Design Project 1 – 1P13 International Airport

ENGINEER 1P13 – Integrated Cornerstone Design Projects in Engineering

Tutorial 03

Team 46

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Submitted:

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Academic Integrity Statement

The student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University.

Ananyaa Rai 400557799

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Inaaya Lalani 400570742

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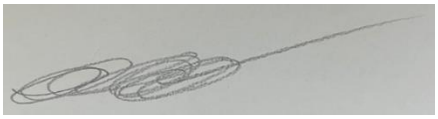
Luca Iacovelli 400579039



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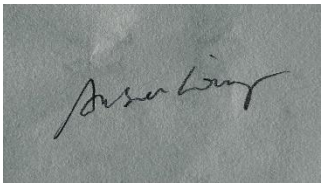

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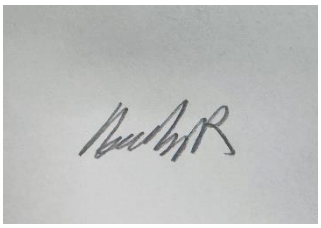
Areeb Rahman 400576635



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Executive Summary

Air travel is a greatly preferred method of transportation for many people, as it is the quickest and most comfortable way to travel across a country, and between countries. However, with our current airport baggage system, there have been an increasing amount of lost check-in bags. Around one third of Canadians have lost their luggage while flying, and of those, 6.7% were unable to recover their belongings [1]. The amount of lost luggage resulting from airlines discourages passengers from checking their bags in, which in turn, leads to them bringing more carry-ons. The additional fees from checking in bags also encourage more carry-ons. However, this slows down the boarding process and is not very efficient. In this project, we aimed to combat this issue by designing an automated airport luggage mechanism that was able to accept and transport baggage safely and efficiently using as few resources as possible. Some additional characteristics we wanted to implement were a smooth baggage filtration process, a quick check in process for passengers, and a durable and reliable structure. These goals would provide a solution to the luggage problems passengers face in today's air travel, expensive check in fees, as well as unreliable luggage handling. There were a few constraints that we needed to strategically overcome and take into consideration when building and designing our mechanism. In order to conserve resources and make the mechanism as cost efficient as possible for the passengers, we needed to limit the amount of material we used. We did this by designing a very simple and straightforward mechanism, that consisted of a ramp, pulley, and supports. Another constraint we had to take into consideration was the restriction line. Our mechanism needed to be able to retract behind the restriction line as that path needed to be clear. Our solution to this was to have our ramp retract and deploy. It's resting position would be behind the line, and when needed, it would extend past the line. When not in use, the ramp would stand upright supported by two stationary struts on either side. A rope tied to the top of the ramp, wrapped around a pulley attached to the rotary actuator. When it was time to extend the ramp, the pulley would rotate, making the string taught and pulling the ramp down at the same time. And when the ramp needed to go back to its resting position, the pulley would rotate in the opposite direction, restoring the slide to it's original state. A counter weight was also attached to the bottom of the ramp to help it go back behind the restriction line. During the check-in stage, each bag is scanned to determine if it meets the requirements to be checked in, and if it doesn't. The bags that are not accepted, go in the reject bin and are then returned back to its owner. The bags that are accepted are picked up by the Q-arm and are placed on top of the ramp at platform A, allowing them to slide down onto, platform B. The design portion combats the issue of cost as it conserves resources. The other part of the issue, the lost baggage, was solved in the programing aspect of the project. Our code organized all of the flights and passenger's data into their respective lists. From this, we were able to keep track of each passenger, their gates, the plane they are on, if they have a layover, and if their flight is delayed or not. Using this information, we can keep track of the bags and ensure that they get safely delivered to the right destination

with the help of our mechanism. This design and process is expected to achieve all of our initial goals. It is cost efficient for the manufacturers as it focuses on conserving resources with its simplistic nature, making it cost efficient for the passengers as well. The mechanism also safely transports the luggage from one platform to the other, and reliably gets the luggage to where it needs to be, reducing the chances of lost and misplaced bags. This design does have its flaws as it does not ensure a success rate of 100%. This is because there is no way of accounting for uncontrollable situations, such as if someone accidentally takes the wrong bag. However, our design does significantly improve the outcome of these prominent issues which will encourage more passengers to use the check-in system, resulting in a quicker and more efficient boarding process. In our original problem statement, we were aiming for a success rate of 75-85%, and with our current design, we are ensuring a success rate similar to our original plan.

Main Body

Strategy

Prior to designing selecting our mechanism design, we outlined our main objectives that we wanted to focus on. For us, this was efficiency, durability, and tolerance against error. Several different models and designs were explored before we came to our final mechanism, ensuring that with each prototype we learnt more about what works and what doesn't work. Our group met regularly to discuss changes and updates; each change would be agreed upon by the entire group before being made final. Our final concept selection and further refinements was focused on keeping the mechanism simple and aligned with our 3 objectives. Overall, this strategy allowed our mechanism and software to be designed carefully, with each detail fleshed out in its entirety before it would be fully manufactured.

Mechanism Design

For the mechanism, our team wanted something simple but functional. We decided to use a rotary actuator connected to the ramp with a rope, as this setup allowed for smooth extension and retraction of the ramp to transfer luggage between Plate A and Plate B without crossing the rejection line when it is not activated. We decided to use a rotary actuator because of its simplicity of implementation and compatibility to our initial design. To save time and money, we 3D-printed most of the parts and laser cut a few, which worked out excellently in terms of precision because our team manager had access to high-quality CNCs at his part-time aerospace manufacturing firm. Despite a few minor setbacks, such as reprinting faulty parts due to misalignment of the hole, the mechanism was successfully refined to meet all functional requirements. Our use of the rotary actuator simplified the design to a simple winch mechanism, but raised concerns regarding power output given the weight of the slide. We wanted to retract the mechanism clean and quickly but also be able to have the rotary actuator use its "braking" mechanism at when it is deployed so we would have to

worry about a profile controller, complicating our mechanical and software designs. Using the online documentation for the rotary actuator, its stalling torque was used to maximize the heaviest counterweight we could install that matched our needs.

Software Design

For the software, we divided the work into smaller sections to allow everyone to concentrate on specific aspects of the project. We began by creating flowcharts to ensure that the program logic aligned with our desired outcomes. The program handled key aspects such as Q-Arm movements, luggage scanning, and sorting, along with processing flight and passenger data. More importantly, functions like pick_up(), reject(), and drop_off() were implemented for automated Q-Arm luggage handling, while rotary actuator commands like bot.rotate_stepper_cw() and bot.rotate_stepper_ccw() enabled the ramp's deployment and retraction. After having a desired code, testing was a big part of the process because we had to tweak things like timing and angles for the Q-Arm to make sure it worked perfectly with the scanner and actuator. In the end, we were able to connect everything together, and it felt great to see it all working as one automated system.

Iterations

There were many points in this design and programing process where we had to revisit and refine our work after testing it, before finalizing it. In our original design, we used a gear and axle system which rotated and extended the struts holding the ramp. However, after looking over our design and testing the degrees of freedom on Inventor, we realized that we might encounter issues with this design. Such as, not enough torque to rotate the axle and deploy the ramp. From this we decided to replace the axle and gear with a pulley system. While doing our team and individual codes, we had to constantly test our programs to make sure they worked and produced the desired outcome. When we encountered issues, we would write print statements and go over the code to help us locate the issue and debug it. This was our general process while writing the programs, until we all were able to finalize the individual and team codes.

Solution

During out testing periods, we were able to successfully test our mechanisms with no issues at all. We also had the same results during the demonstration section in our team’s interview. However, the luggage would always fall off Platform B due to it going too fast. Despite this not being a requirement, if given more time, fixing this would be something to consider to achieve perfection.

Refinements

Given the opportunity to revisit and refine our design, or given more time, there are a few changes we would suggest implementing. The first would be to find a better substitute for the string and pulley part of our mechanism. Looking at it from a real word perspective, a string or rope would not be a reliable long-term solution as it would need a lot of maintenance from anticipated wear and tear. A better solution would be a sturdier mechanism that deploys and retracts the ramp, such as a scissor lift to lift the ramp up and pull it back down. Another change would be adjusting the steepness of our ramp. The ramp in our current design would also not be ideal in a real world setting as the luggage slides down very fast, which would result in a lot of damage being done to the bags. We combated this by adding friction to slow down the speed of the bags, but a better solution would have been to lessen the incline.

Reflection

In comparison to our original plan, we were able to complete each milestone on time. There were a few factors that prompted us to reconsider our strategy and reallocate time, one of which was the development of our mechanism. Throughout the iterative building process, we changed our design and faced new obstacles. For example, the main ramp of our mechanism was originally intended to be 3D printed. Due to time constraints, we had to laser cut instead, which introduced a new issue with ramp friction. The acrylic material was slippery causing the luggage to not reach the platform. This was readily rectified by sandblasting it with aluminum oxide, improving the friction felt on the luggage. As a result, the time for testing the entire mechanism using our actuator and q-arm code was reduced.

Reference List

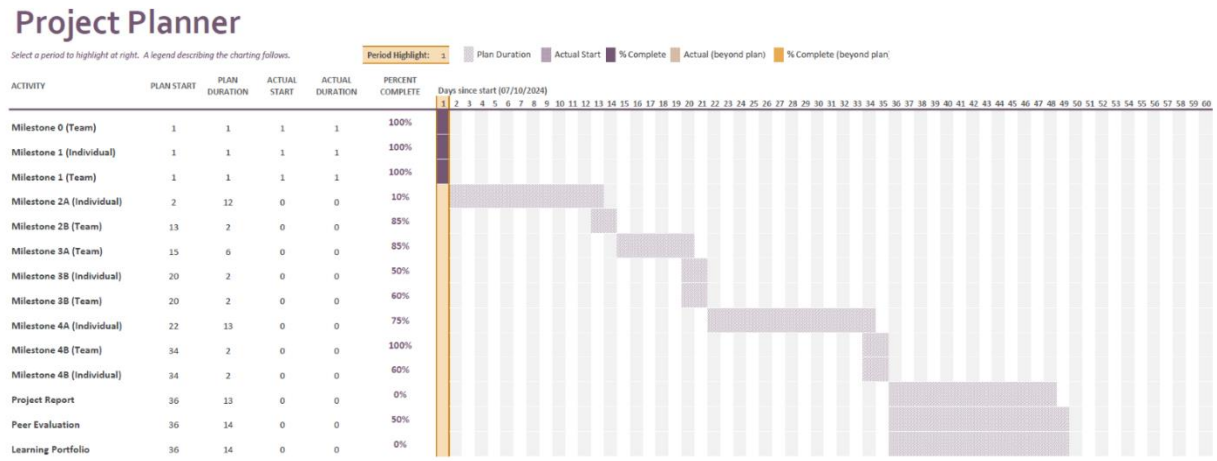
[1] “Nearly a third of Canadians have lost their luggage while flying: Survey,” CTVNews, https://www.ctvnews.ca/canada/nearly-a-third-of-canadians-have-lost-their-luggage-while-flying-survey-1.6293134 (accessed Dec. 4, 2024).

[2] MatWeb, " Detailed Material Properties Datasheet," [Online]. Available: https://www.matweb.com/search/datasheet.aspx?bassnum=O1303. [Accessed Dec. 1, 2024].

Appendices

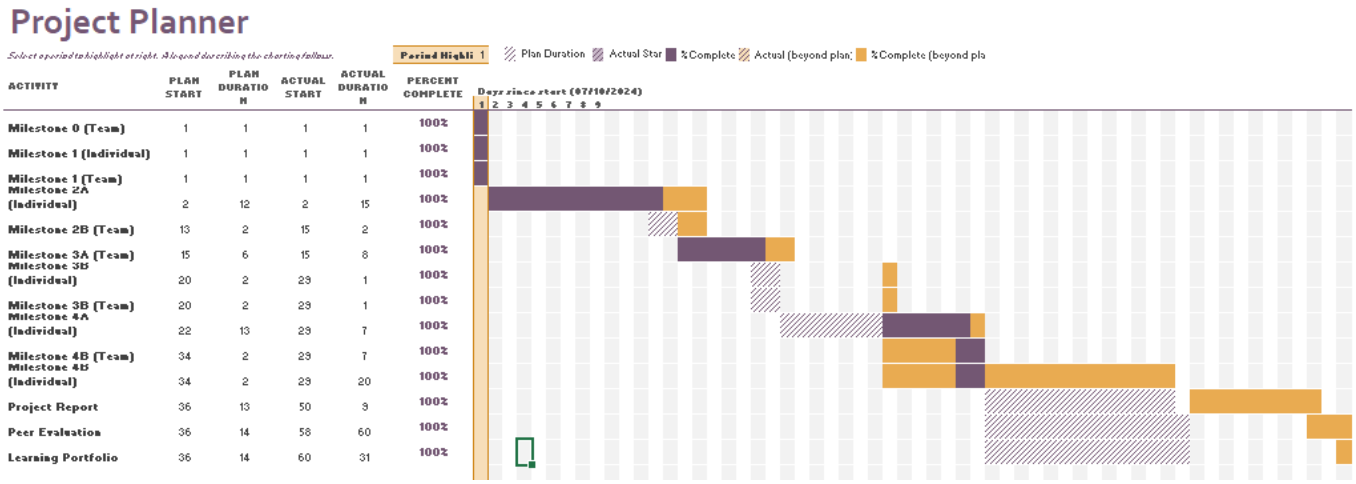
Appendix A: Project Schedule

Preliminary Gannt Chart:



ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Milestone 0 (Team)	1	1	1	1	100%
Milestone 1 (Individual)	1	1	1	1	100%
Milestone 1 (Team)	1	1	1	1	100%
Milestone 2A (Individual)	2	12	0	0	10%
Milestone 2B (Team)	13	2	0	0	85%
Milestone 3A (Team)	15	6	0	0	85%
Milestone 3B (Individual)	20	2	0	0	50%
Milestone 3B (Team)	20	2	0	0	60%
Milestone 4A (Individual)	22	13	0	0	75%
Milestone 4B (Team)	34	2	0	0	100%
Milestone 4B (Individual)	34	2	0	0	60%
Project Report	36	13	0	0	0%
Peer Evaluation	36	14	0	0	50%
Learning Portfolio	36	14	0	0	0%

Final Gannt Chart:



ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Milestone 0 (Team)	1	1	1	1	100%
Milestone 1 (Individual)	1	1	1	1	100%
Milestone 1 (Team)	1	1	1	1	100%
Milestone 2A (Individual)	2	12	2	15	100%
Milestone 2B (Team)	13	2	15	2	100%
Milestone 3A (Team)	15	6	15	8	100%
Milestone 3B (Individual)	20	2	23	1	100%
Milestone 3B (Team)	20	2	23	1	100%
Milestone 4A (Individual)	22	13	23	7	100%
Milestone 4B (Team)	34	2	23	7	100%
Milestone 4B (Individual)	34	2	23	20	100%
Project Report	36	13	50	9	100%
Peer Evaluation	36	14	58	60	100%
Learning Portfolio	36	14	60	31	100%

Agenda

Week	Notes
5	- Started groups - Chose roles - Worked on problem statement, objectives, and constraints
6	- Finalized concept sketches - Started Cads
7	- Started printing pieces - Worked on cad
8	- Created flow-charts for code - Continued printing parts - Laser cut slide piece
9	- Worked on code for q-arm - Continued printing parts - Continued working on group code
10	- Tested code for q-arm - Made small sizing changes to cad following print mistake - Assembled most of the final mechanism - Finished up group code
11	- Prepared for interview - Scheduled Printing session - Started final report

Logbook of Additional Meeting & Discussions

Weeks & Milestones	**Meeting/Discussion Notes**
Week 1: Milestone 0, Milestone 1	As a team, we reviewed everyone's roles and responsibilities and created our initial game plan

Week 2: Milestone 2	Round robin discussion where everyone presented their individual sketches and models. After assessing the pros and cons of each design, we created our team mechanism, a simple but effective ramp and pully system
Week 3: CAD Work Period	After finalizing the CAD model, we dissected our mechanism to see which parts needs fabrication and how (3D printing or laser cutting)
Week 4: Milestone 3	After reviewing the code needed, we delegated the functions to each team member and started working on our flowcharts to understand hoe each function works.
Week 5: Coding Work Period	We had a quick check-in to see everyone's progress and helped each other where needed with the hopes everyone has their functions done for week 11.
Week 6: Milestone 4	With the basic q-arm and actuator code ready to do from previous weeks, we tested the codes with the physical environment (adding tweaks wherever necessary)
Week 7: Work Period	We integrated all the completed functions together and started working on our final project report.
Week 8: Interview	Day before the interview, we walkthrough our team CAD model and code one final time in preparation for the interview. Additionally, we discussed what documents were needed for our report to be complete.

Appendix B: Scheduled Weekly Meetings

Logbook of Design Studio Meetings

Week	Feedback	Action Items

1	• Everything looks good in our initial problem statement as well as FOCs
	• Overall feedback on sketches:
	  o Consider the limitations of the actuators, look into implementing both in your ideas if needed
	  o Also remember to consider how these mechanisms will work in reality
	• Feedback on individual sketches:
	  o Luca: rotary actuator doesn't have enough force
	  o Inaaya: ensure it's mounted to remove any degrees of freedoms
	  o Ananyaa: use rotary actuator to bring out the ramp
	  o Areeb: isn't generating the speed that you need. As a whole concept it works maybe not realistic however
	  o Anson: in most cases the linear actuator won't have enough distance, maybe add another actuator to get the final stretch required
		• Revise our sketches to inline with TA's feedback (overall and individual)
		• Looking forward to next week, consider the process of modeling these sketches in Autodesk

2	• Might be an issue with retracting the ramp using the rotary actuator o Fully constrain it on inventor to make sure it extends and retracts properly • Determine what other properties need to be fixed/adjusted • Take into consideration the weight of the ramp and if the actuators will have enough force/torque to move it	• Consider cutting holes in the ramp and making it thinner, making it weigh less, which would allow the actuators to move it • Add constraints to the ramp pre-emptively to make sure it works

3	What We Discussed:
	• Luca did the math, and we found that the counterweight should be1-2 kgs at most
	• 3D print the pully, slits and ramp
	  o pully needs to be smooth so we can sand if necessary
	  o ramp do be possibly printed on Wednesday
	• On track with the Gantt chart right now and we hope to have the 2 weeks near the end to fix any issues that arise when assembling
	Feedback:
	• Look into how you are connecting the counterweight and what will it be?
	• Ensure all fabricated parts fit the time limit
	  o Currently the ramp was too long to 3D print and takes too much time
		• Consider laser cutting the ramp as it will save time
		  o 3D print any connection parts required to connect the ramp

4	What We Discussed: • Completed the three team function flow charts • We went over the individual functions as a group and assigned them to each member	N/A (everything looks good)

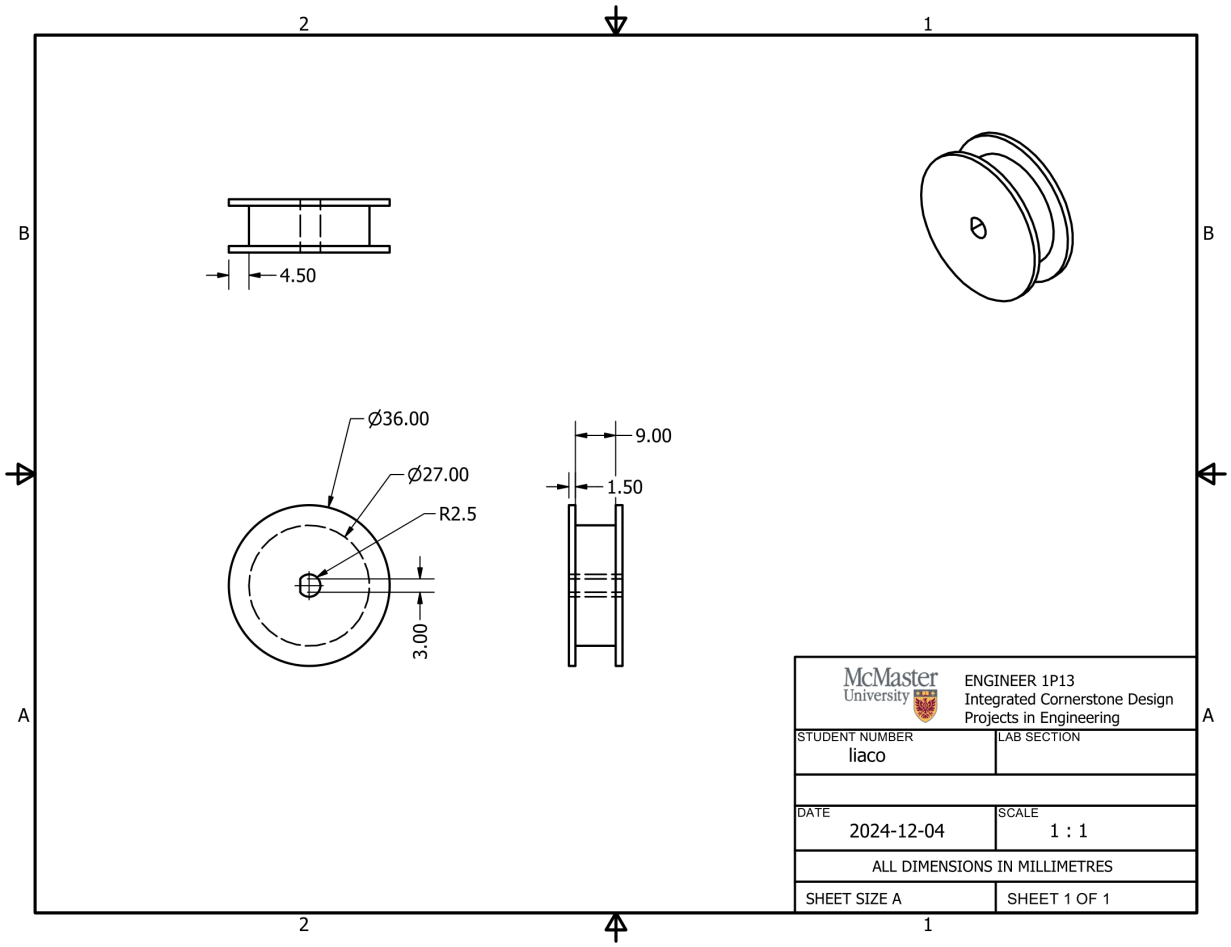
	• Split based on preference and skill level • Last feedback from TA design wise was to edit our model as it was over fabrication time limits.	
5	fleet & passenger • Change any specific cells in the final list from strings to floats to be used later in other functions (e.g. overweight) graphical_Mon46() • Looks good! • Fix the formatting of turtle output later once all functions completed	• Continue working on individual functions • Reschedule print time for failed print in design studio
6	• Keep up the good work • Look to have individual functions ready for next week	• Work on our codes

Appendix C: List of Sources

Material	Density (g/cc)	Yield Strength (MPa)
PLA (3D Printing) [2]	1.25	45-60
Acrylic (Laser Cutting) [2]	1.18	70-110
Aluminum (Other Parts) [2]	2.70	200-600

