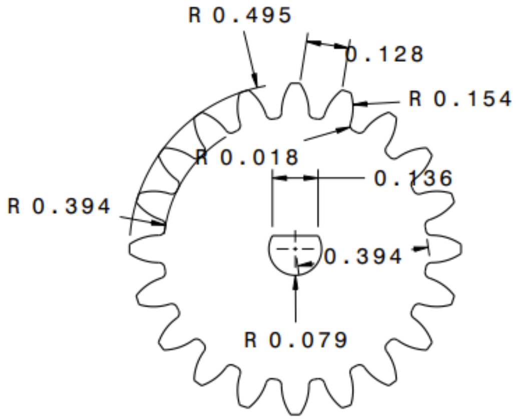
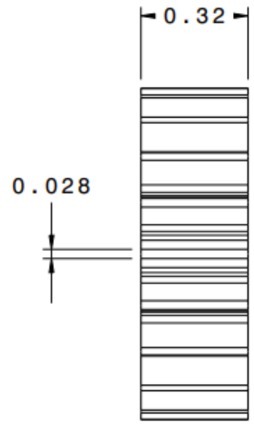
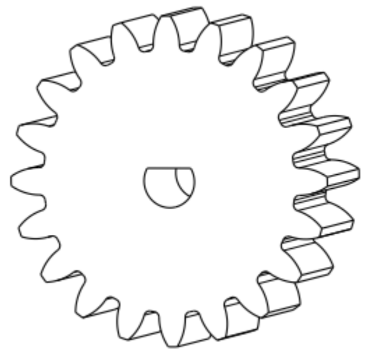
A	_

NOTES:
1. ALL VALUES EXPRESSED IN INCHES
MATERIAL: METAL ALLOY







Isometric view
Scale: 3:1

DESIGNED BY: Eithin Pero DATE: 2021-12-09	Carleton University AERO 2001 L1		
STUDENT NUMBER: 101203184			
SIZE: B		Big Gear	
SCALE: 3:1	WEIGHT (lb): 0.05	DRAWING NUMBER: Part 5	SHEET: 14/17

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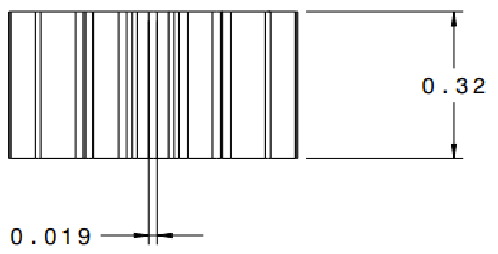

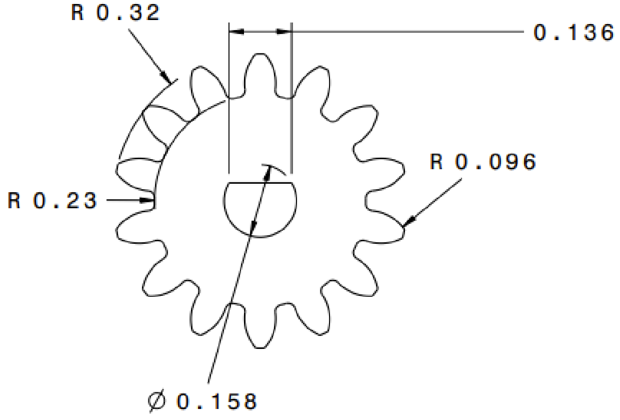

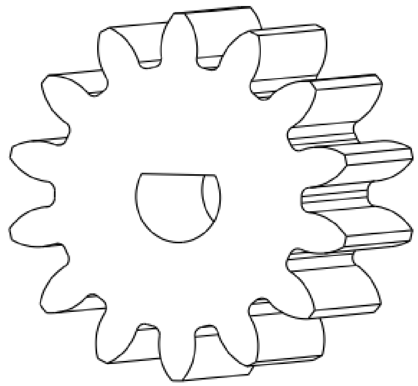

Isometric view
Scale: 5:1

NOTES:
1. ALL VALUES EXPRESSED IN INCHES
MATERIAL: METAL ALLOY

DESIGNED BY: Eithin Pero DATE: 2021-12-09	Carleton University AERO 2001 L1	
STUDENT NUMBER: 101203184		
SIZE B	Team 1-7	
SCALE 4:1 / WEIGHT (lb) 0.025	DRAWING NUMBER Small Gear	SHEET 15/17