Appendix D: Supporting Documents

Part	***Designed by***
Pulley	Luca
Slide	Inaaya and Luca
Long Rail	Inaaya and Luca
Short Rail	Inaaya and Luca
Counterweight	Luca
Slide Axle	Luca
Support Shaft	Luca
Slide Strut	Inaaya and Luca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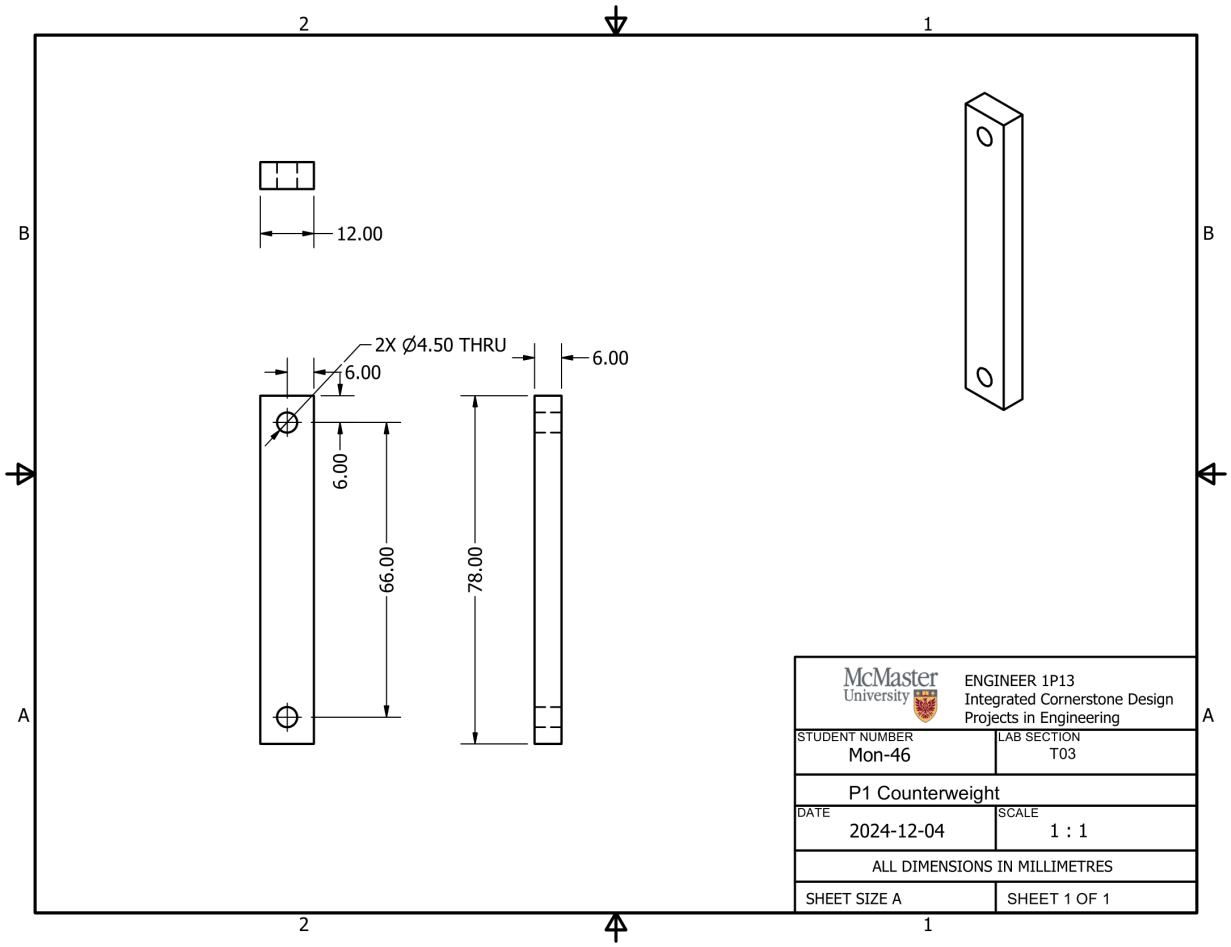
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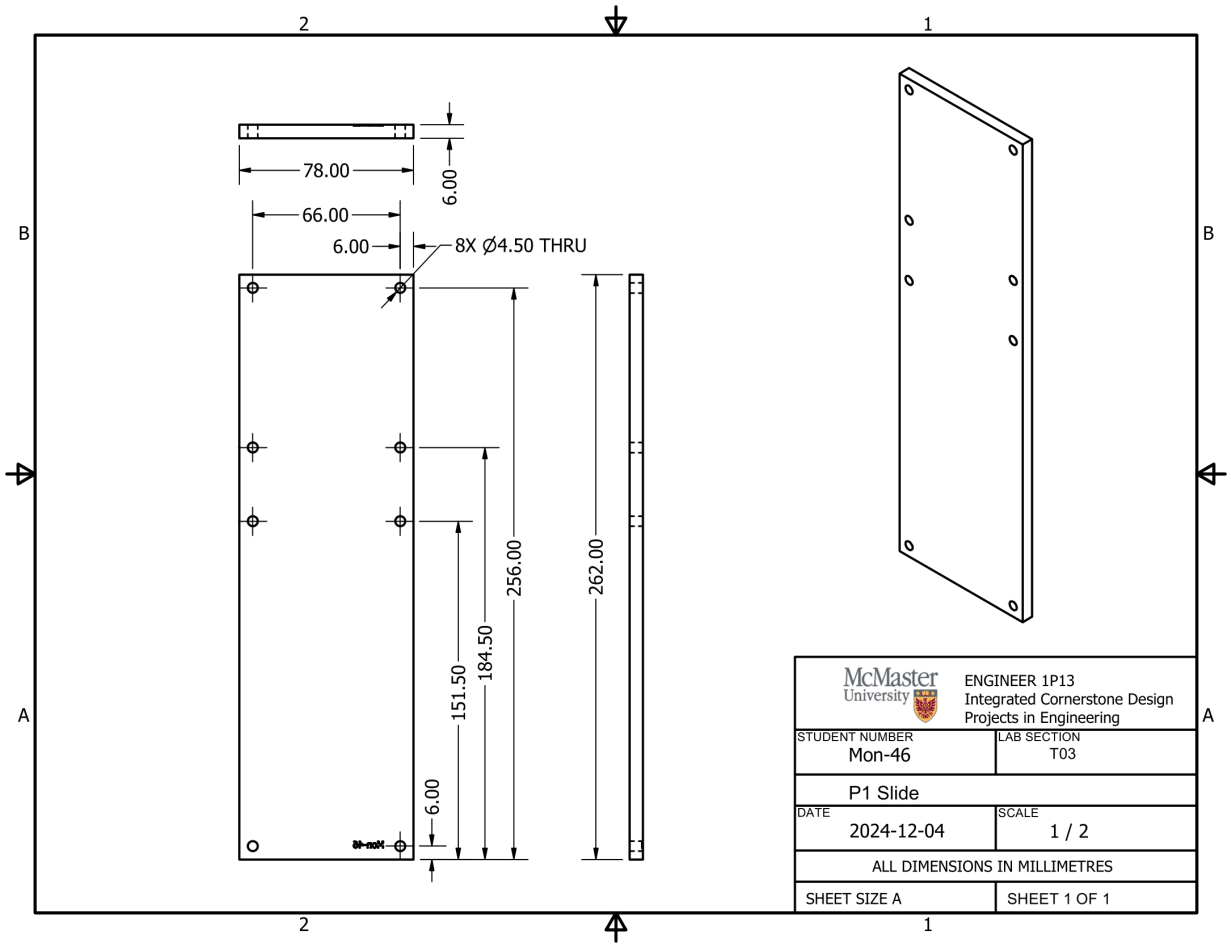
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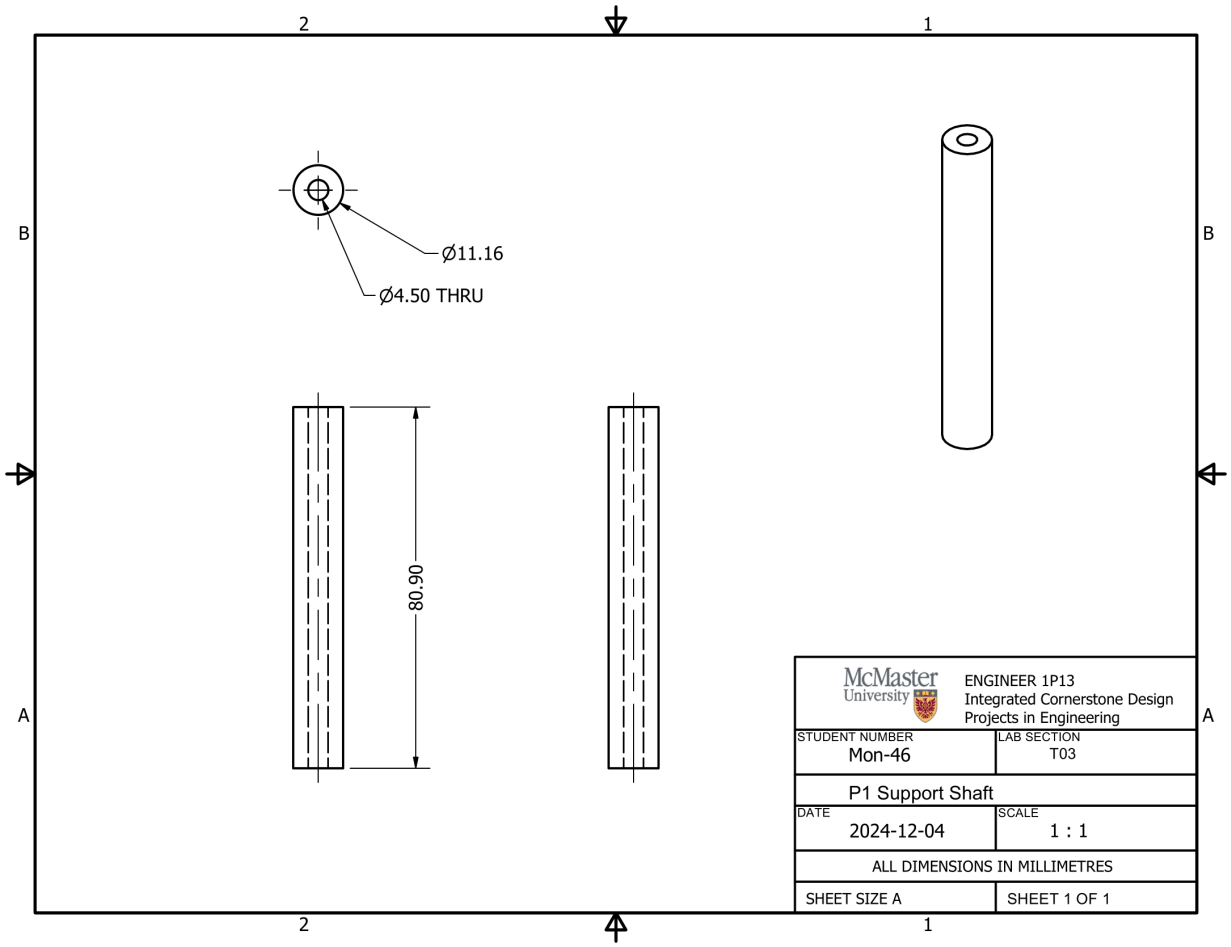
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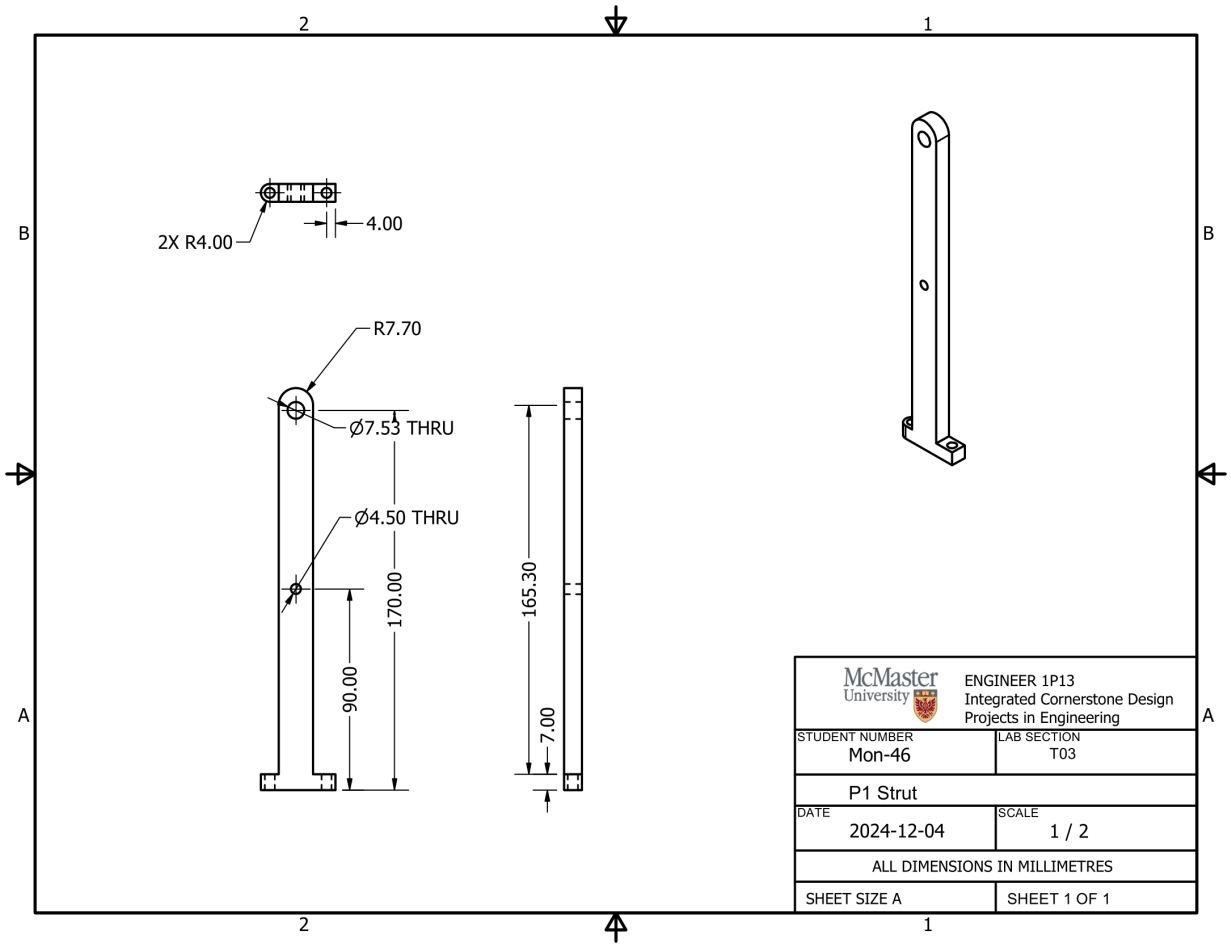
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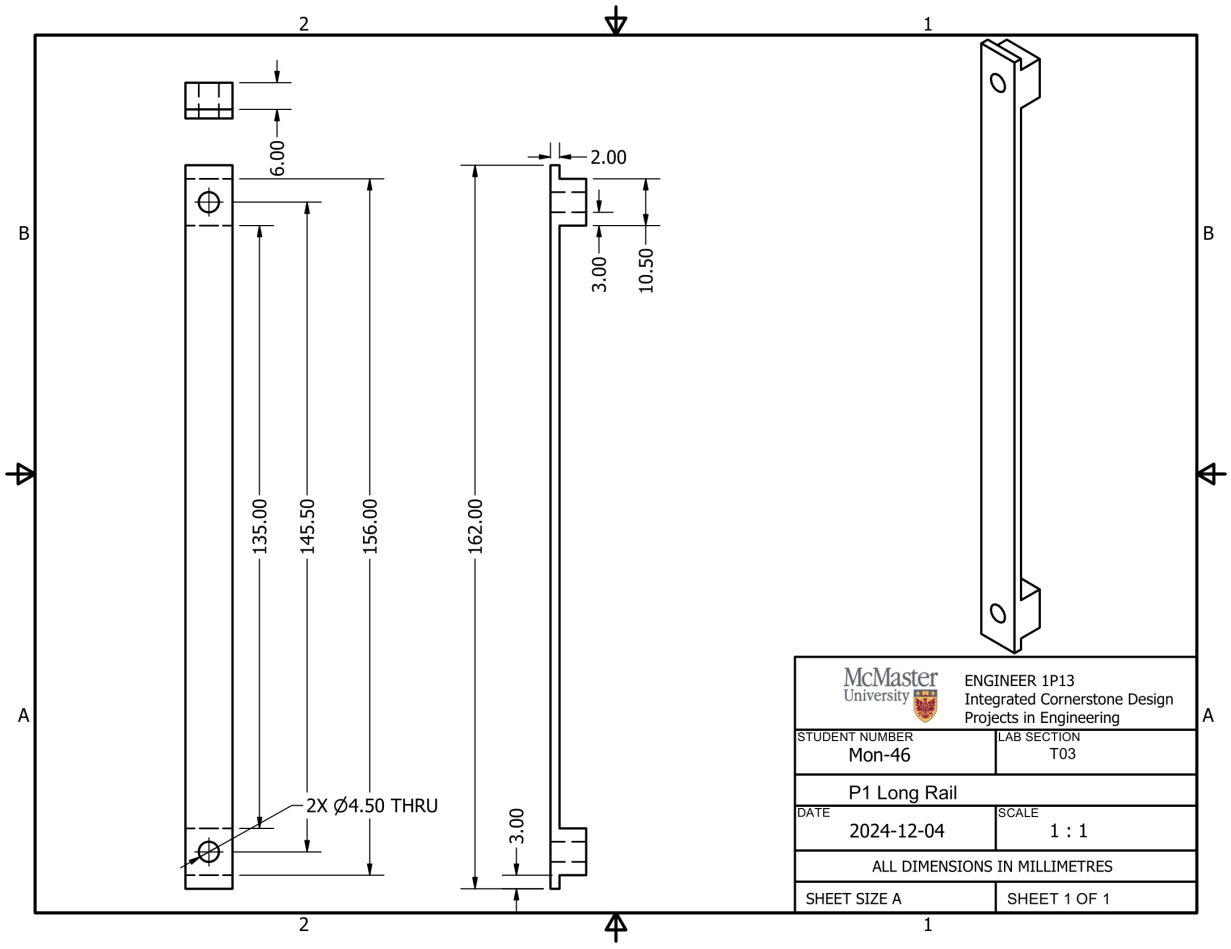
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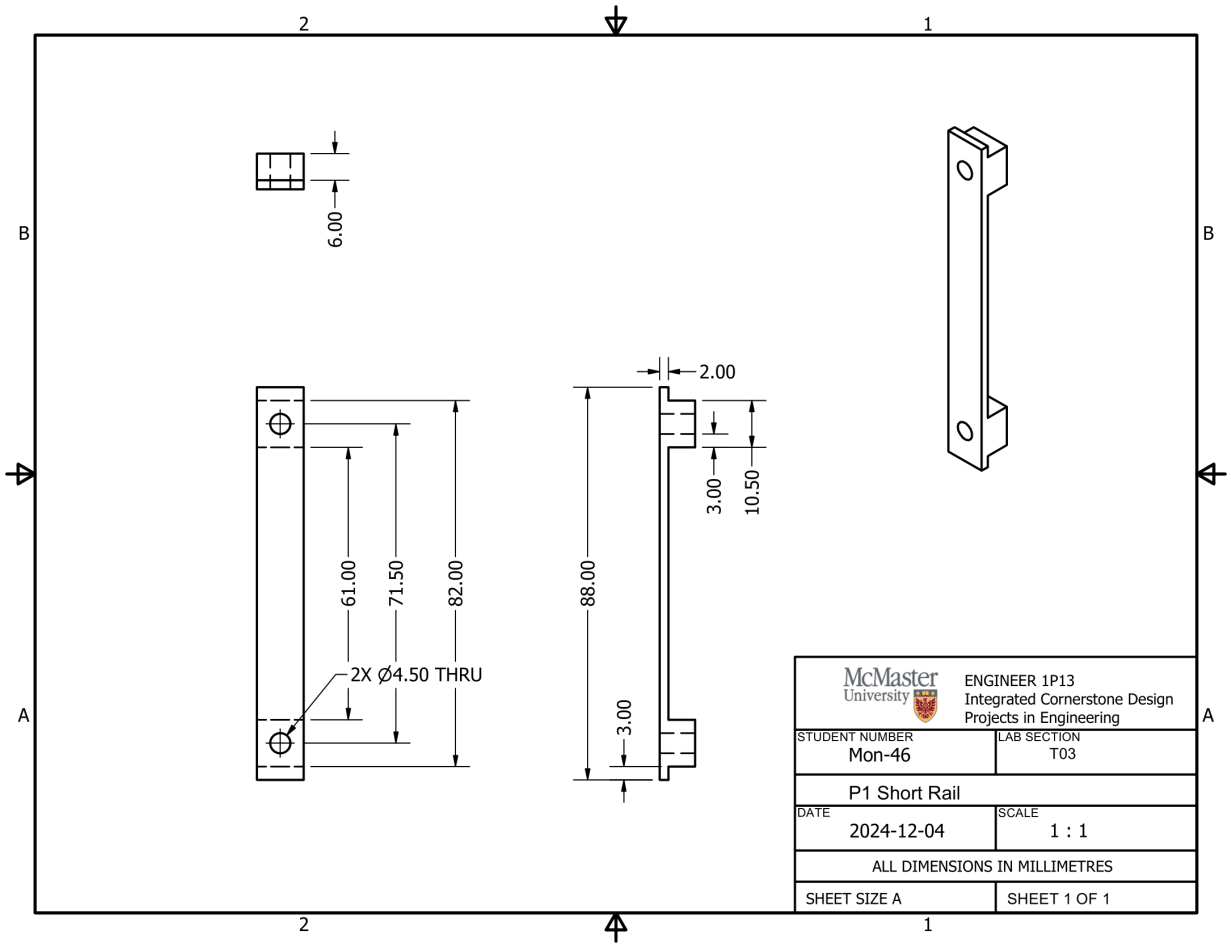
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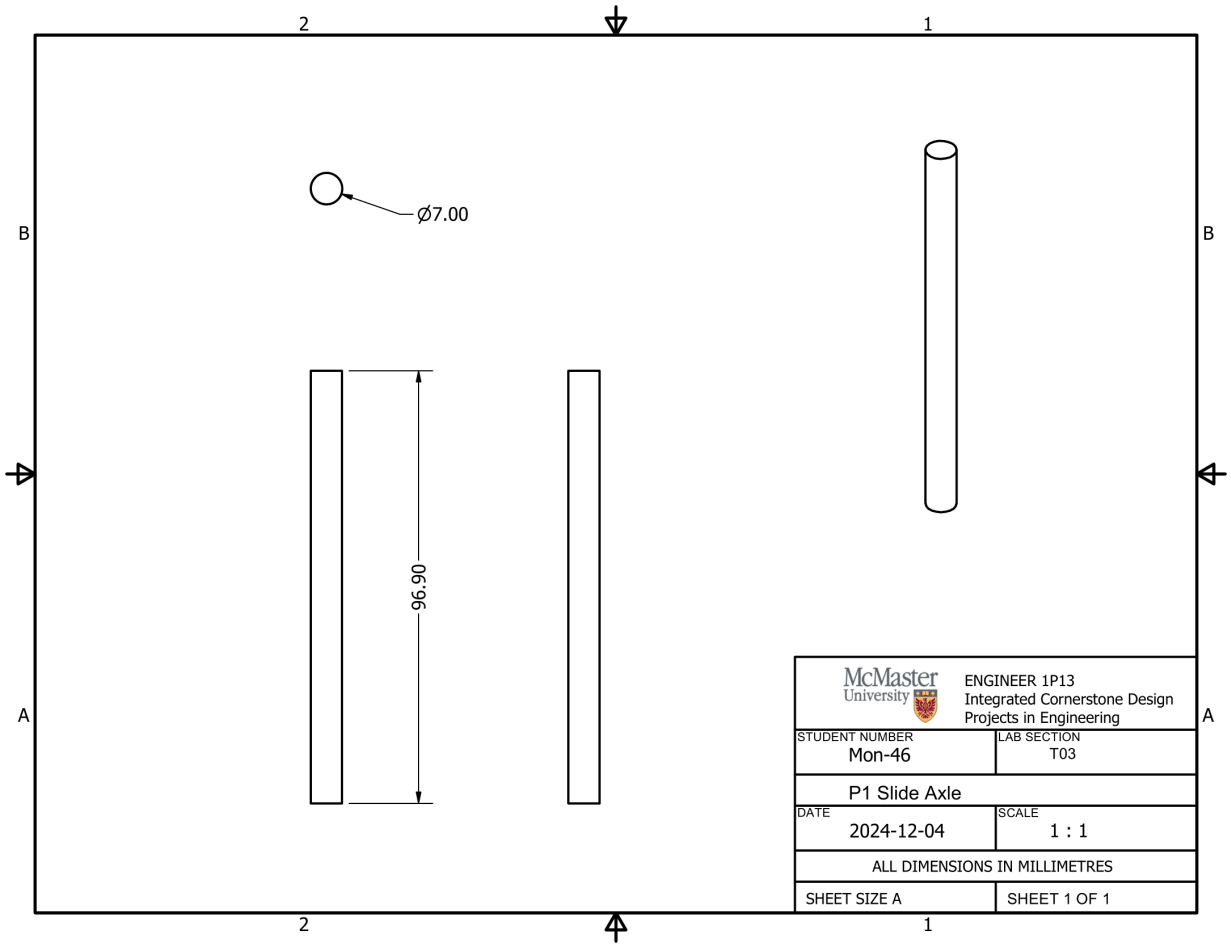
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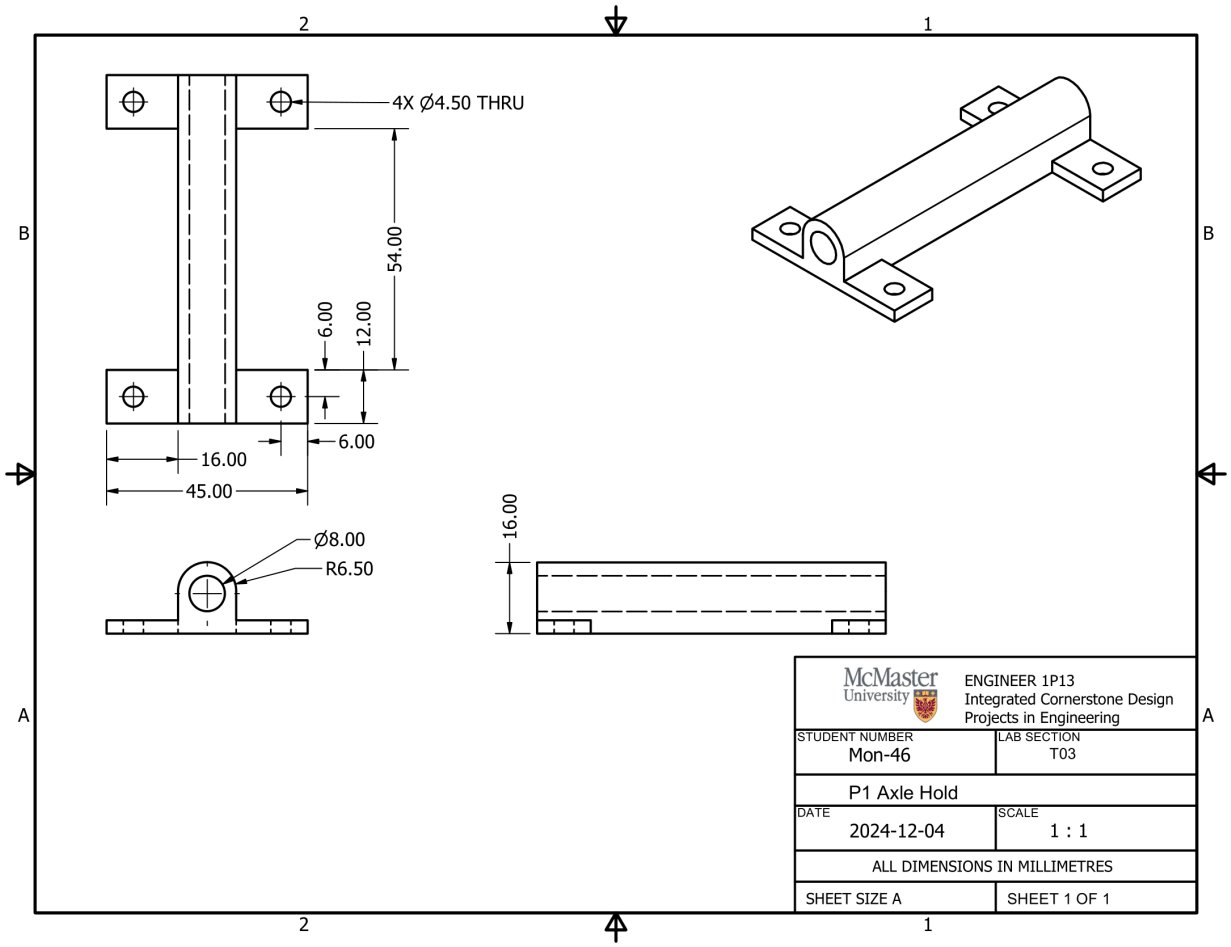
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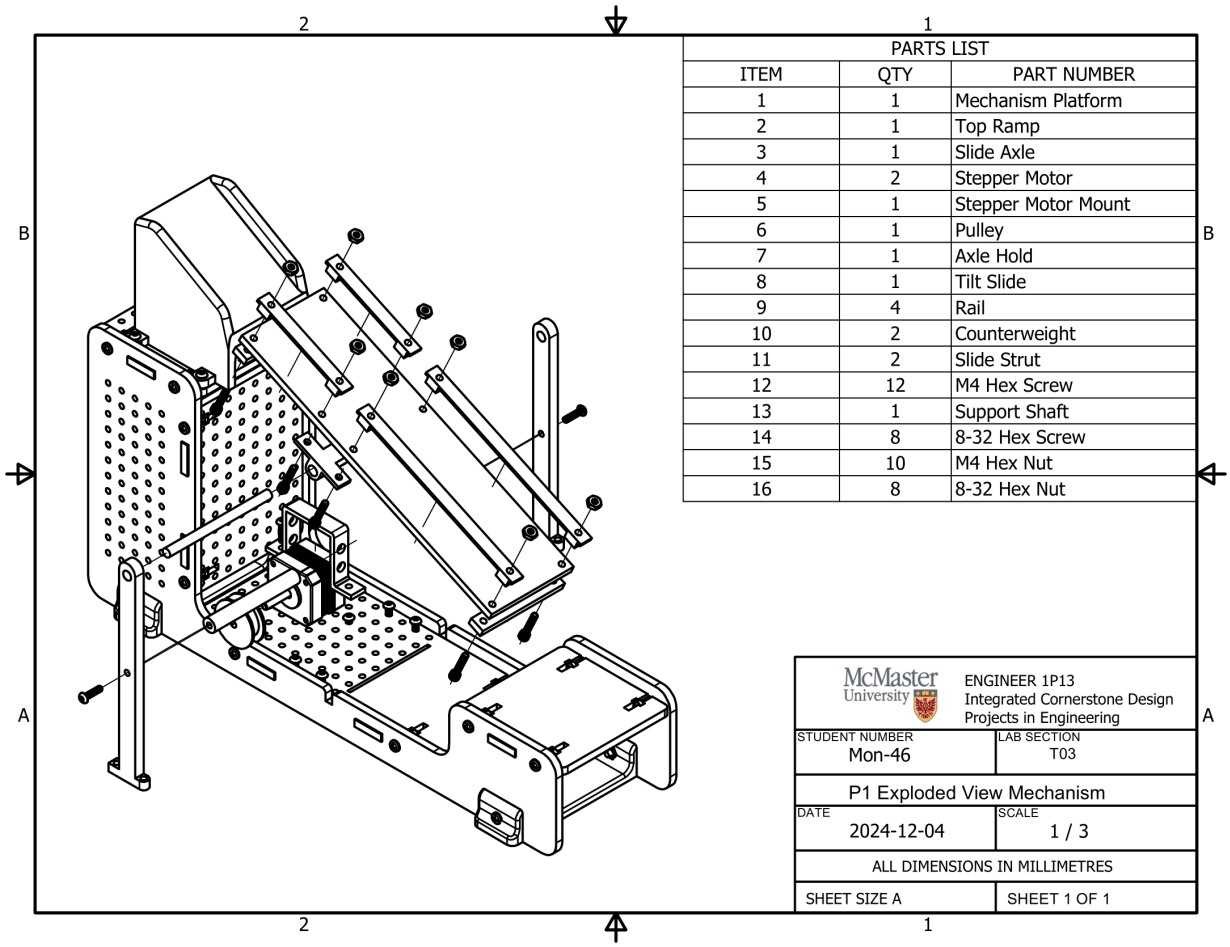
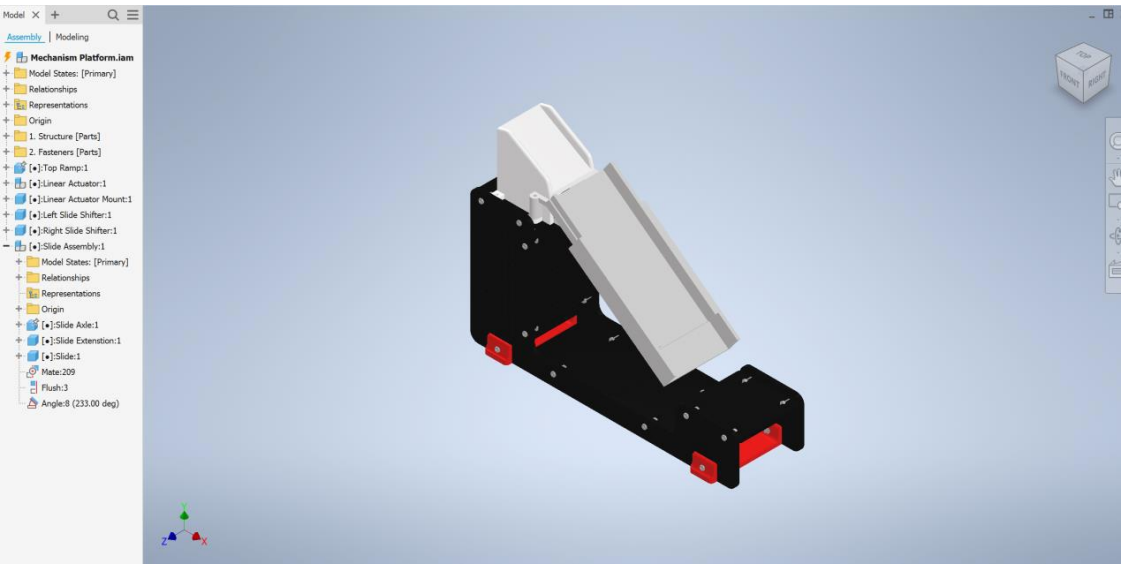


PARTS LIST		
ITEM	QTY	PART NUMBER
1	1	Mechanism Platform
2	1	Top Ramp
3	1	Slide Axle
4	2	Stepper Motor
5	1	Stepper Motor Mount
6	1	Pulley
7	1	Axle Hold
8	1	Tilt Slide
9	4	Rail
10	2	Counterweight
11	2	Slide Strut
12	12	M4 Hex Screw
13	1	Support Shaft
14	8	8-32 Hex Screw
15	10	M4 Hex Nut
16	8	8-32 Hex Nut

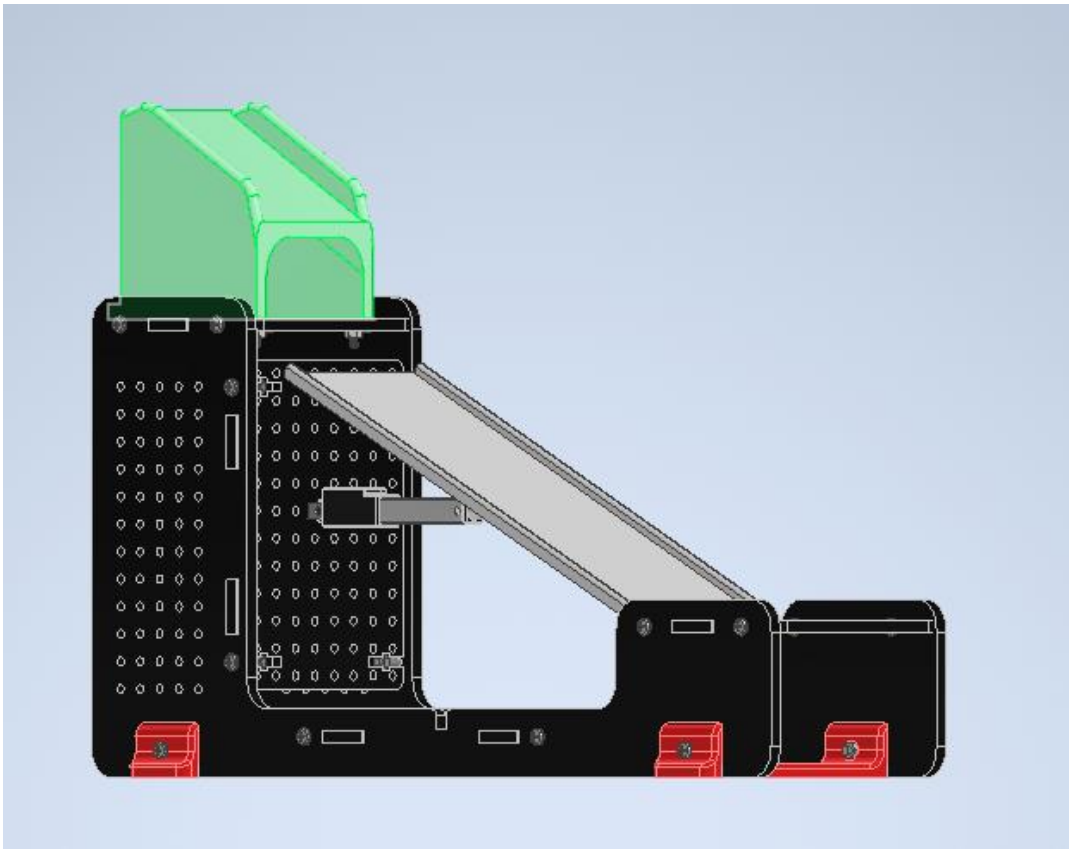
Milestone 2 Designs:

Luca:



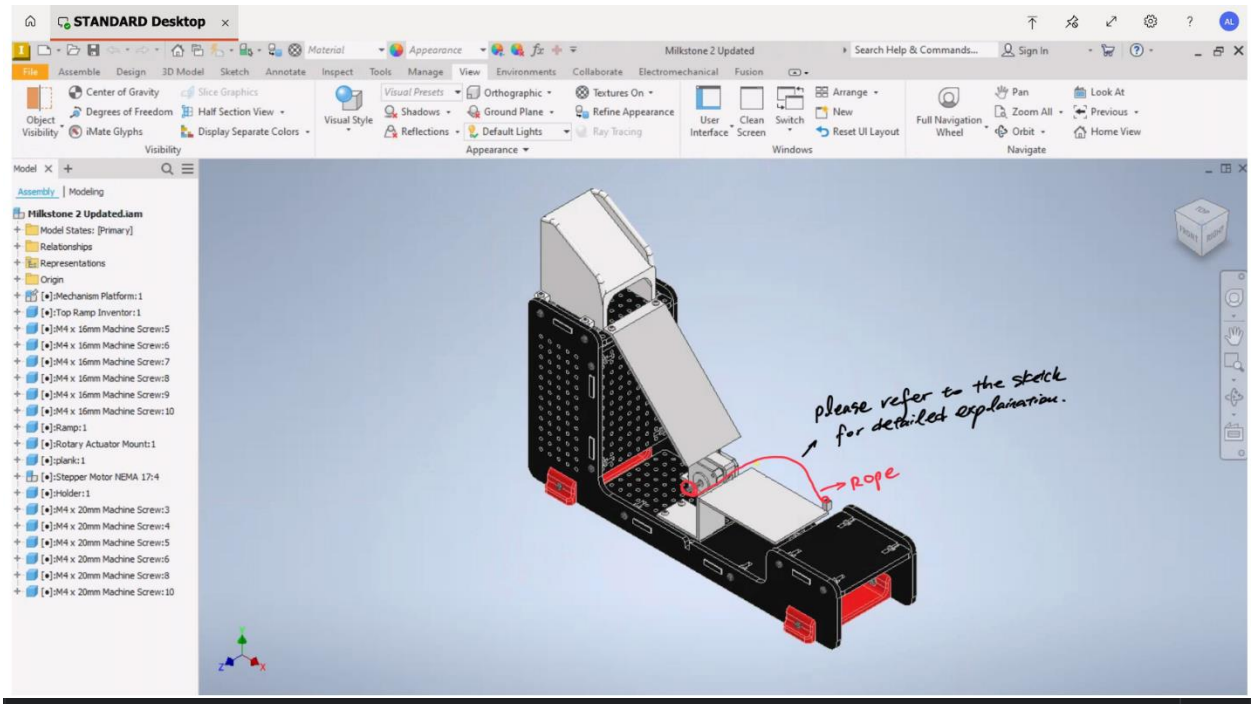

```python
    ##Luca
    def overweight(passengers, fleet):
        '''
        Counts the number of passengers with overweight luggage on each plane

        Parameters
        ----------
        passengers : list
            list of passengers
        fleet : list
            list of planes

        Returns
        -------
        list
            - a list of passengers who are overweight and by what amount
            - a list of each plane and their overweight count

        '''
        ##Initialize empty lists
        passenger_weight = []
        fleet_weight = []

        for plane in fleet:
            overweight_count = 0

            weight_limit = plane[7]

            ##Loop through each passenger and compare their weight to the planes maximum weight
            for passenger in passengers:
                weight = passenger[6]

                if (plane[4] == passenger[2]):
                    ##Append passenger info if overweight
                    if (weight > weight_limit):
                        weight_info = [passenger[0], passenger[1], passenger[2], round(weight - weight_limit, 1)]

                        passenger_weight.append(weight_info)
                        ##Track num of overweight passengers
                        overweight_count += 1

            fleet_weight.append([plane[0], overweight_count])

        return passenger_weight, fleet_weight
```

Ananyaa:



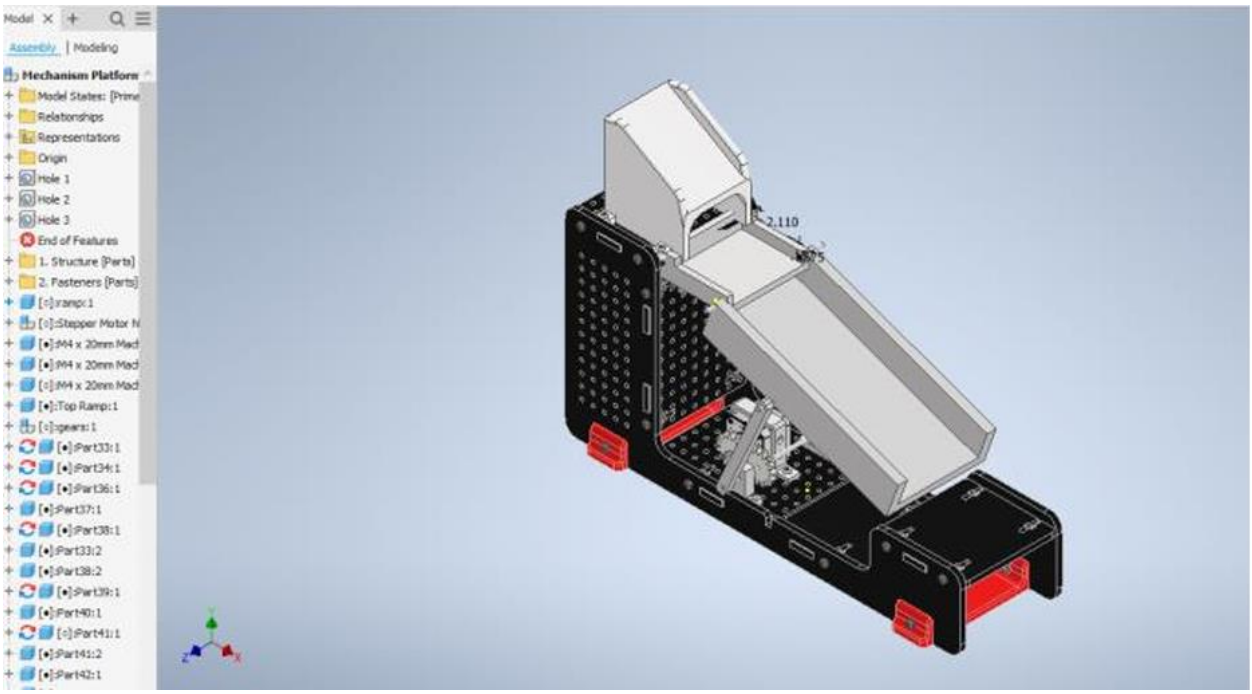
```
def daily_data(passengers,fleet):
    '''
    Counts total number of business and economy seats sold for each plan

    Parameters
    ----------
    passengers : list
        2d list of passengers info

    Returns
    -------
    daily : list
        2d list of total seats sold

    '''
    daily = []
    for plane in fleet:
        gate1 = plane[4] #get gate number
        economy = 0
        business = 0
        for person in passengers:
            gate2 = person[2] #get gate number of person
            if gate1 == gate2: #compare to check if in same flight
                '''check seat type and add to total'''
                gate_seats = [] #sub-list to incldue indivdual gate info
                seat_type = person[3]
                if seat_type == "E":
                    economy += 1
                elif seat_type == "B":
                    business += 1

        gate_seats.append(gate1)
        gate_seats.append(economy)
        gate_seats.append(business)
        daily.append(gate_seats) #add indivdual gate info to overall list


    return daily
```

Anson:



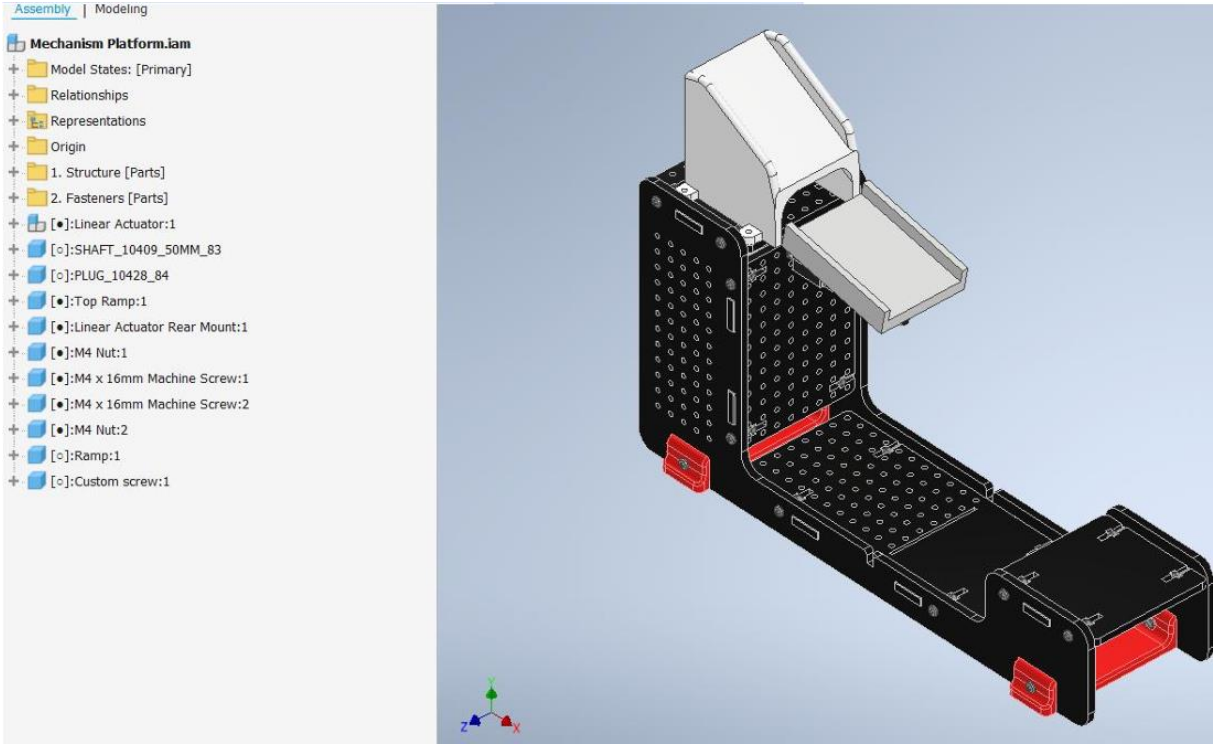

```
1 usage
def time_delay(passenger_data, fleet_data):
    """reports the total number of passengers from all the flights that are going to depart late and layover.
    parameter: passenger_data, fleet_data
    inputs: passenger_data(); fleet_data():
    outputs: produces a 2D list with the plane models and the total number of passengers that will arrive late and have a layov
    """
    final_delayed_passengers = []

    for plane in fleet_data:
        plane_model = plane[0]  # Plane Number
        plane_gate = plane[4]  # Gate Number
        plane_arrival_status = plane[6]  # Arrival status
        late_passenger_count = 0

        # Check if the plane itself is late
        if plane_arrival_status == "Late":
            for passenger in passenger_data:
                passenger_gate = passenger[2]  # Gate for this passenger's flight
                passenger_arrival_status = passenger[5]  # Arrival status for the passenger
                layover_status = passenger[7]  # Layover status for the passenger

                if passenger_gate == plane_gate and passenger_arrival_status == "Late" and layover_status == "Layover":
                    late_passenger_count += 1

            final_delayed_passengers.append([plane_model, late_passenger_count])

    return final_delayed_passengers

print(time_delay(passenger_data(), fleet_data()))
```

Inaaya:




```python
##Inaaya
def oversold(passenger_data, fleet_data, daily_data):
    '''
    Creates a 2d list of the number of oversold seats in economy and business for each flight

    ***NOTE - passenger_data is not used as fleet_data has the number of each seat type
    and daily_data has the number of sold seats for eahc plane, thus the difference is the
    number of seats oversold

    Parameters
    ----------
    passenger_data : 2d list
        list of passengers
    fleet_data : 2d list
        list of plane data
    daily_data : 2d list
        list of seat information for each plane

    Returns
    -------
    oversold_business_seats : 2d list
        list of each plane and the number of oversold busines seats
    oversold_economy_seats : 2d list
        list of each plane and the number of oversold economy seats

    '''

     # Initializing empty lists for both oversold business and economy class seats
    oversold_business_seats = []
    oversold_economy_seats = []


    # Finding the plane model and number of availlable business and economy seats in each plane
    for plane in fleet_data:
        model = plane[0]
        available_business_seats = plane[1]
        available_economy_seats = plane[2]
        gate = plane[4]

        # Find where the gates are the same in fleet_data and daily_data, and record the number of sold seats for each class in the corresponding plane model
        for seat_info in daily_data:
            if seat_info[0] == gate:
                sold_business_seats = seat_info[1]
                sold_economy_seats = seat_info[2]

                # Calculating how many oversold seats there are
                oversold_business = sold_business_seats - available_business_seats
                oversold_economy = sold_economy_seats - available_economy_seats

                # If there are oversold seats, append the oversold seats lists, if there are no oversold seats or left over seats, append the list with "0"
                if oversold_business > 0:
                    oversold_business_seats.append([model, oversold_business])
                elif oversold_business <= 0:
                    oversold_business_seats.append([model, 0])

                if oversold_economy > 0:
                    oversold_economy_seats.append([model, oversold_economy])
                elif oversold_economy <= 0:
                    oversold_economy_seats.append([model, 0])

                break

    return oversold_business_seats, oversold_economy_seats
```

Areeb:




```
##Areeb
def layover(passengers, fleet):
    '''
    Purpose: Tracking number of passengers per plane with layovers while documenting their
    names and gate.
    Input: List of passenger data and list of fleet data
    Output: 2-D list containing how many passenger with layovers each plane has and another 2-D list
    containing the first name, last name and gate of each passenger with a layover.
    '''
    plane_layover = [] #contains layover count for each plane
    passenger_layover = [] #contains info on passengers with layovers
    for person_information in passengers: #Goes through each person's info

        if person_information[7] == 'Layover':

            temporary_info = [] #Temporary list is intialized to store passenger info

            temporary_info.append(person_information[0]) #first name appended to temporary list
            temporary_info.append(person_information[1]) #first letter of last name appended
            temporary_info.append(person_information[2]) #gate appended to temporary list
            passenger_layover.append(temporary_info) #temporary list appended to passenger_layover list


    for plane_info in fleet:
        temporary_info = []
        temporary_info.append(plane_info[0]) #plane model appended to temporary list
        temporary_info.append(plane_info[4]) #gate corresponding to plane model appended
        plane_layover.append(temporary_info) #temporary list appended to plane_layover list


    for layover_info in plane_layover:
        gate2 = layover_info[1] #gate for each plane is recorded in this variable
        layover_counter = 0 #layover counter initialized

        for person_information in passenger_layover: #goes through each passenger with layoer's info
            gate = person_information[2] #gate for each passenger is recorded

            if gate in gate2: #Since passenger_layover list only includes passengers with layover each time a certain gate appears in the list, layover counter is added to that specifc plane.
                layover_counter += 1

            layover_info[1] = layover_counter #Gate for corresponding plane is replaced by the number of layovers for that plane

    return plane_layover, passenger_layover
```

Appendix E: Design Studio Worksheets

Team-46 Submissions:

MILESTONE 0 (TEAM): COVER PAGE

Team ID: Mon-46

Please list full names and MacID's of all *present* Team Members

Full Name:	**MacID:**
Ananyaa Rai	raia25
Inaaya Lalani	lalani4
Luca Iacovelli	iacovell
Anson Liang	lianj26
Areeb Rahman	rahmaa94

Any student that is ***not*** present for Design Studio will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their P-1 grade.

Insert your Team Portrait in the dialog box below

Team Portrait


MILESTONE 0 – TEAM CHARTER

Team ID: Mon-46

Project Leads:

Identify team member details (Name and MacID) in the space below.