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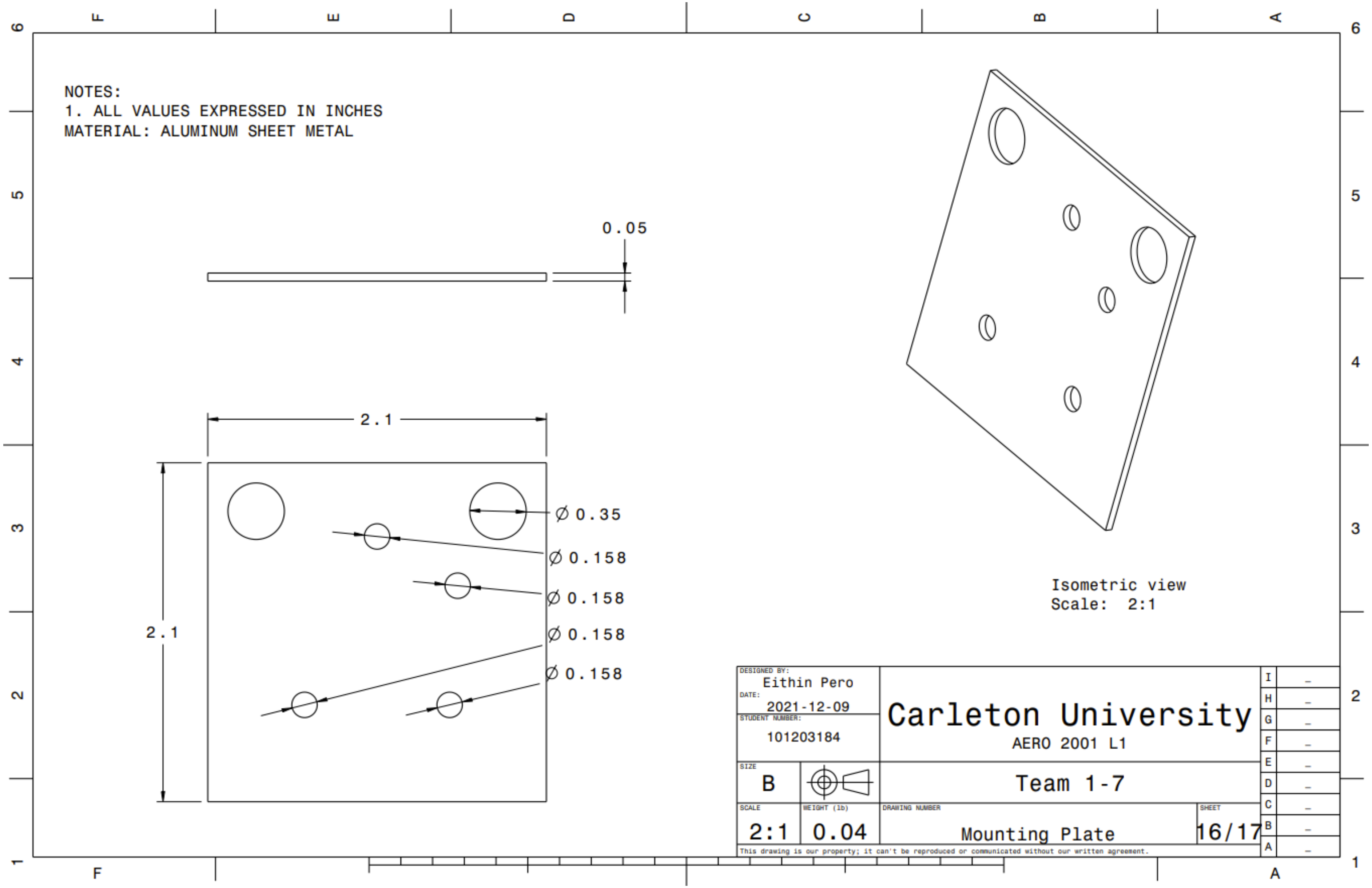
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0.05
2.1
2.1
Ø 0.35
Ø 0.158
Ø 0.158
Ø 0.158
Ø 0.158
Isometric view
Scale: 2:1
DESIGNED BY:
Eithin Pero
DATE:
2021-12-09
STUDENT NUMBER:
101203184
Carleton University
AERO 2001 L1
SIZE
B
Team 1-7
SCALE
2:1
WEIGHT (lb)
0.04
DRAWING NUMBER
Mounting Plate
SHEET
16/17
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