Role:	Team Member Name:	MacID
Manager	Luca	iacovell
Administrator	Inaaya	lalani4
Coordinator	Ananyaa	raia25
Subject Matter Expert	Anson	lianj26
Subject Matter Expert	Areeb	rahmaa94

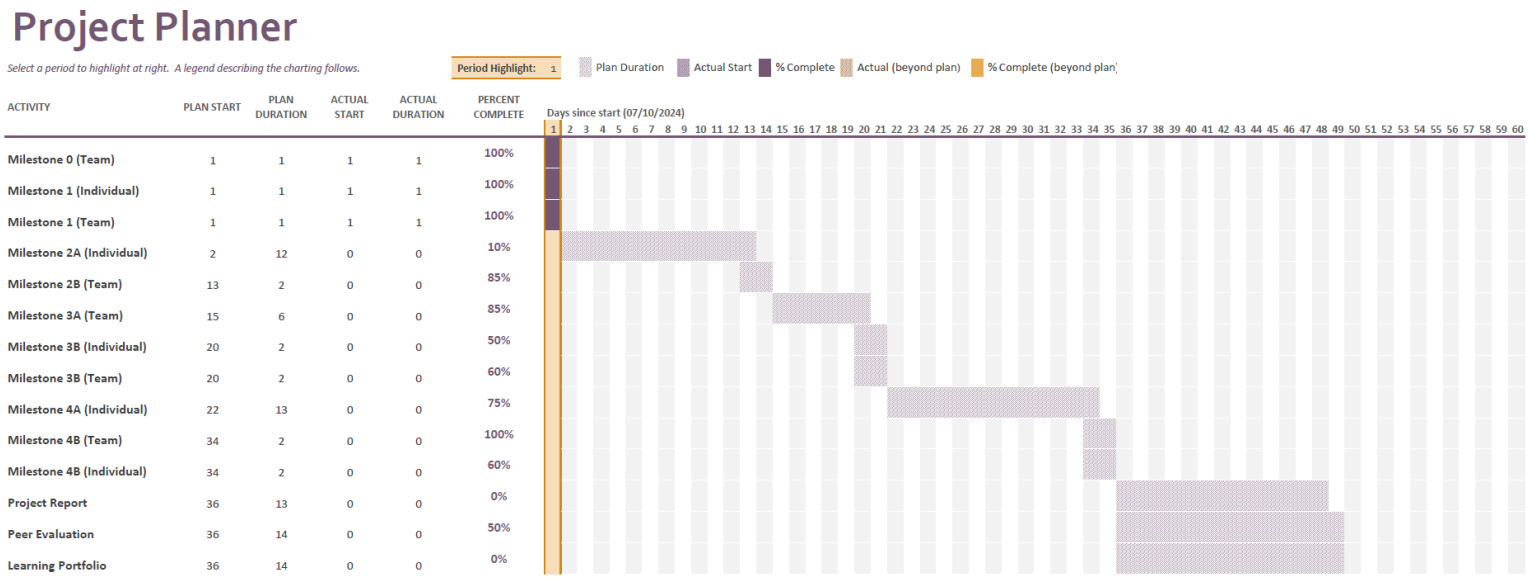
MILESTONE 0 – PRELIMINARY GANTT CHART (TEAM MANAGER ONLY)

Team ID: Mon-46

Only the **Project Manager** is completing this section!

Full Name of Team Manager:	**MacID:**
Luca Iacovelli	iacovell

Preliminary Gantt chart



MILESTONE 1 (TEAM): COVER PAGE

Team ID: Mon-46

Please list full names and MacID's of all *present* Team Members

Full Name:	**MacID:**
Ananyaa Rai	raia25
Inaaya Lalani	lalani4
Luca Iacovelli	iacovell
Anson Liang	lianj26
Areeb Rahman	rahmaa94

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MILESTONE 1 (STAGE 1) – PROBLEM STATEMENT, OBJECTIVES AND CONSTRAINTS

Team ID: Mon-46

Write out your initial problem statement in the box below.

Initial Problem Statement
To design an automated system to speed up the check-in process for passengers as well as streamlining the baggage filtering process, minimizing lost luggage.

List out your functions, objectives and constraints in the box below.

Functions	Objectives	Constraints

• Transfer luggage between platforms
• Categorizing different types of luggage based off of airline/airport regulations
• Scanning tickets and bag tags
	- Should have a durable structure
	- Should be able to complete the task quickly
	- Able to function in a small area of space
	- Successful rate should be between 75%-85%
		• Restriction line
		• Limited mounting area (TBD):
		  ○ Base:b mm^2
		  ○ Walls:w mm^2
		• Weight (TBD): m g
		• Material used
		• Machinery limitations (Q-Arm overheating etc.)
		• Force output vs speed of actuators

MILESTONE 1 (STAGE 3) – INFORMAL TA CHECK-IN

During and after your informal TA check-in document their feedback in the box below.

Feedback

• Everything looks good in our initial problem statement as well as FOCs
• Overall feedback on sketches:
  ○ Consider the limitations of the actuators, look into implementing both in your ideas if needed
  ○ Also remember to consider how these mechanisms will work in reality
• Feedback on individual sketches:
  ○ Luca: rotary actuator doesn't have enough force
  ○ Inaaya: ensure it's mounted to remove any degrees of freedoms
  ○ Ananyaa: use rotary actuator to bring out the ramp
  ○ Areeb: isn't generating the speed that you need. As a whole concept it works maybe not realistic however
  ○ Anson: in most cases the linear actuator won't have enough distance, maybe add another actuator to get the final stretch required

List out action items to address any of your team's concerns and your TA's feedback

Action Items
• Revise our sketches to inline with TA's feedback (overall and individual) • Looking forward to next week, consider the process of modeling these sketches in Autodesk

MILESTONE 2 (TEAM) – COVER PAGE

Team ID: Mon-46

Please list full names and MacID's of all *present* Team Members

Full Name:	**MacID:**
Ananyaa Rai	raia25
Inaaya Lalani	lalani4
Luca Iacovelli	iacovell
Anson Liang	lianj26
Areeb Rahman	rahmaa94

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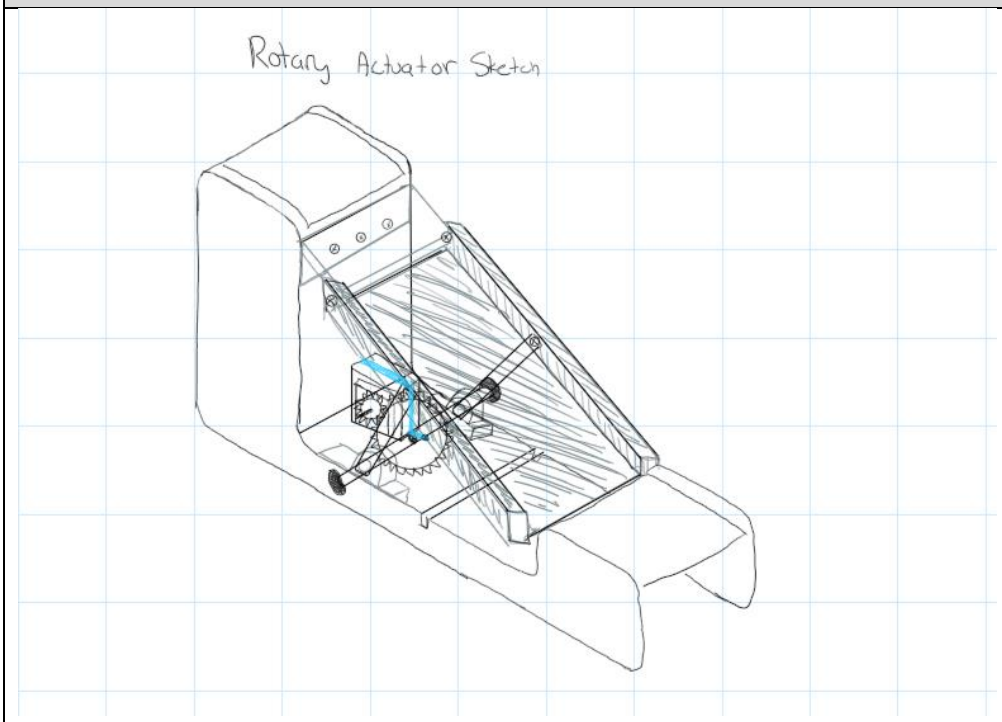
MILESTONE 2 (STAGE 2) – MECHANISM DECISION AND CAD MODEL

Team ID: Mon-46

Attach your teams chosen finalized mechanism concept sketch in the following box

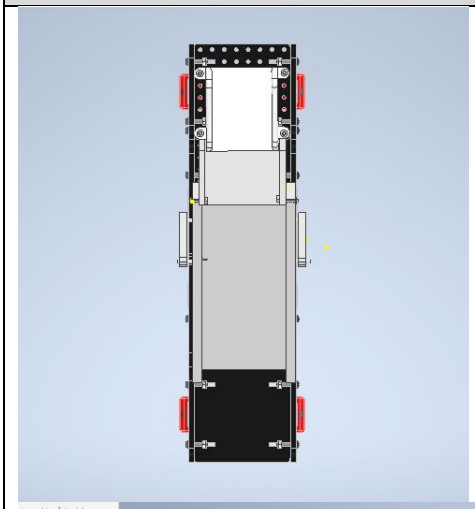
Finalized Concept Sketch


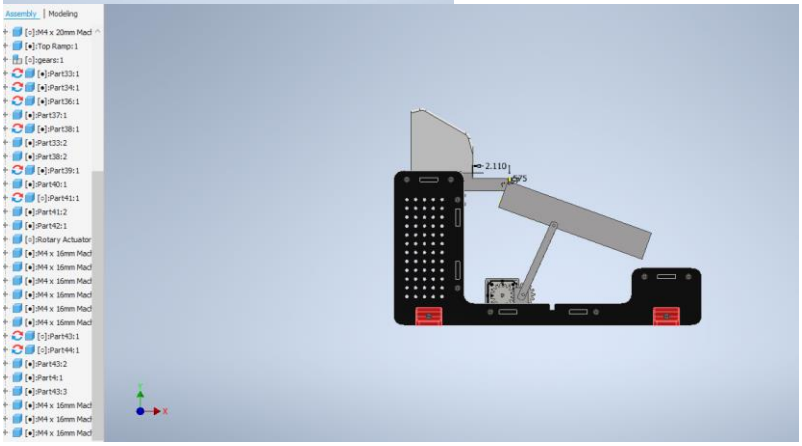
Justify why your team chose this design

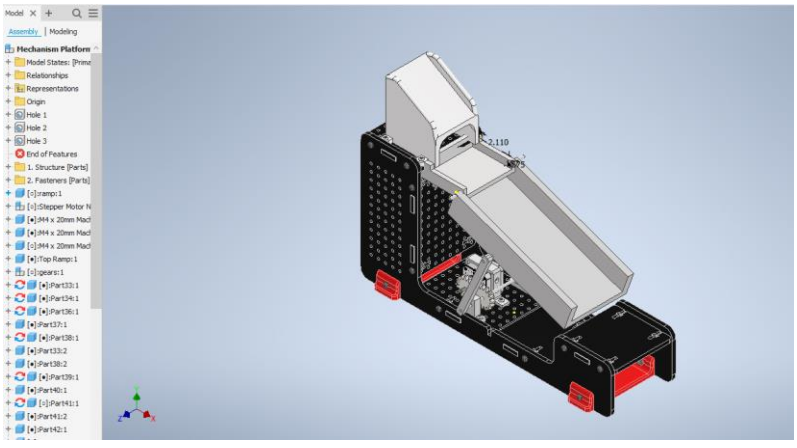
Justification
We chose this design as it was realistic and accommodated for all the constraints that we listed in the previous milestone. It's ability to be deployed AND retracted easily using the same mechanism seems efficient and effective. The group also conceptualized a similar mechanism using a linear actuator and a string to pull the slide down and a weight to move it back into place.

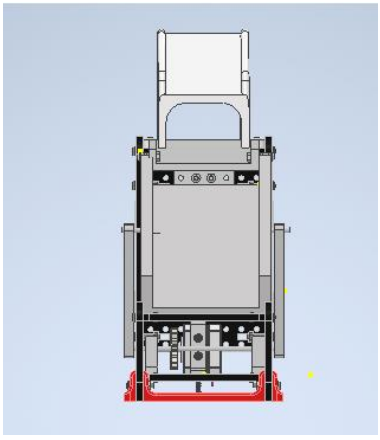
Attach multiple screenshots of different views of your CAD model to the following box

CAD Model Screenshots









Changes we are making:

- Using a linear actuator instead of rotary actuator
    - This addresses our biggest concern of power as the linear actuator would efficiently produce the power needed to extend the ramp.
    - Additionally, the overall concept becomes simpler as we remove any extra parts such as the gears and axels required initially.
- To allow the linear actuator to work with the concept, a string is connected to the actuator when fully extended. We then pull the actuator in, releasing the tension in the string, resulting in the ramp extending. This idea is used in reverse to bring the ramp back in.

MILESTONE 2 (STAGE 3) – INFORMAL TA CHECK-IN

During and after your informal TA check-in document their feedback in the box below.

Feedback
• Might be an issue with retracting the ramp using the rotary actuator   - Fully constrain it on inventor to make sure it extends and retracts properly • Determine what other properties need to be fixed/adjusted • Take into consideration the weight of the ramp and if the actuators will have enough force/torque to move it

List out action items to address any of your team's concerns and your TA's feedback

Action Items
• Consider cutting holes in the ramp and making it thinner, making it weigh less, which would allow the actuators to move it • Add constraints to the ramp pre-emptively to make sure it works

WORK PERIOD: FABRICATION TIME – COVER PAGE

Team ID: Mon-46

Please list full names and MacID's of all *present* Team Members

Full Name:	**MacID:**
Ananyaa Rai	raia25
Inaaya Lalani	lalani4
Luca Iacovelli	iacovell
Anson Liang	lianj26
Areeb Rahman	rahmaa94

Any student that is ***not*** present for their scheduled Lab-B session will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their P-1 grade.

WORK PERIOD: FABRICATION TIME (STAGE 1) – INFORMAL TA CHECK-IN

Team ID: Mon-46

During and after your informal TA check-in document their feedback in the box below.

What Was Presented

• Luca did the math, and we found that the counterweight should be1-2 kgs at most
• 3D print the pully, slits and ramp
  ○ pully needs to be smooth so we can sand if necessary
  ○ ramp do be possibly printed on Wednesday
• On track with the Gantt chart right now and we hope to have the 2 weeks near the end to fix any issues that arise when assembling

Feedback
• Look into how you are connecting the counterweight and what will it be? • Ensure all fabricated parts fit the time limit   ○ Currently the ramp was too long to 3D print and takes too much time

List out action items to address any of your team's concerns and your TA's feedback

Action Items
• Consider laser cutting the ramp as it will save time   ○ 3D print any connection parts required to connect the ramp

MILESTONE 3 (TEAM) – COVER PAGE

Team ID: Mon-46

Please list full names and MacID's of all *present* Team Members

Full Name:	**MacID:**
Inaaya Lalani	lalani4
Ananyaa Rai	raia25
Luca Iacovelli	iacovell
Areeb Rahman	rahmaa94
Anson Liang	lianj26

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MILESTONE 3 (STAGE 1) – FUNCTION ASSIGNMENT

Team ID: Mon-46

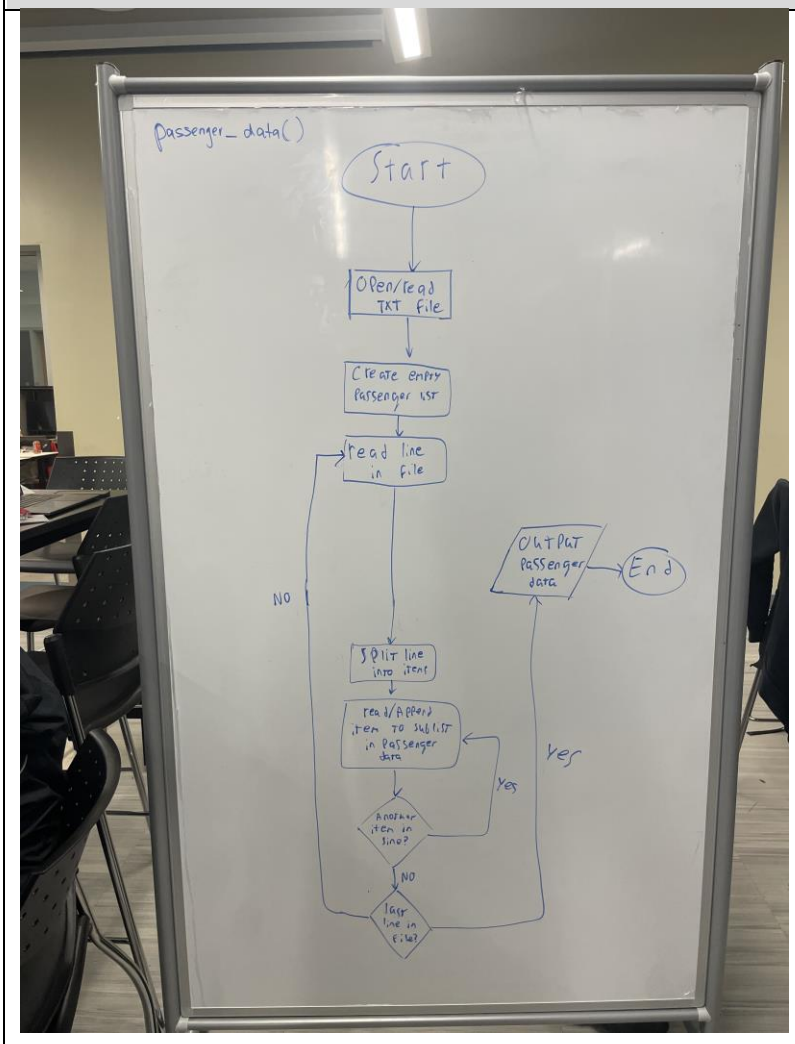
Using the table below assign each function to one member of your team. Only assign the fifth function time_delay() if your team has five members you may delete the box otherwise.

Function	Full Name	MacID
daily_data()	Ananyaa Rai	raia25
oversold()	Inaaya Lalani	lalani4
overweight()	Luca Iacovelli	iacovell
layover()	Areeb Rahman	rahmaa94
time_delay()	Anson Liang	lianj26

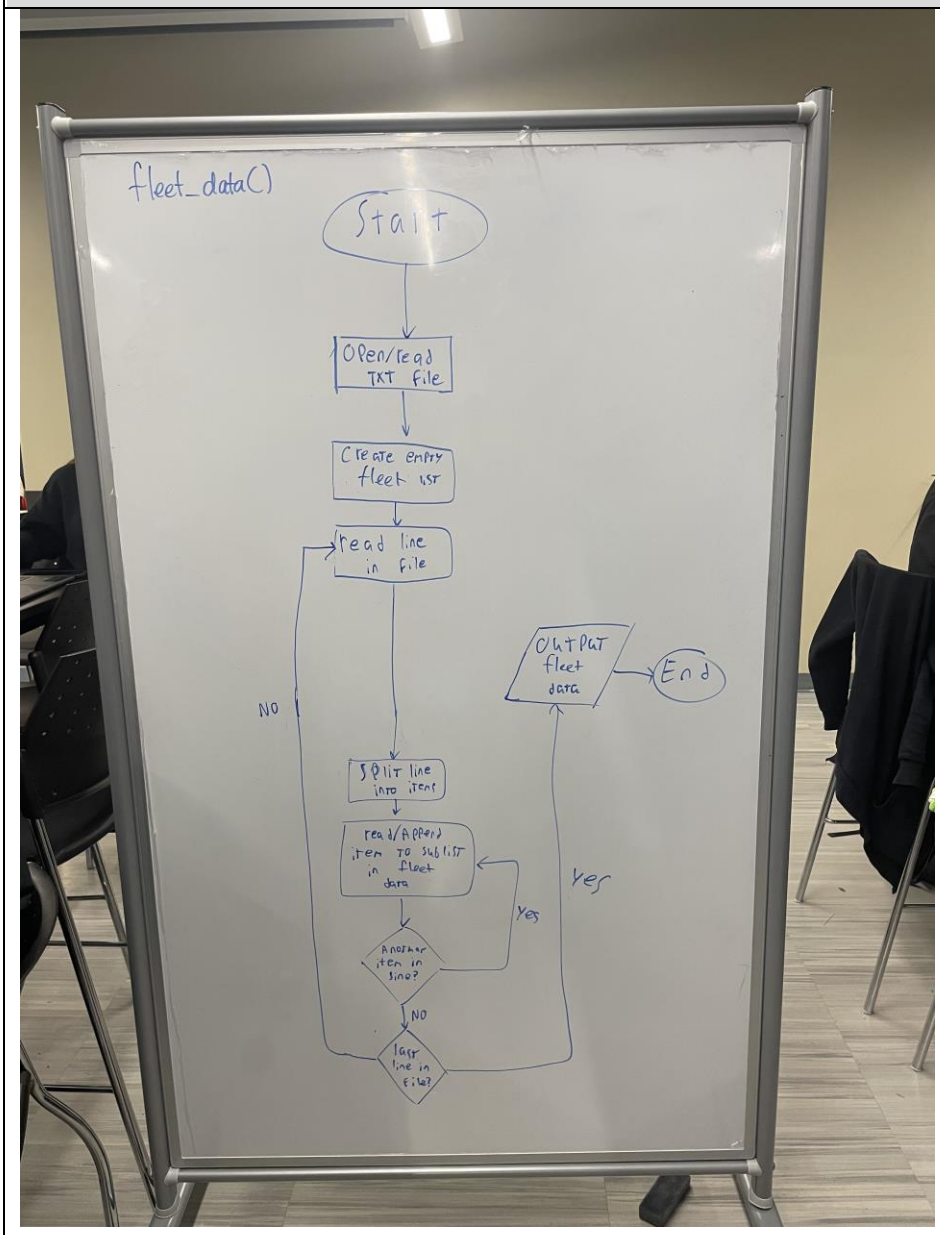
MILESTONE 3 (STAGE 2) – FLOWCHART

Insert images of flowcharts in the boxes below for the three group functions: passenger_data(), fleet_data() and graph_teamID().

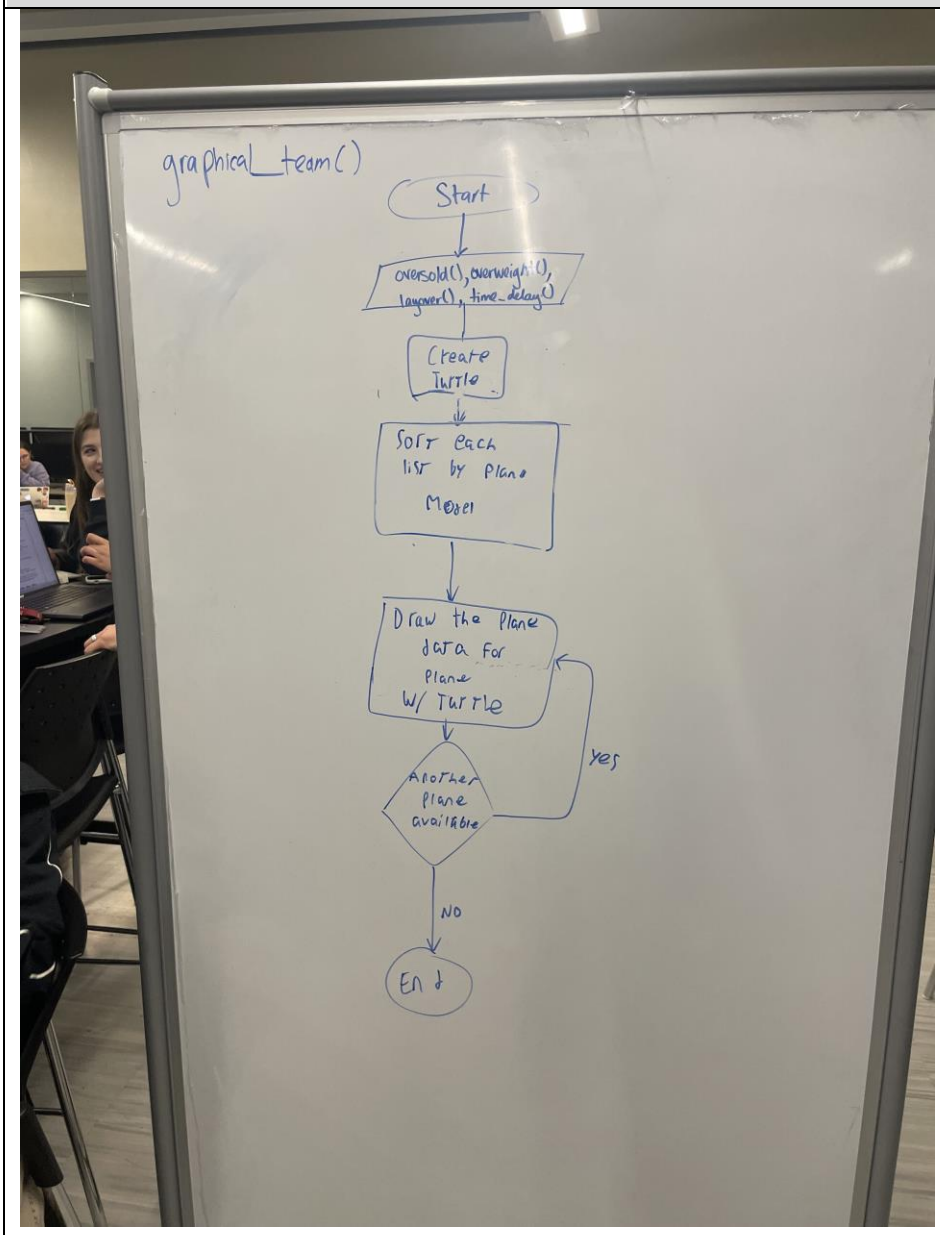
passenger_data()



fleet_data()


fleet_data()
Start
Open/read TXT file
Create empty fleet list
read line in file
SPLIT line into items
read/Append item TO sublist in fleet data
Another item in line?
Yes
NO
last line in File?
NO
Yes
OUTPUT fleet data
End

graph_teamID()



MILESTONE 3 (STAGE 4) – INFORMAL TA CHECK-IN

During and after your informal TA check-in document their feedback in the box below.

What we presented
• Completed the three team function flow charts • We went over the individual functions as a group and assigned them to each member   ○ Split based on preference and skill level • Last feedback from TA design wise was to edit our model as it was over fabrication time limits.

Feedback
GREAT JOB!

List out action items to address any of your team's concerns and your TA's feedback

Action Items
N/A (everything look good)

WORK PERIOD: CODE YOUR FUNCTION – COVER PAGE

Team ID: Mon-46

Please list full names and MacID's of all *present* Team Members

Full Name:	**MacID:**
Ananyaa Rai	raia25
Luca Iacovelli	iacovell
Areeb Rahman	rahmaa94
Anson Liang	lianj26
Inaaya Lalani	lalani4

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WORK PERIOD: CODE YOUR FUNCTION (STAGE 1) – INFORMAL TA CHECK-IN

Team ID: Mon-46

During and after your informal TA check-in document their feedback in the box below.

Feedback
fleet & passenger • Change any specific cells in the final list from strings to floats to be used later in other functions (e.g. overweight) graphical_Mon46() • Looks good! • Fix the formatting of turtle output later once all functions completed

List out action items to address any of your team's concerns and your TA's feedback

Action Items
• Continue working on individual functions • Reschedule print time for incident in design studio

MILESTONE 4 (TEAM) – COVER PAGE

Team ID: Mon-46

Please list full names and MacID's of all *present* Team Members

Full Name:	**MacID:**
Luca Iacovelli	iacovell
Anson Liang	lianj26
Ananyaa Rai	raia25
Areeb Rahman	rahmaa94
Inaaya Lalani	lalani4

Any student that is ***not*** present for their scheduled Design Studio session will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their P-1 grade.

MILESTONE 4 (STAGE 1) – ACTUATOR CODE

Team ID: Mon-46

Insert screenshots of your actuator code to the box below.

Actuator Code Screenshots
bot.activate_stepper_motor() time.sleep(2) bot.rotate_stepper_cw(5) time.sleep(2) bot.rotate_stepper_ccw(5)

MILESTONE 4 (STAGE 2) – Q-ARM CODE

Insert screenshots of your Q-Arm code to the box below.

Q-Arm Code Screenshots

```
#pick up suitcase
def pick_up():
    arm.rotate_base(-90)
    time.sleep(2)
    arm.rotate_shoulder(-5)
    time.sleep(2)
    arm.rotate_elbow(50)
    time.sleep(2)
    arm.control_gripper(45)

#move to rejection bin
def rejection_bin():
    arm.rotate_elbow(-50)
    time.sleep(2)
    arm.rotate_shoulder(5)
    time.sleep(2)
    arm.rotate_base(90)
    time.sleep(2)
    arm.rotate_base(90)

#drop suitcase
def drop_suitcase_platform():
    arm.rotate_shoulder(45)
    time.sleep(2)
    arm.control_gripper(-5)
```

```
def drop_suitcase_rejection():
    arm.rotate_shoulder(35)
    time.sleep(2)
    arm.rotate_elbow(35)
    time.sleep(2)
    arm.control_gripper(-5)

#move to platform
def platform():
    arm.rotate_elbow(-50)
    time.sleep(2)
    arm.rotate_shoulder(5)
    time.sleep(2)
    arm.rotate_base(90)

#main program
scanner.barcode_check()
pick_up()
rejection_bin()
drop_suitcase_rejection()
arm.home()
table.rotate_table_angle(90)

scanner.barcode_check()
pick_up()
platform()
drop_suitcase_platform()
arm.home()
```

```
table.rotate_table_angle(90)

'''scanner.barcode_check()
pick_up()
rejection_bin()
drop_suitcase_rejection()
arm.home()
table.rotate_table_angle(90)

scanner.barcode_check()
pick_up()
platform()
drop_suitcase_platform()
arm.home()
table.rotate_table_angle(90)'''
```

MILESTONE 4 (STAGE 3) – INFORMAL TA CHECK-IN

During and after your informal TA check-in document their feedback in the box below.

Feedback
- Keep up the work - Look to have individual functions ready for next week

List out action items to address any of your team's concerns and your TA's feedback

Action Items
• Work on induvial codes

MILESTONE 1 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

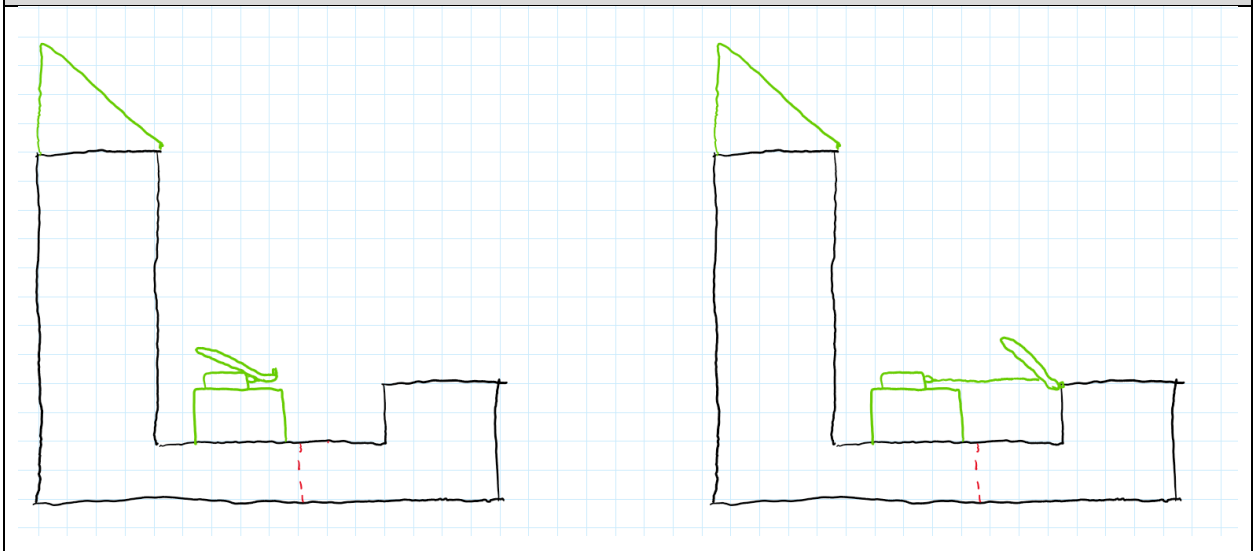
Full Name:	MacID:
Luca Iacovelli	iacovell

MILESTONE 1 (STAGE 2) – MECHANISM CONCEPT SKETCHES

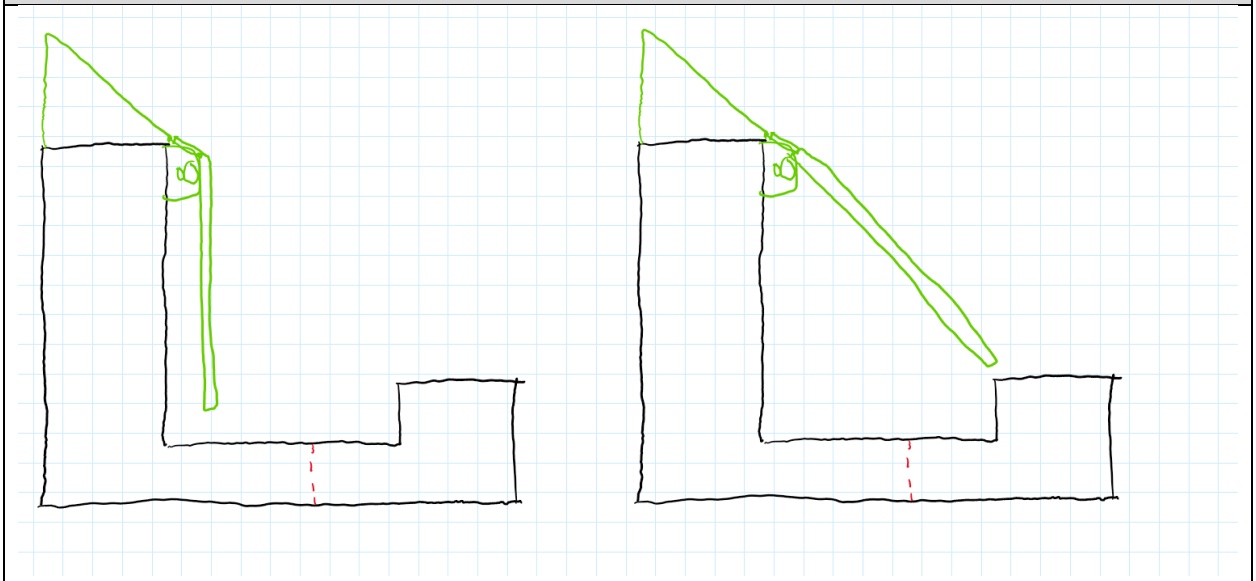
Team ID: Mon-46

Insert images of your initial mechanism sketches in the box below.

Linear Actuator Sketch



Rotary Actuator Sketch



MILESTONE 2 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

Full Name:	MacID:
Luca Iacovelli	iacovell

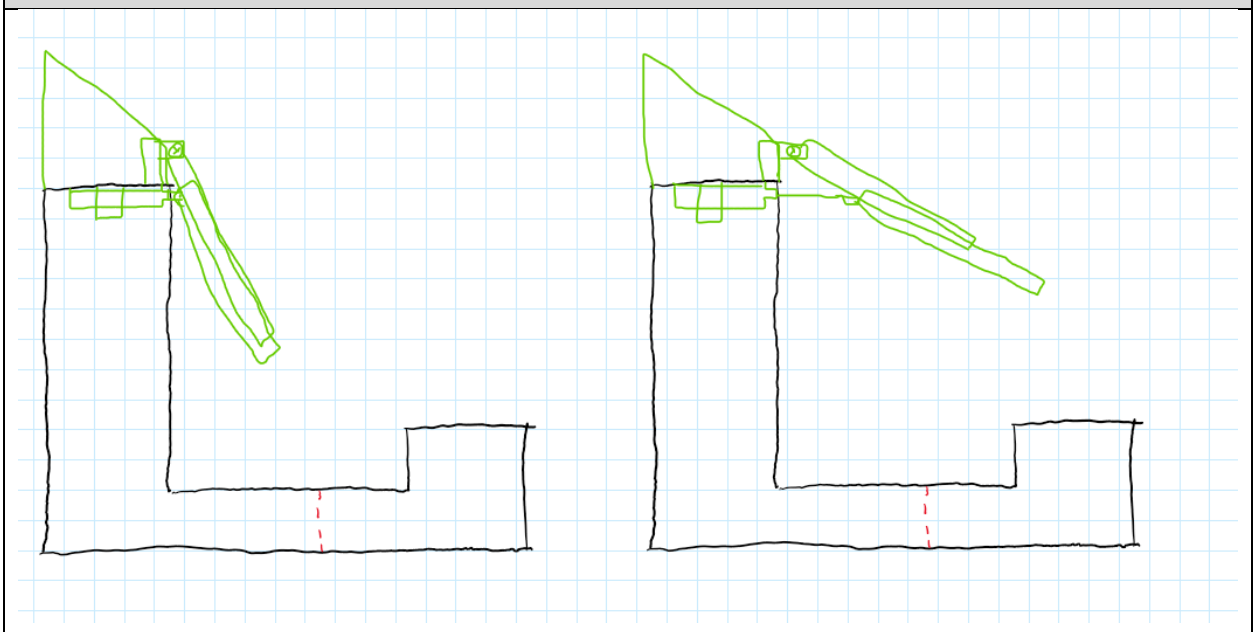
MILESTONE 2 (STAGE 1) – FINALIZED CONCEPT SKETCHES AND CAD MODEL WORKSHEET

Team ID: Mon-46

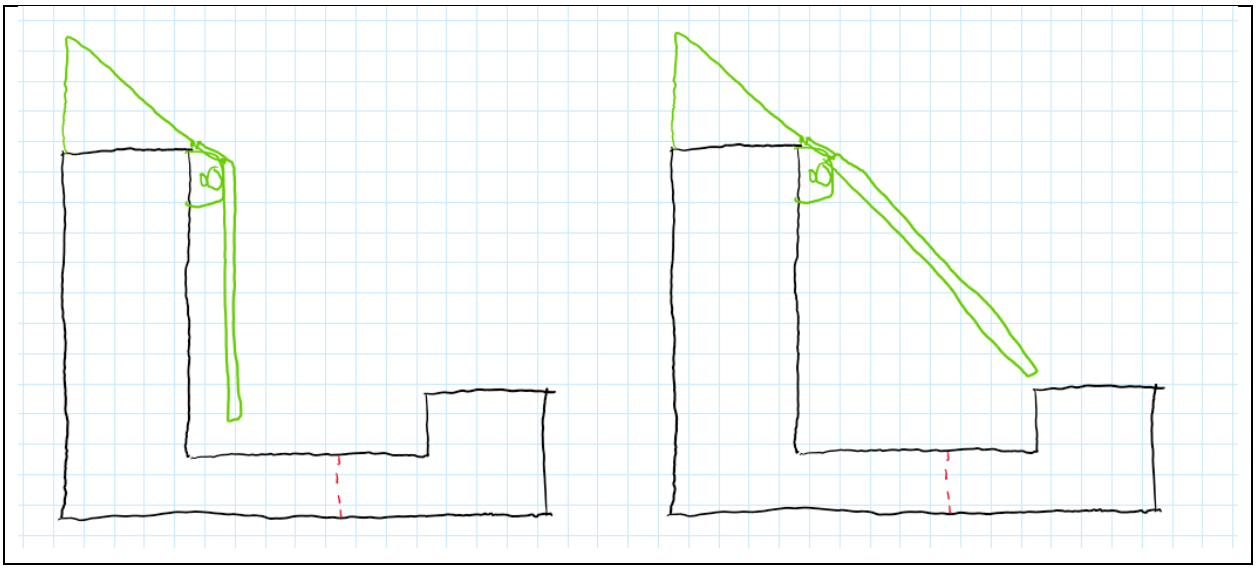
This is an individual deliverable and should be completed by each team member **prior** to Design Studio.

Attach images to the following three boxes of your mechanism sketch concepts and ideas.

Refined Linear Actuator Sketch

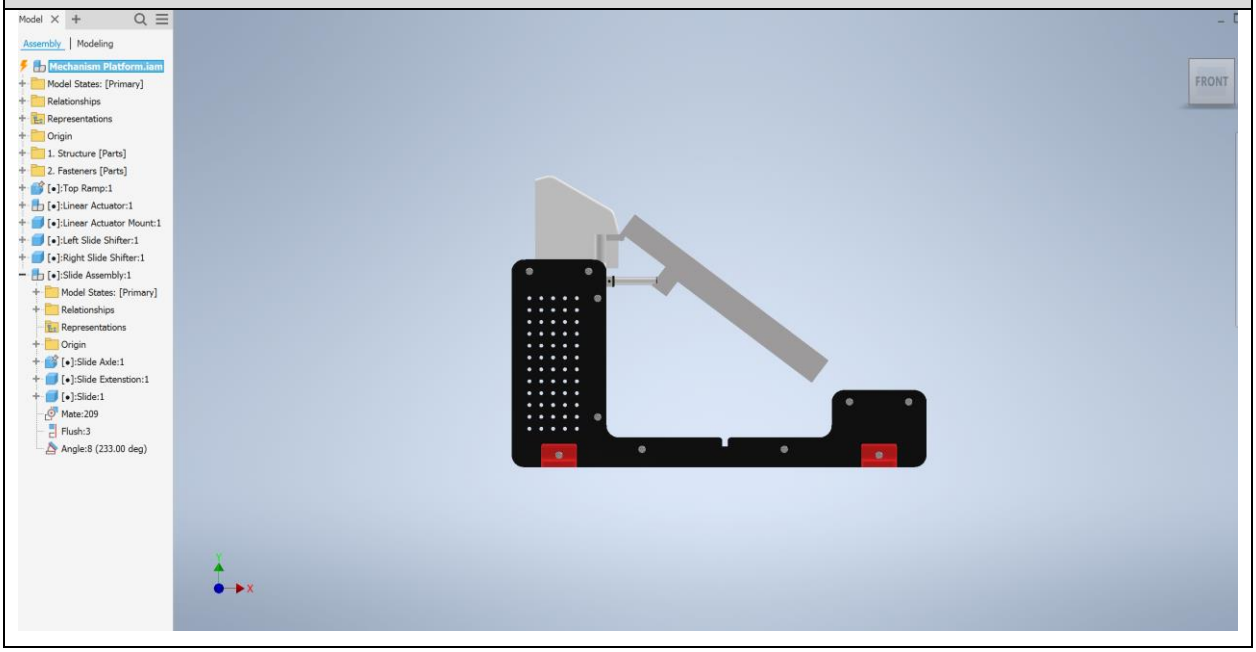


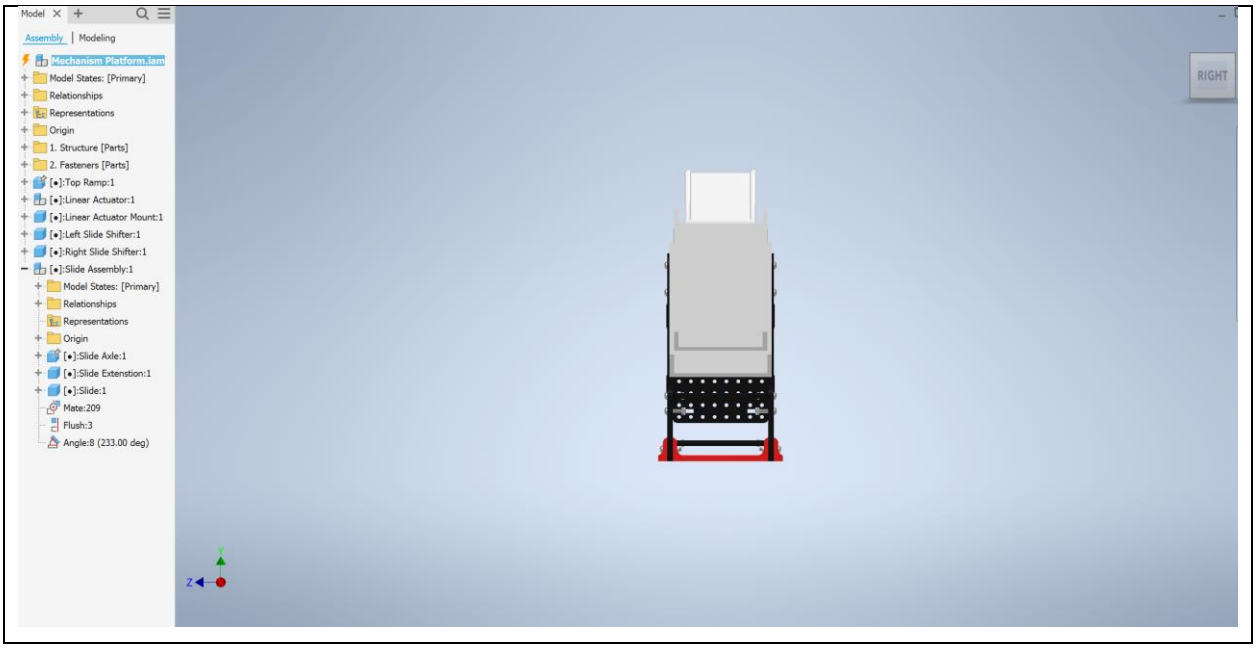
Refined Rotary Actuator Sketch

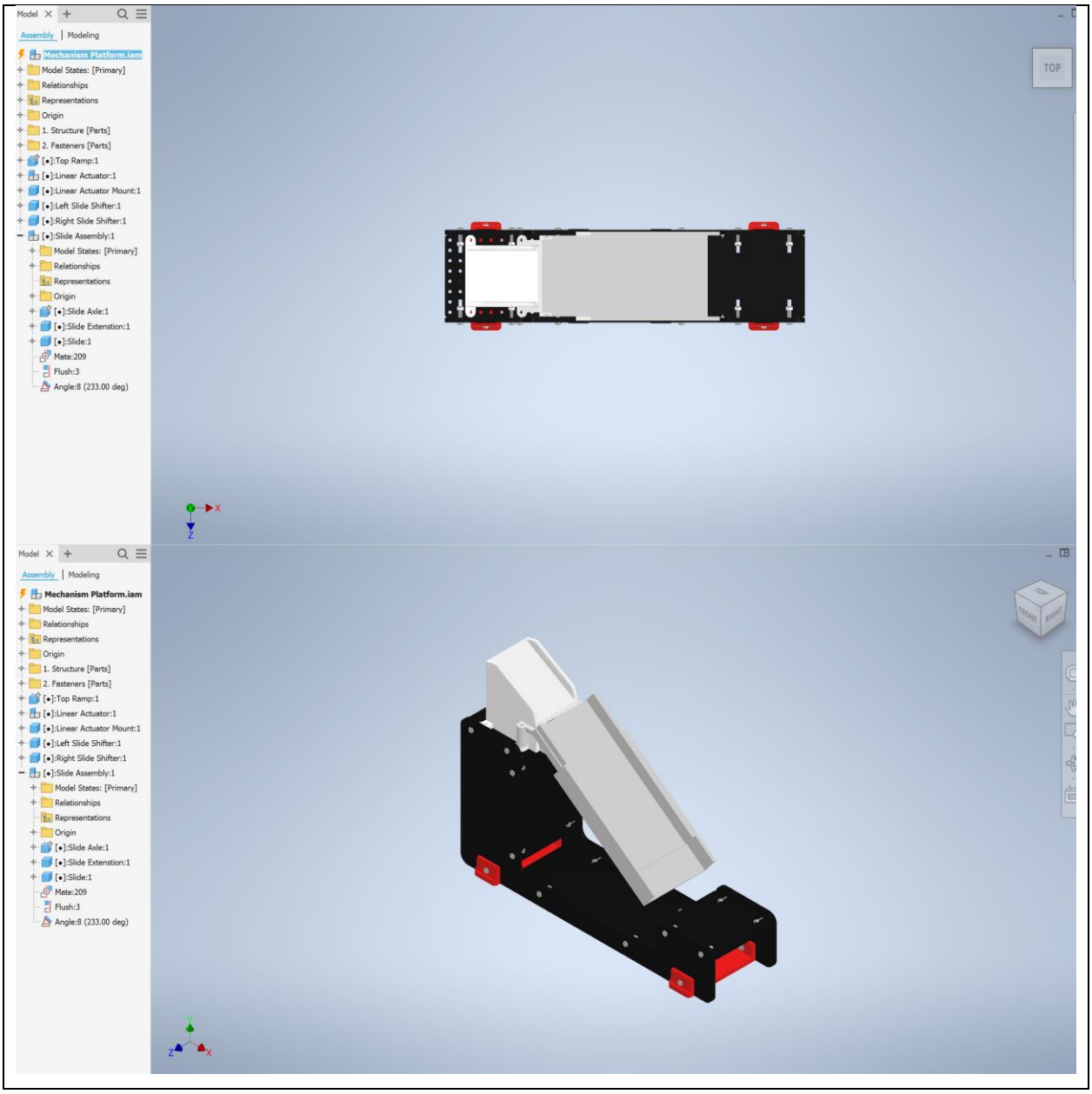


CAD Model Screenshots

Include screenshots of the top, front, right and isometric views of your CAD model. All design features of your CAD model should be visible.




Model
Assembly
Modeling
Mechanism Platform.iam
Model States: [Primary]
Relationships
Representations
Origin
1. Structure [Parts]
2. Fasteners [Parts]
[•]:Top Ramp:1
[•]:Linear Actuator:1
[•]:Linear Actuator Mount:1
[•]:Left Slide Shifter:1
[•]:Right Slide Shifter:1
[•]:Slide Assembly:1
Model States: [Primary]
Relationships
Representations
Origin
[•]:Slide Axle:1
[•]:Slide Extenstion:1
[•]:Slide:1
Mate:209
Flush:3
Angle:8 (233.00 deg)
RIGHT
Z


Model
Assembly | Modeling
Mechanism Platform.iam
Model States: [Primary]
Relationships
Representations
Origin
1. Structure [Parts]
2. Fasteners [Parts]
[•]:Top Ramp:1
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[•]:Linear Actuator Mount:1
[•]:Left Slide Shifter:1
[•]:Right Slide Shifter:1
[•]:Slide Assembly:1
Model States: [Primary]
Relationships
Representations
Origin
[•]:Slide Axle:1
[•]:Slide Extenstion:1
[•]:Slide:1
Mate:209
Flush:3
Angle:8 (233.00 deg)
TOP
Model
Assembly | Modeling
Mechanism Platform.iam
Model States: [Primary]
Relationships
Representations
Origin
1. Structure [Parts]
2. Fasteners [Parts]
[•]:Top Ramp:1
[•]:Linear Actuator:1
[•]:Linear Actuator Mount:1
[•]:Left Slide Shifter:1
[•]:Right Slide Shifter:1
[•]:Slide Assembly:1
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Relationships
Representations
Origin
[•]:Slide Axle:1
[•]:Slide Extenstion:1
[•]:Slide:1
Mate:209
Flush:3
Angle:8 (233.00 deg)
FRONT
RIGHT

MILESTONE 3 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

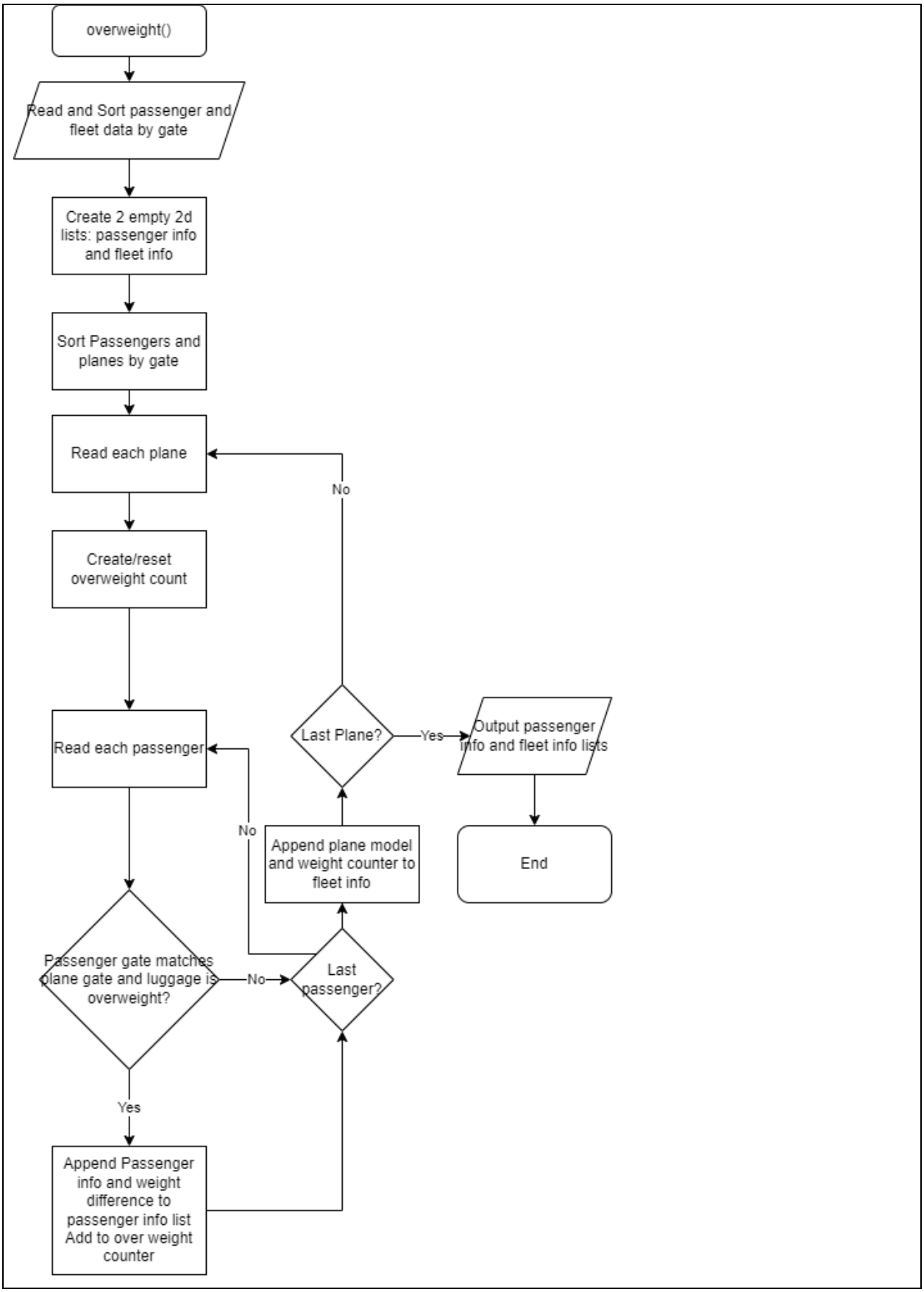
Full Name:	MacID:
Luca Iacovelli	iacovell

MILESTONE 3 (STAGE 2) – FLOWCHART

Team ID: Mon-46

Insert an image of flowchart in the box for your assigned function. Also change the name of the function to match your assigned function.

overweight()


overweight()
Read and Sort passenger and fleet data by gate
Create 2 empty 2d lists: passenger info and fleet info
Sort Passengers and planes by gate
Read each plane
Create/reset overweight count
Read each passenger
Passenger gate matches plane gate and luggage is overweight?
No
Last passenger?
No
Yes
Append Passenger info and weight difference to passenger info list Add to over weight counter
Append plane model and weight counter to fleet info
Last Plane?
No
Yes
Output passenger info and fleet info lists
End

MILESTONE 1 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

Full Name:	MacID:
Ananyaa Rai	raia25

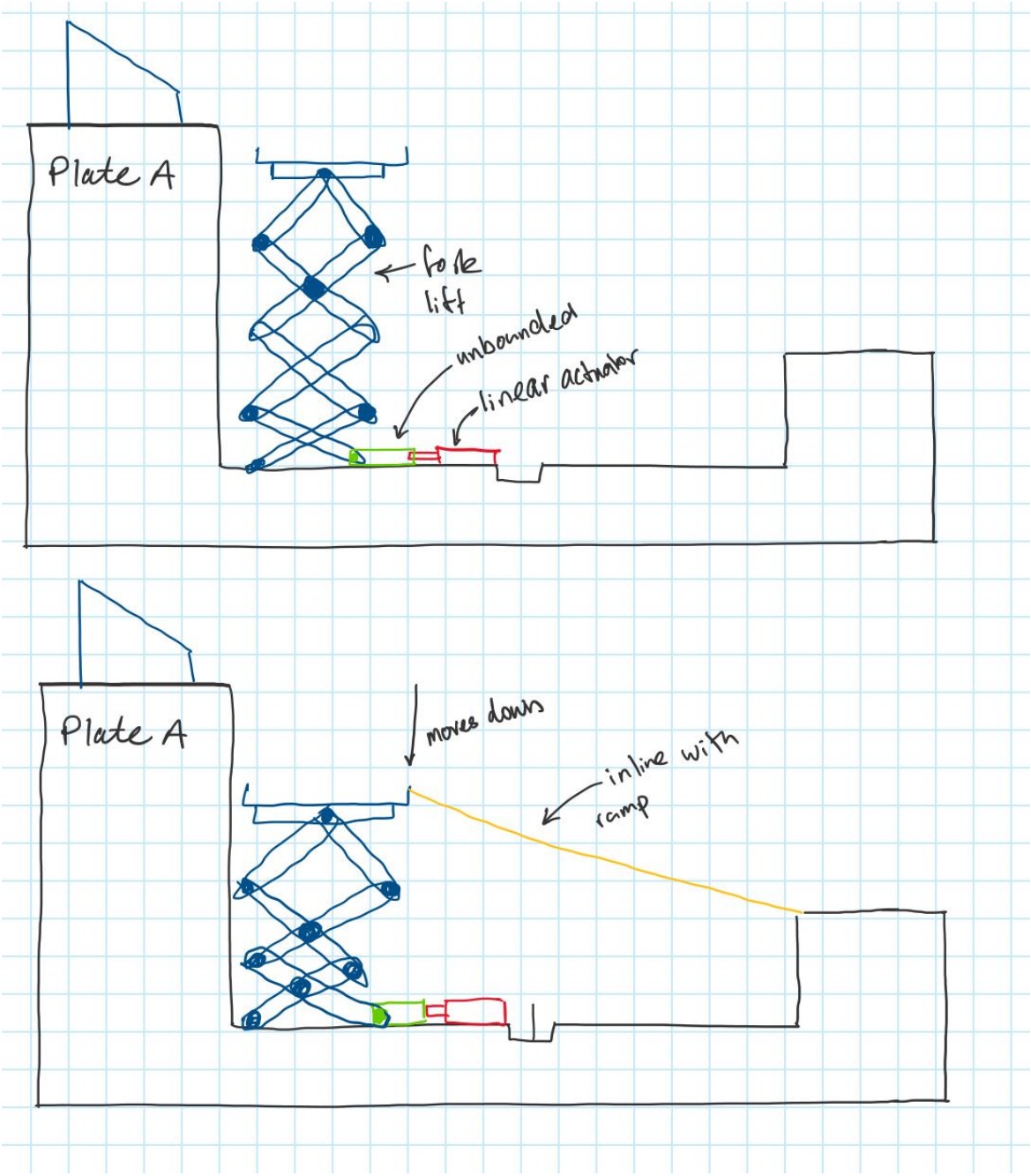
Initial Problem Statement
To design an automated system to speed up the check-in process for passengers as well as streamlining the baggage filtering process, minimizing lost luggage.

MILESTONE 1 (STAGE 2) – MECHANISM CONCEPT SKETCHES

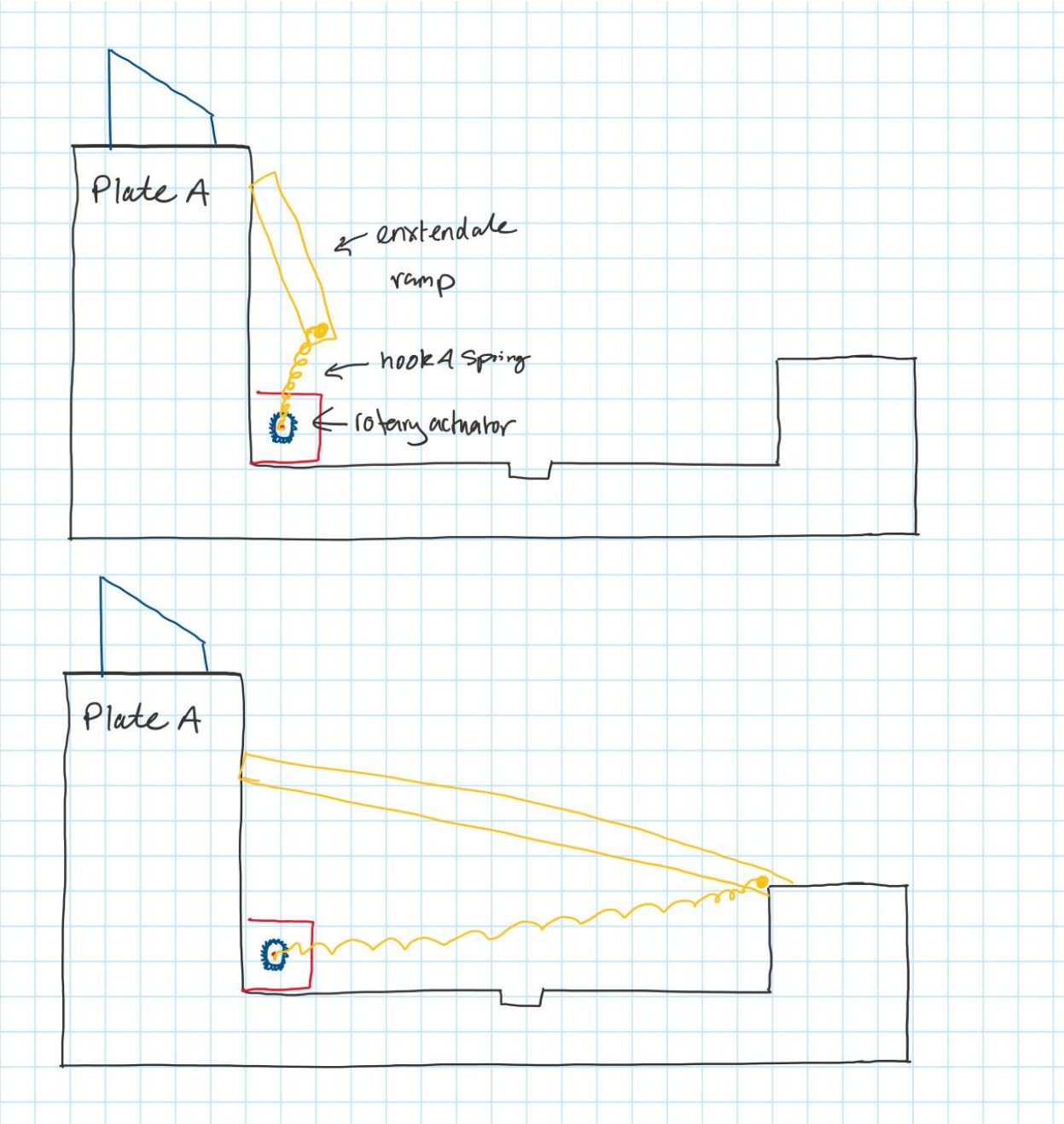
Team ID: Mon-46

Insert images of your initial mechanism sketches in the box below.

Linear Actuator Sketch



Rotary Actuator Sketch



MILESTONE 2 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

Full Name:	MacID:
Ananyaa Rai	raia25

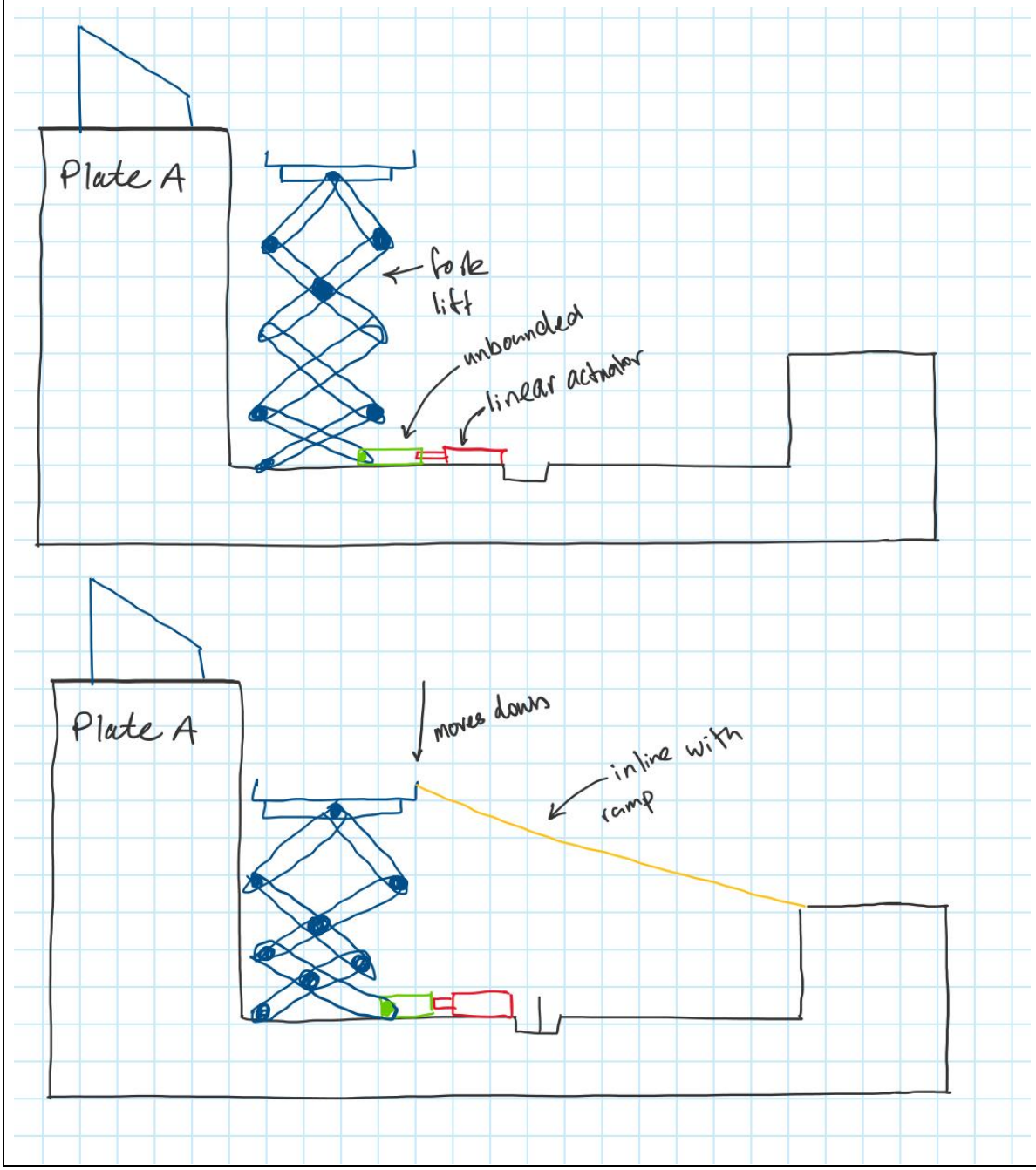
MILESTONE 2 (STAGE 1) – FINALIZED CONCEPT SKETCHES AND CAD MODEL WORKSHEET

Team ID: Mon-46

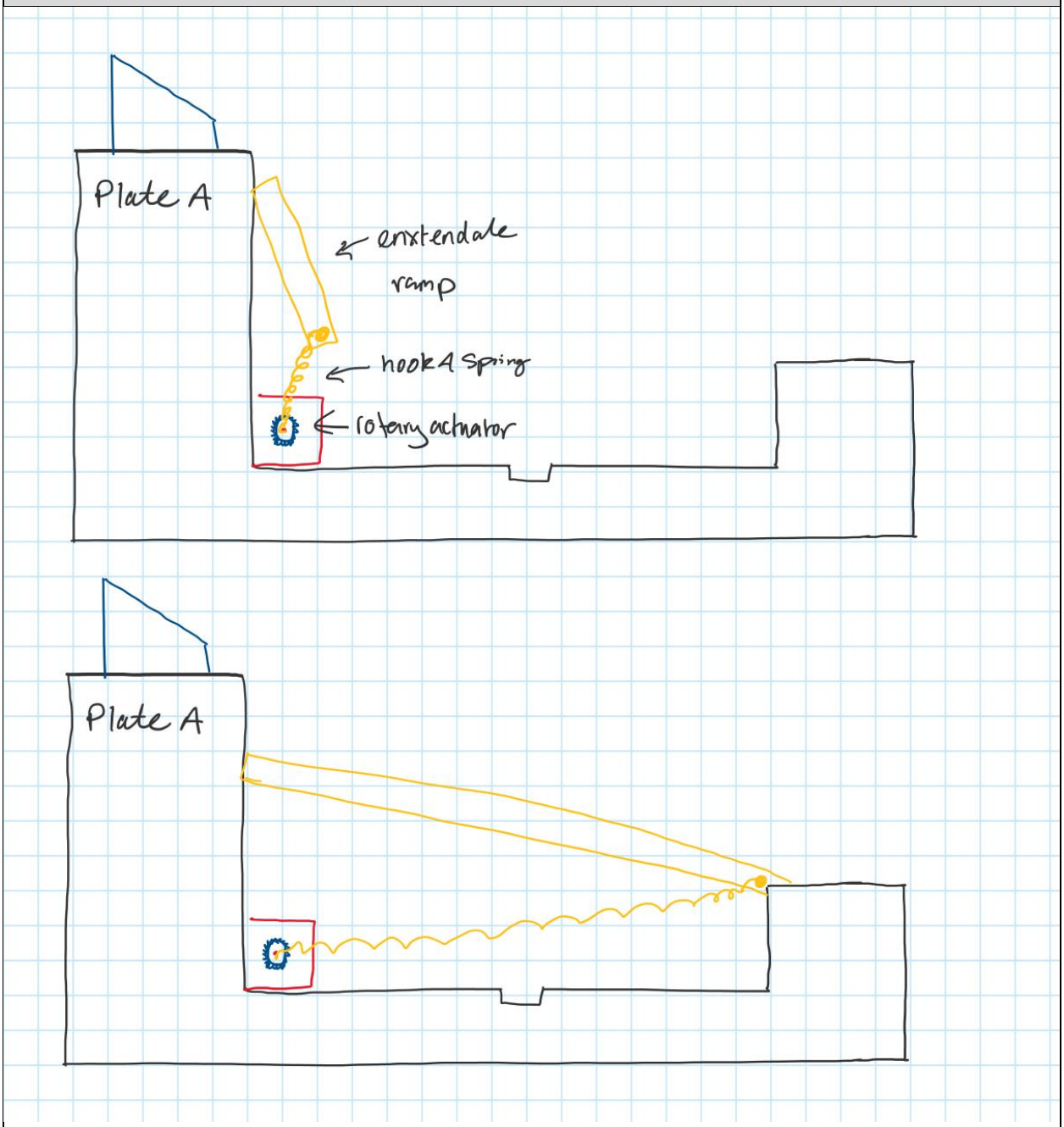
This is an individual deliverable and should be completed by each team member **prior** to Design Studio.

Attach images to the following three boxes of your mechanism sketch concepts and ideas.

Refined Linear Actuator Sketch

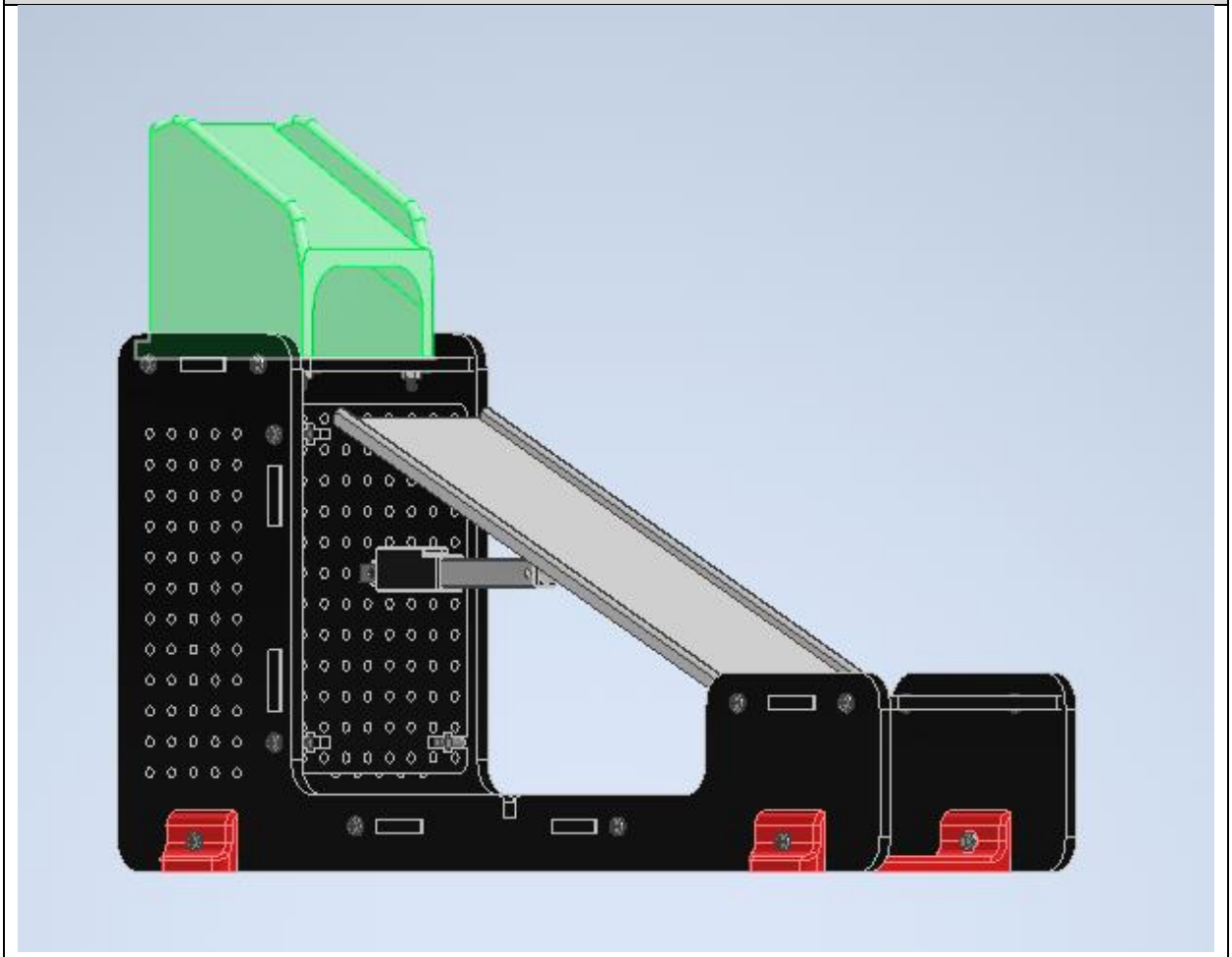


Refined Rotary Actuator Sketch



CAD Model Screenshots

Include screenshots of the top, front, right and isometric views of your CAD model. All design features of your CAD model should be visible.



MILESTONE 3 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

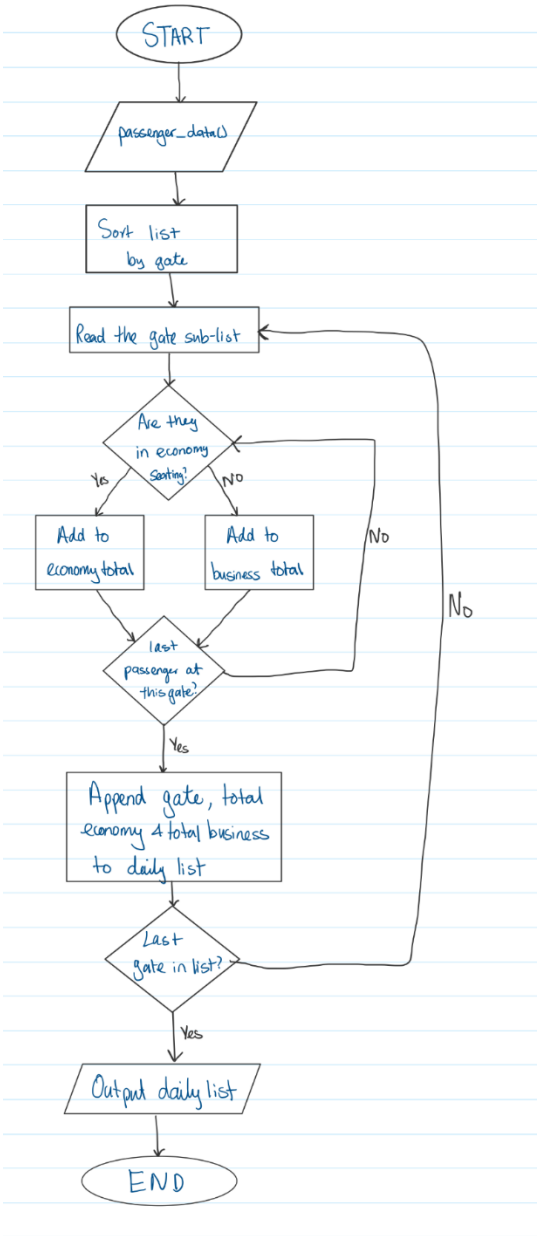
Full Name:	MacID:
Ananyaa Rai	raia25

MILESTONE 3 (STAGE 2) – FLOWCHART

Team ID: Mon-46

Insert an image of flowchart in the box for your assigned function. Also change the name of the function to match your assigned function.

daily_data()



MILESTONE 1 (INDIVIDUAL) – COVER PAGE

Team ID: Monday-46

Please list full name and MacID.

Full Name:	MacID:
Anson Liang	Lianj26

Initial Problem Statement
To design an automated system to speed up the check-in process for passengers as well as streamlining the baggage filtering process, minimizing lost luggage.

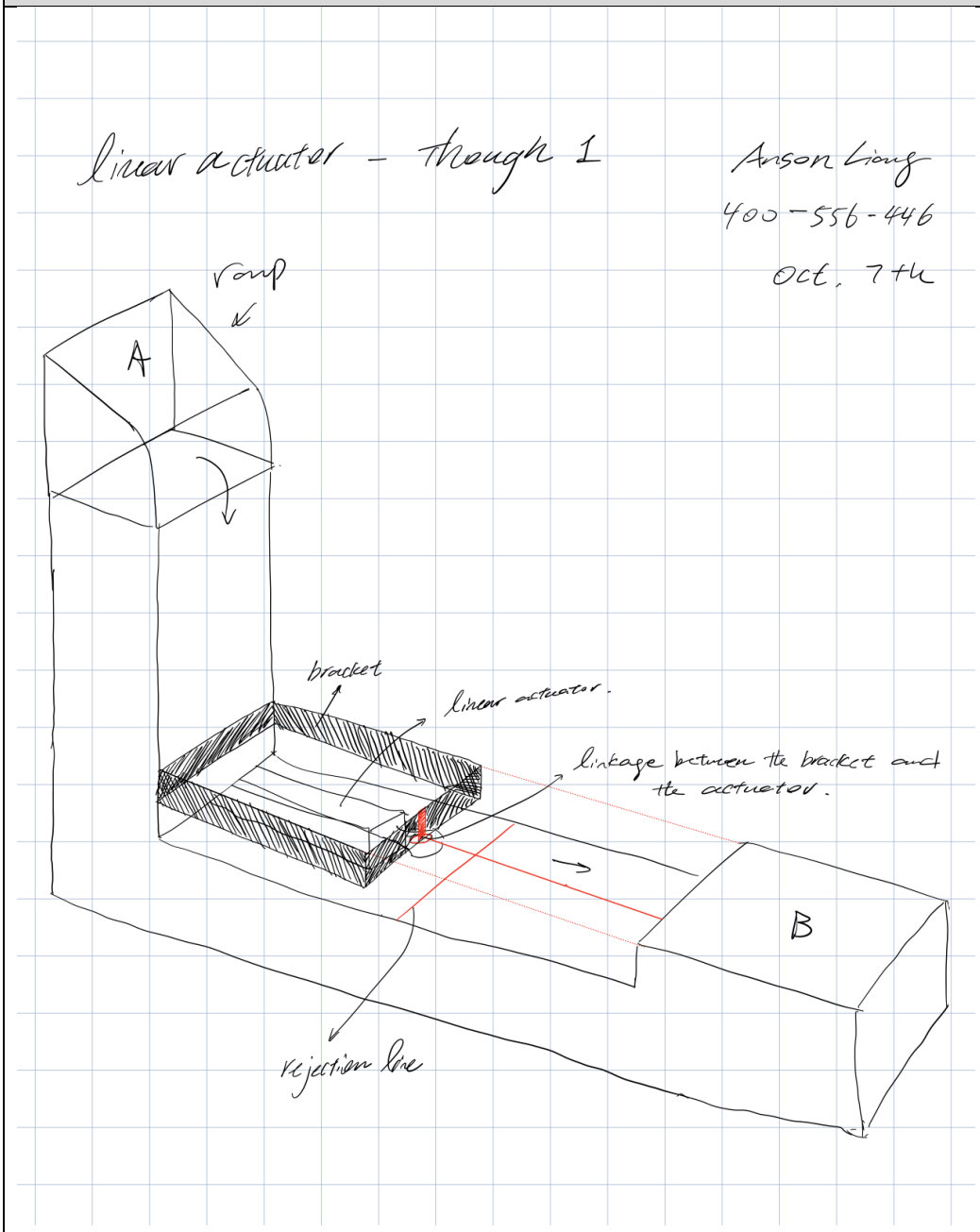
Functions	Objectives	Constraints
• Transfer luggage between platforms • Categorizing different types of luggage based off of airline/airport regulations • Scanning tickets and bag tags • Able to input different needed torque energy for different weight of luggage and output the correct movement for the mechanism.	• Should have a durable structure • Should be able to complete the task quickly • Able to function in a small area of space • Successful rate should be between 75%-85%	• Restriction line • Limited mounting area (TBD): ○ Base:b mm^2 ○ Walls:w mm^2 • Weight (TBD): m g • Material used • Machinery limitations (Q-Arm overheating etc.) • Force output vs speed of actuators

MILESTONE 1 (STAGE 2) – MECHANISM CONCEPT SKETCHES

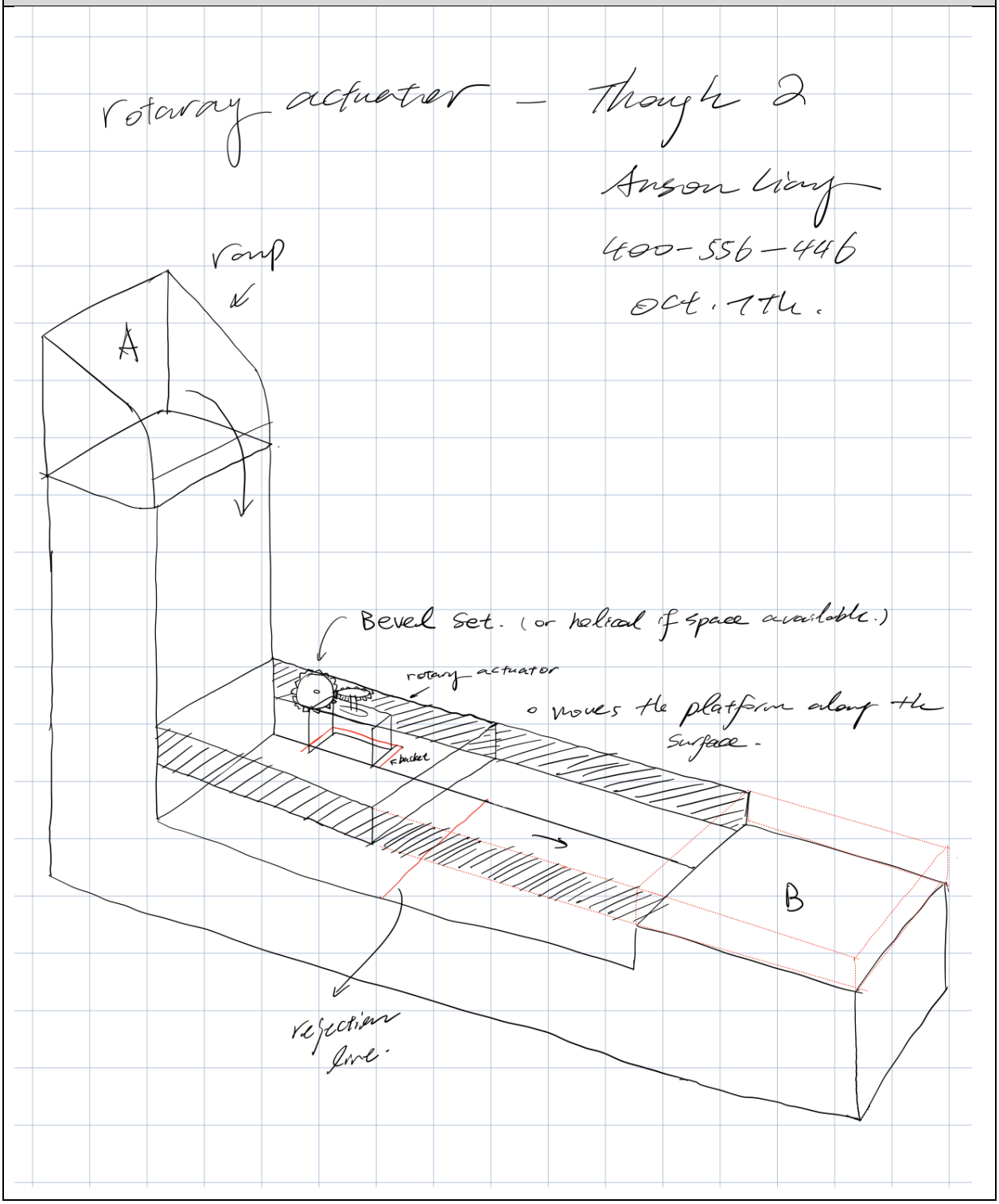
Team ID: Monday-46

Insert images of your initial mechanism sketches in the box below.

Linear Actuator Sketch



Rotary Actuator Sketch



MILESTONE 2 (INDIVIDUAL) – COVER PAGE

Team ID: Monday-46

Please list full name and MacID.

Full Name:	MacID:
Anson Liang	400-556-446

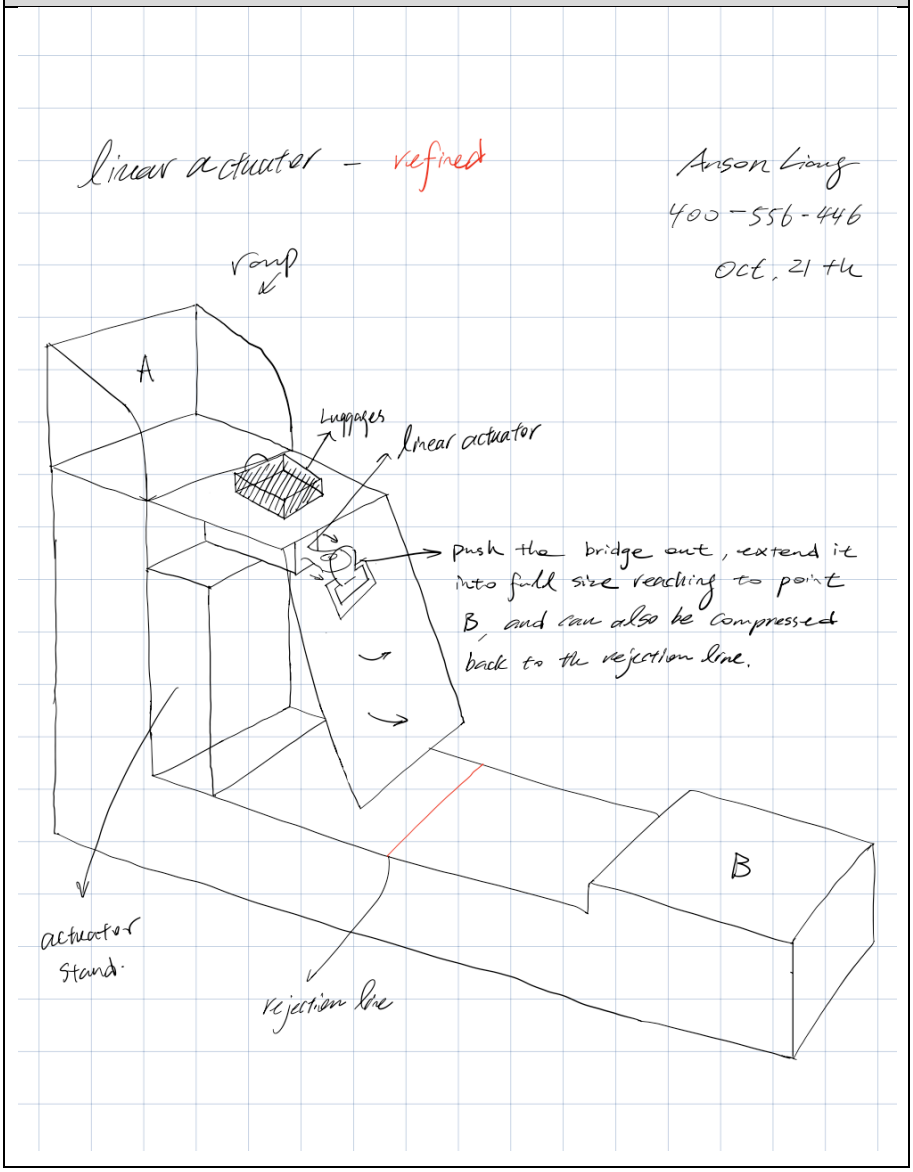
MILESTONE 2 (STAGE 1) – FINALIZED CONCEPT SKETCHES AND CAD MODEL WORKSHEET

Team ID: Monday-46

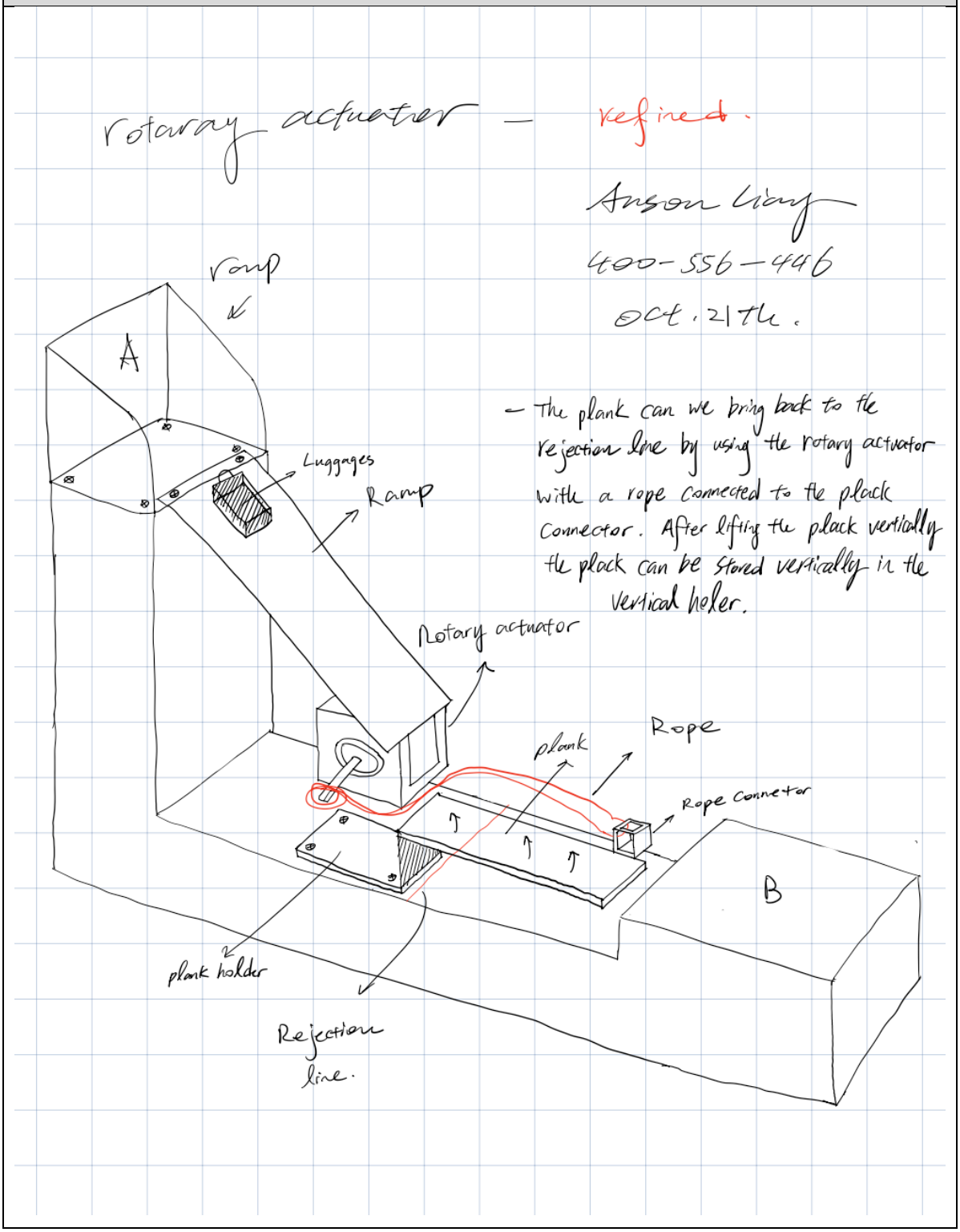
This is an individual deliverable and should be completed by each team member **prior** to Design Studio.

Attach images to the following three boxes of your mechanism sketch concepts and ideas.

Refined Linear Actuator Sketch

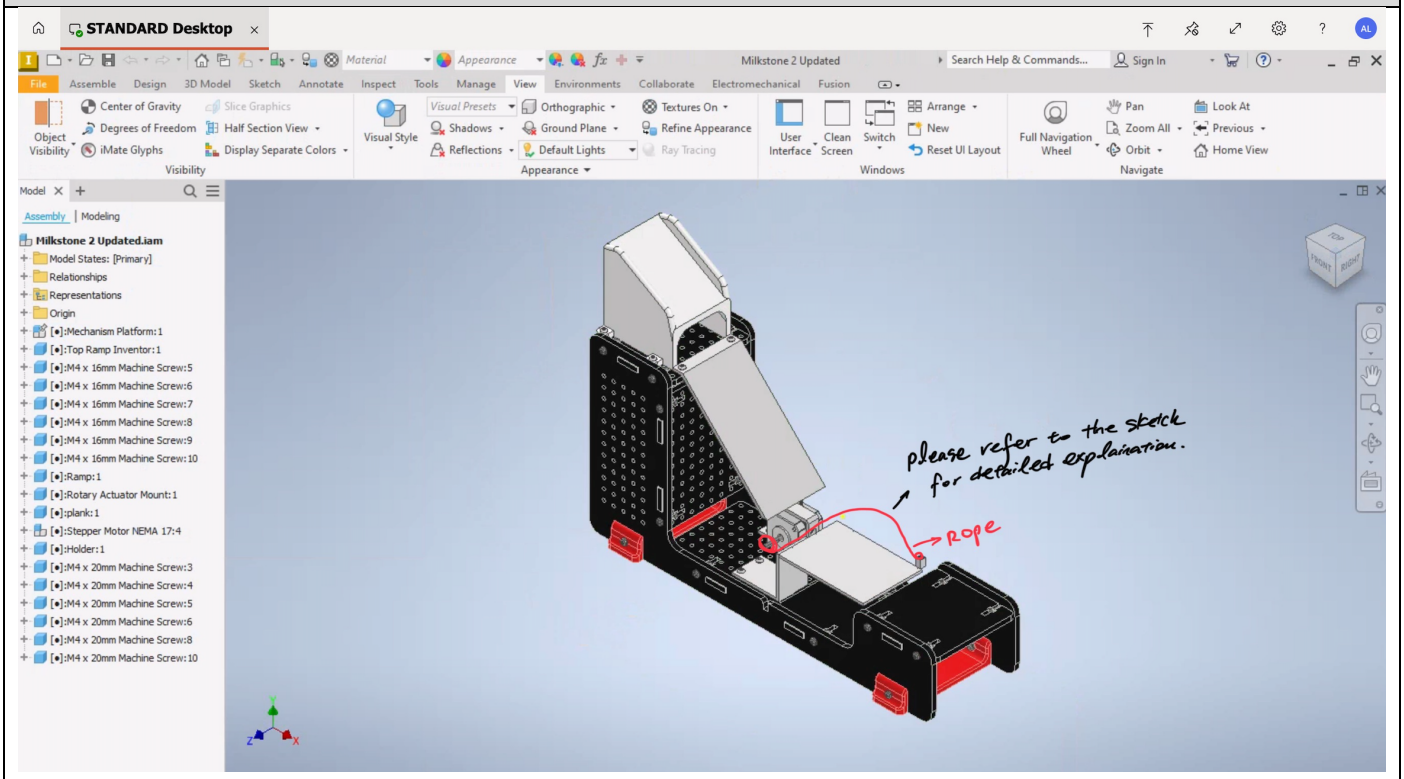


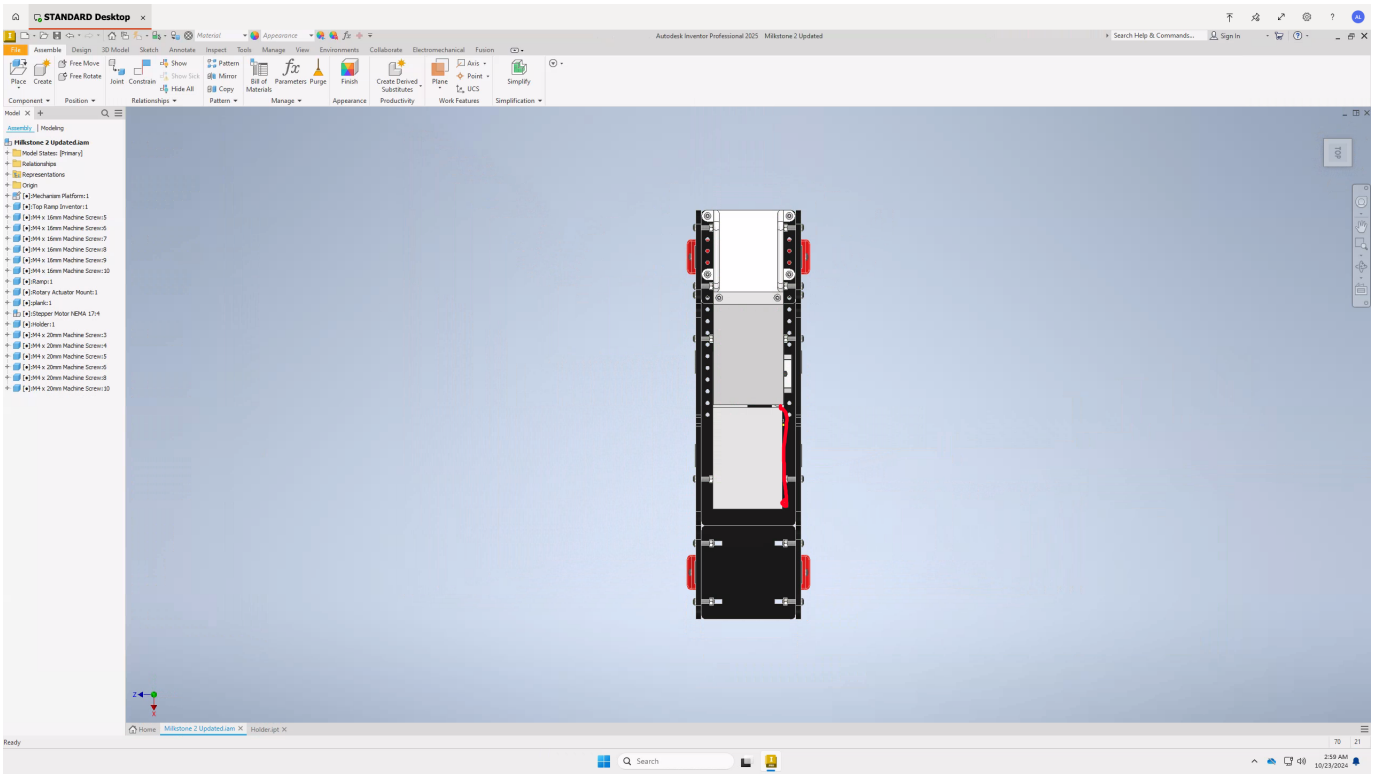
Refined Rotary Actuator Sketch

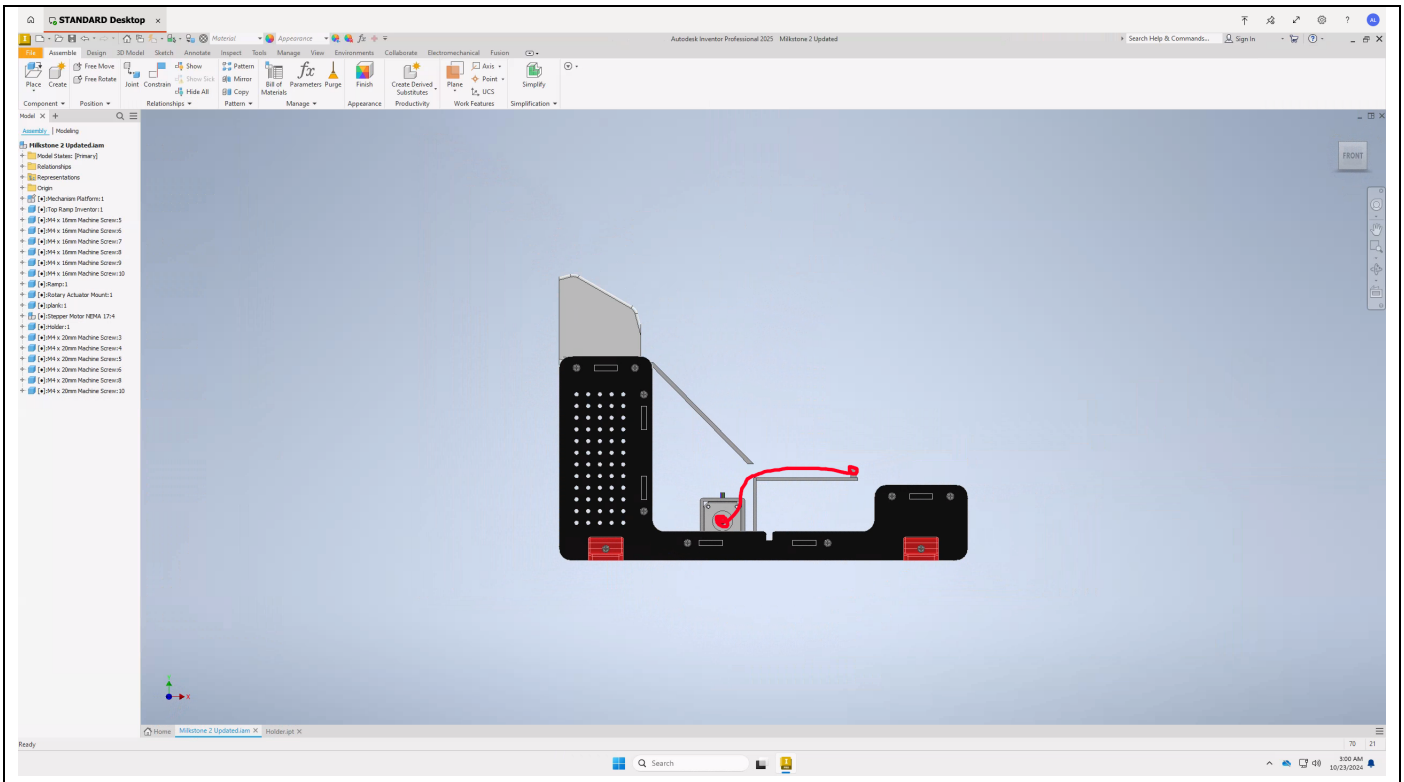


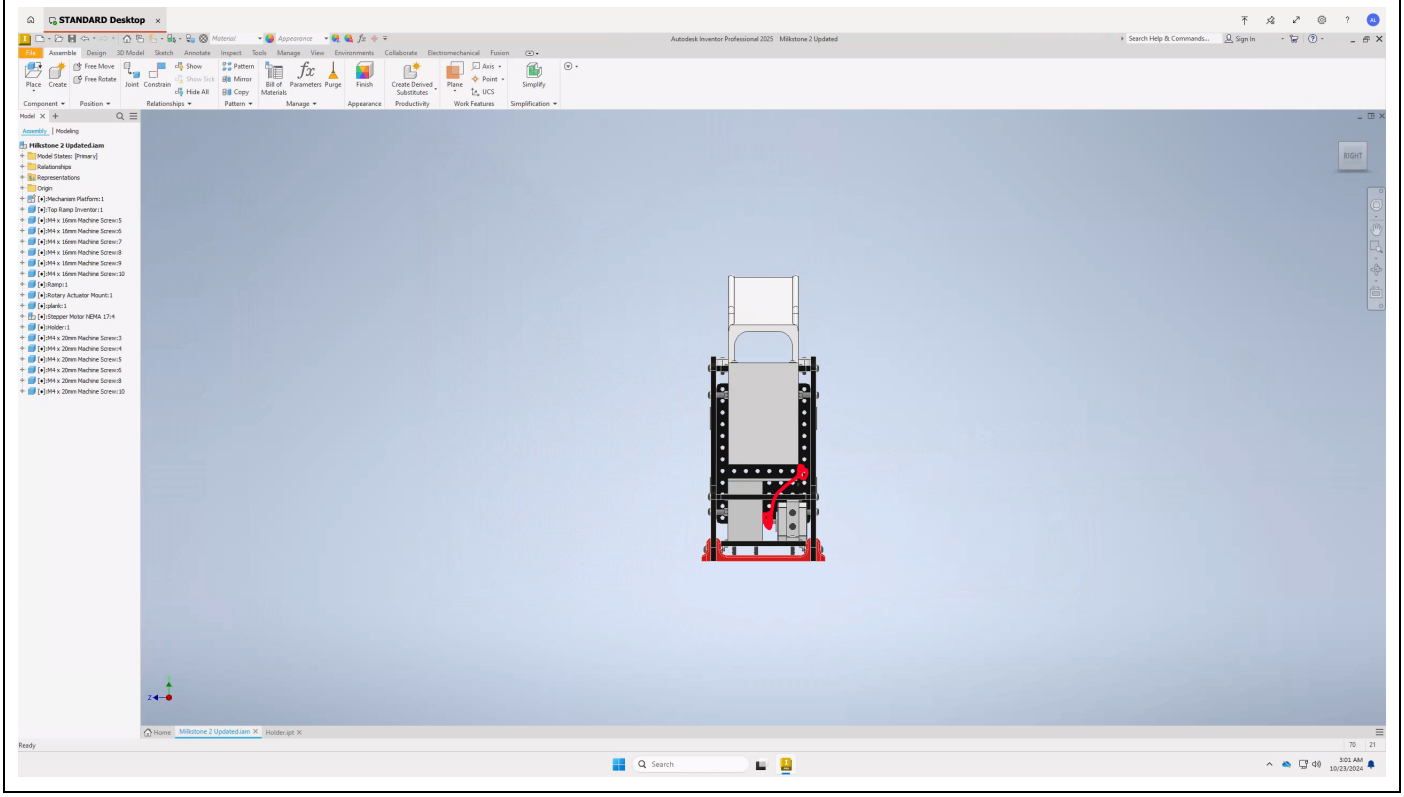
CAD Model Screenshots

Include screenshots of the top, front, right and isometric views of your CAD model. All design features of your CAD model should be visible.






STANDARD Desktop
Autodesk Inventor Professional 2025 Milkstone 2 Updated
FRONT


STANDARD Desktop
Autodesk Inventor Professional 2025 Milkstone 2 Updated
RIGHT

MILESTONE 3 (INDIVIDUAL) – COVER PAGE

Team ID: Monday-46

Please list full name and MacID.

Full Name:	MacID:
Anson Liang	Lianj26

MILESTONE 3 (STAGE 2) – FLOWCHART

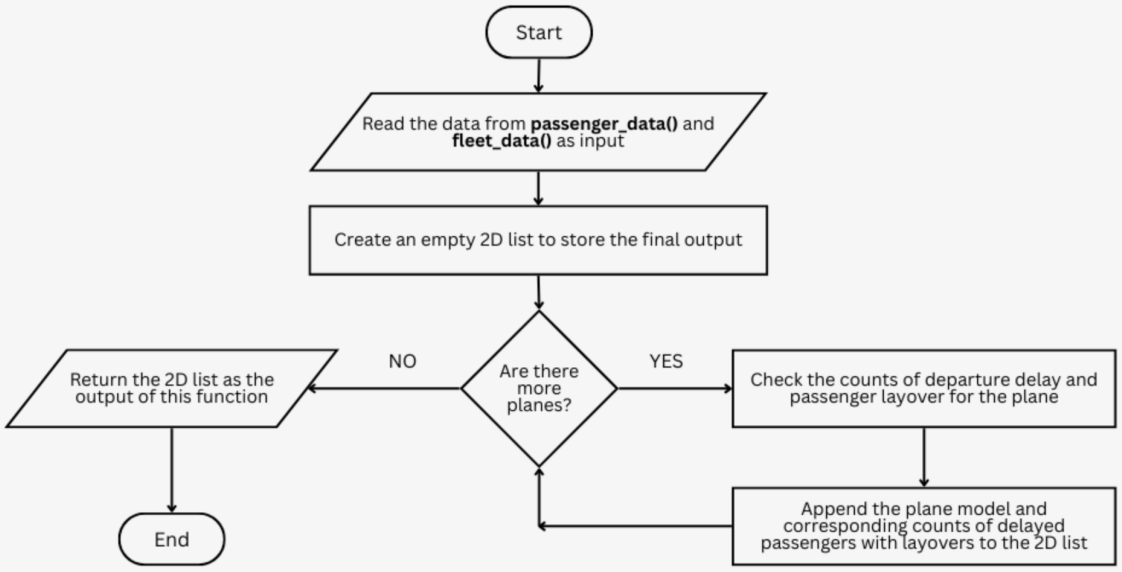
Team ID: Monday-46

Insert an image of flowchart in the box for your assigned function. Also change the name of the function to match your assigned function.

time_delay()

Function: time_delay():
Reports the total number of passengers from different flights' data that are going to depart late and layover

Anson Liang (lianj26)
400-556-446



MILESTONE 1 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

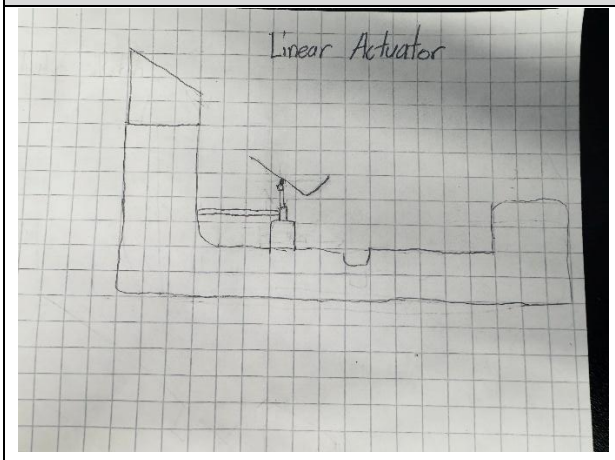
Full Name:	MacID:
Areeb Rahman	Rahmaa94

MILESTONE 1 (STAGE 2) – MECHANISM CONCEPT SKETCHES

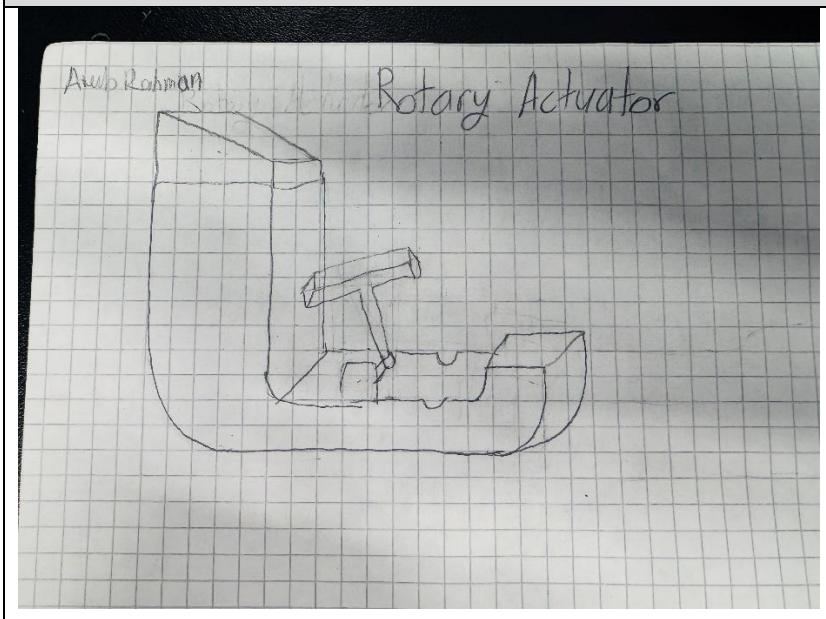
Team ID: Mon-46

Insert images of your initial mechanism sketches in the box below.

Linear Actuator Sketch



Rotary Actuator Sketch



MILESTONE 2 (INDIVIDUAL) – COVER PAGE

Team ID: Day-##

Please list full name and MacID.

Full Name:	MacID:
Areeb Rahman	rahmaa94

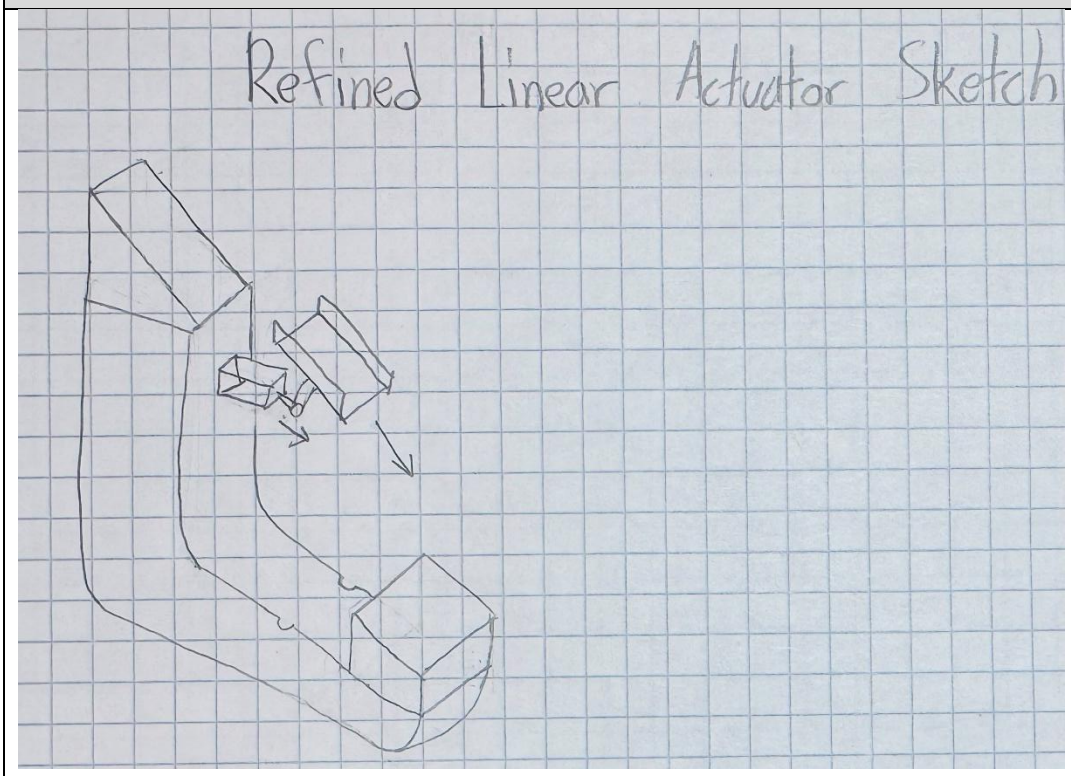
MILESTONE 2 (STAGE 1) – FINALIZED CONCEPT SKETCHES AND CAD MODEL WORKSHEET

Team ID: Mon-46

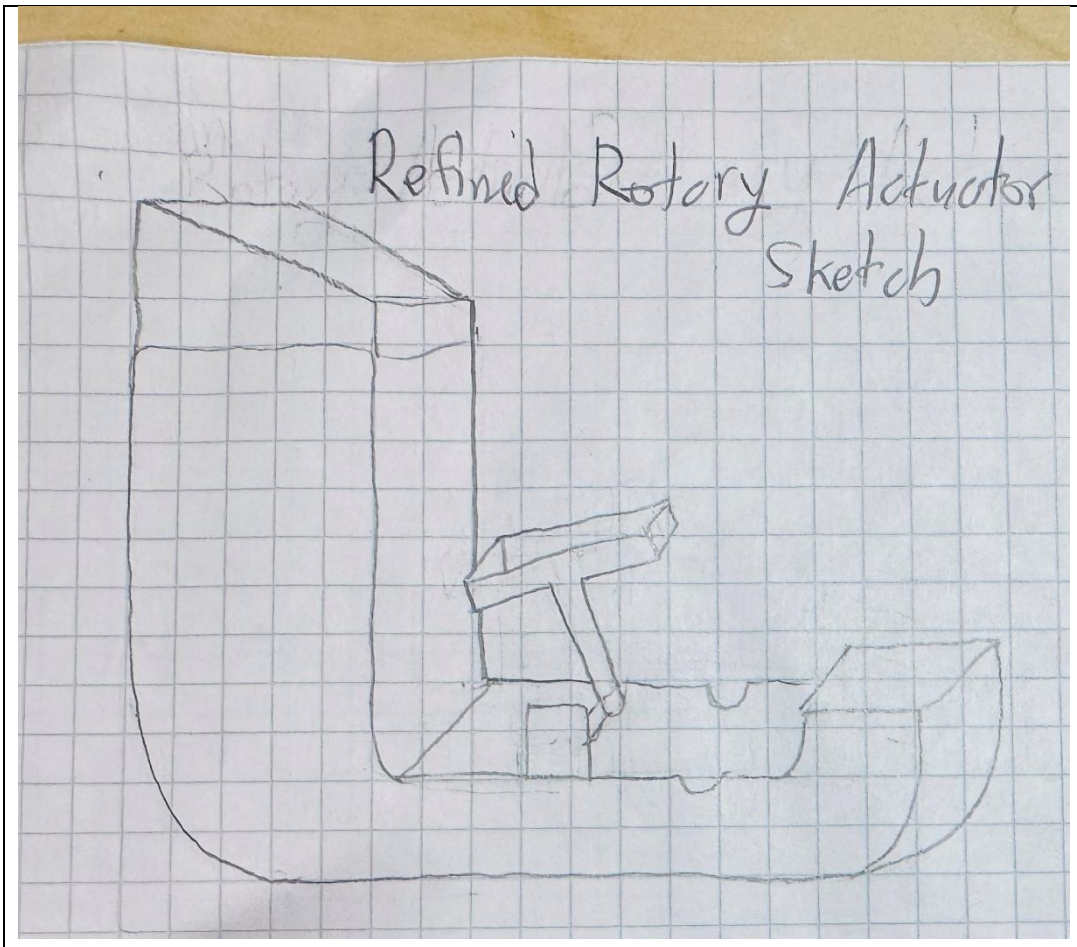
This is an individual deliverable and should be completed by each team member **prior** to Design Studio.

Attach images to the following three boxes of your mechanism sketch concepts and ideas.

Refined Linear Actuator Sketch

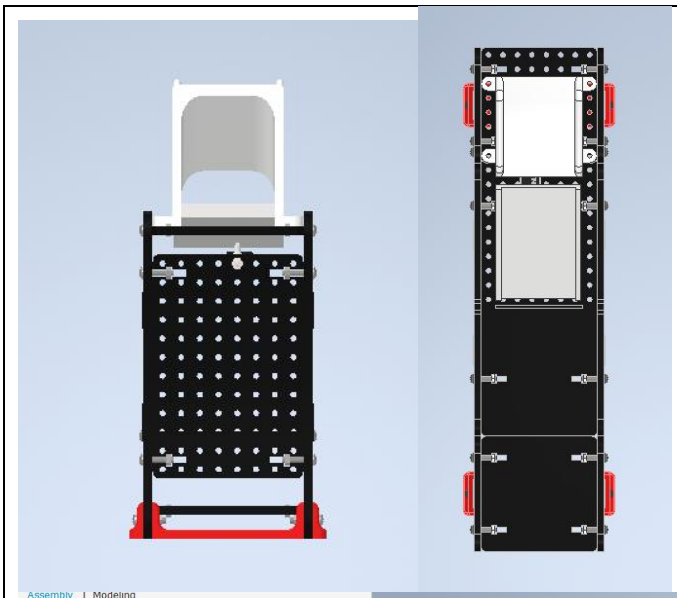


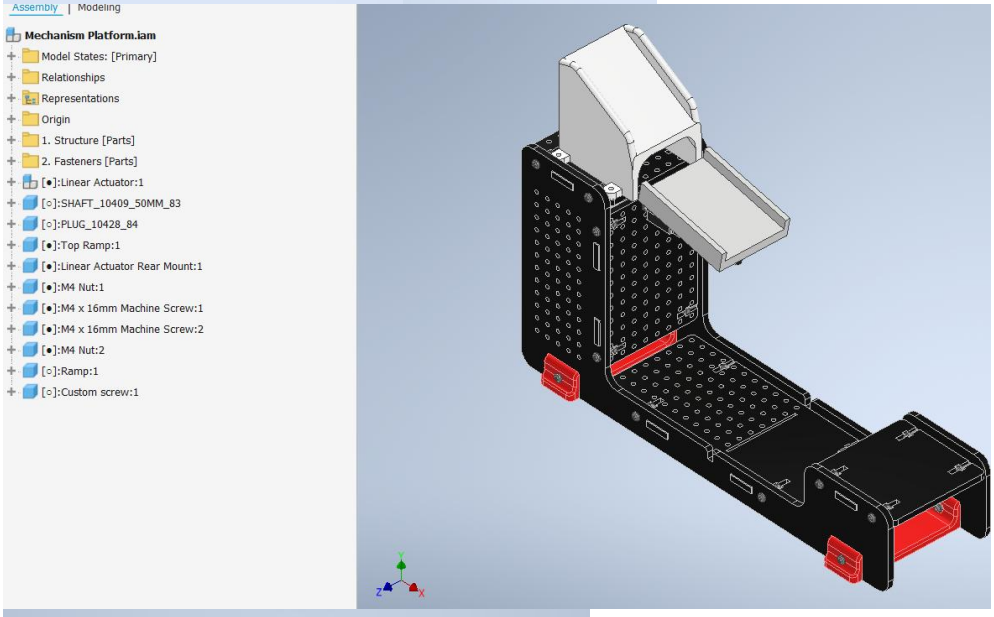
Refined Rotary Actuator Sketch

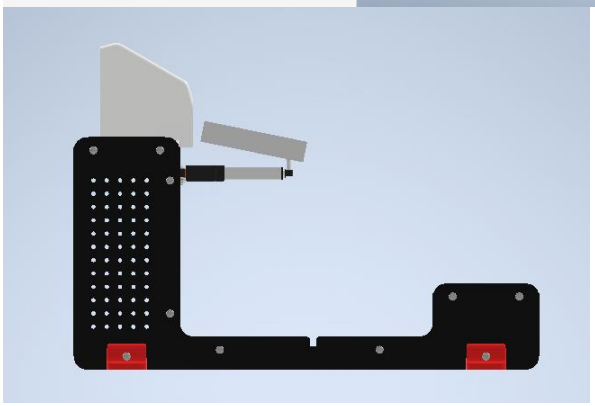


CAD Model Screenshots

Include screenshots of the top, front, right and isometric views of your CAD model. All design features of your CAD model should be visible.




Assembly | Modeling
Mechanism Platform.iam
Model States: [Primary]
Relationships
Representations
Origin
1. Structure [Parts]
2. Fasteners [Parts]
[●]:Linear Actuator:1
[○]:SHAFT_10409_50MM_83
[○]:PLUG_10428_84
[●]:Top Ramp:1
[●]:Linear Actuator Rear Mount:1
[●]:M4 Nut:1
[●]:M4 x 16mm Machine Screw:1
[●]:M4 x 16mm Machine Screw:2
[●]:M4 Nut:2
[○]:Ramp:1
[○]:Custom screw:1



MILESTONE 3 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

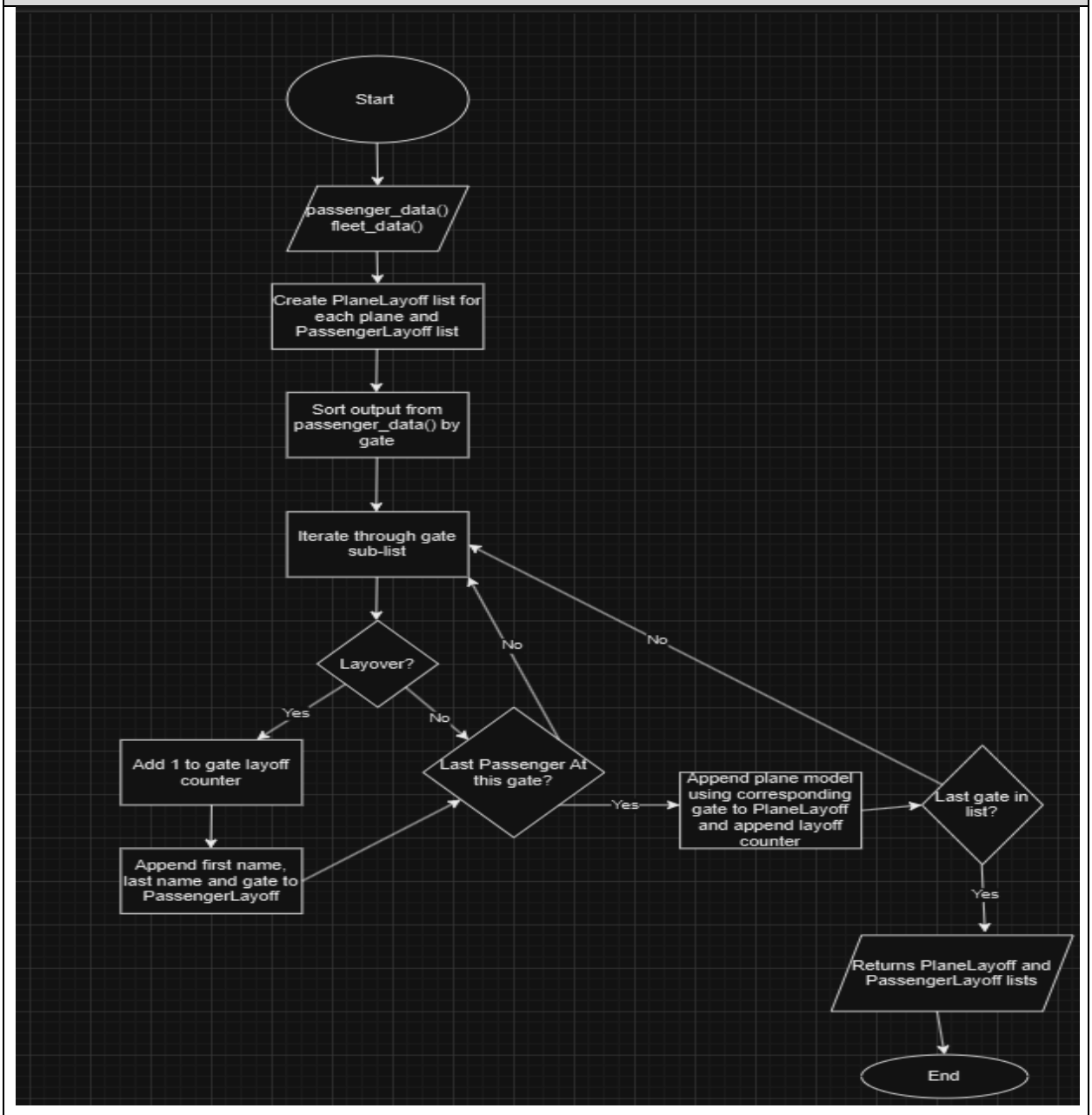
Full Name:	MacID:
Areeb Rahman	400576635

MILESTONE 3 (STAGE 2) – FLOWCHART

Team ID: Mon-46

Insert an image of flowchart in the box for your assigned function. Also change the name of the function to match your assigned function.

layover()



MILESTONE 1 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

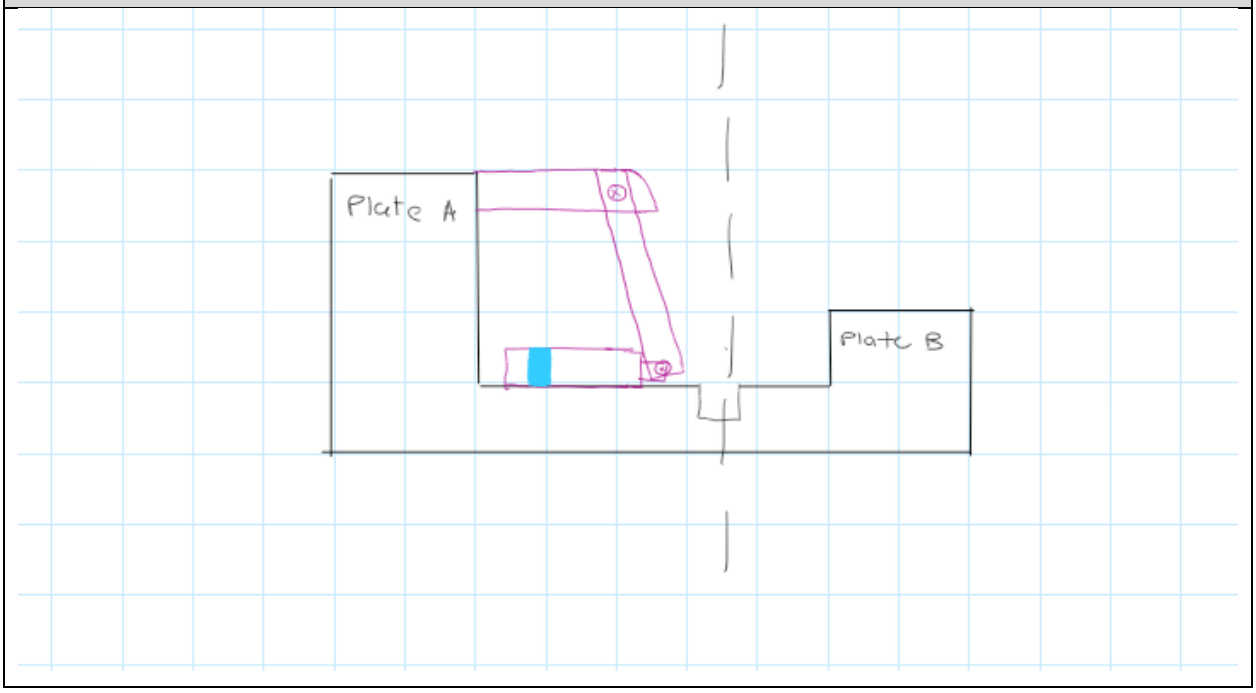
Full Name:	MacID:
Inaaya Lalani	Lalani4

MILESTONE 1 (STAGE 2) – MECHANISM CONCEPT SKETCHES

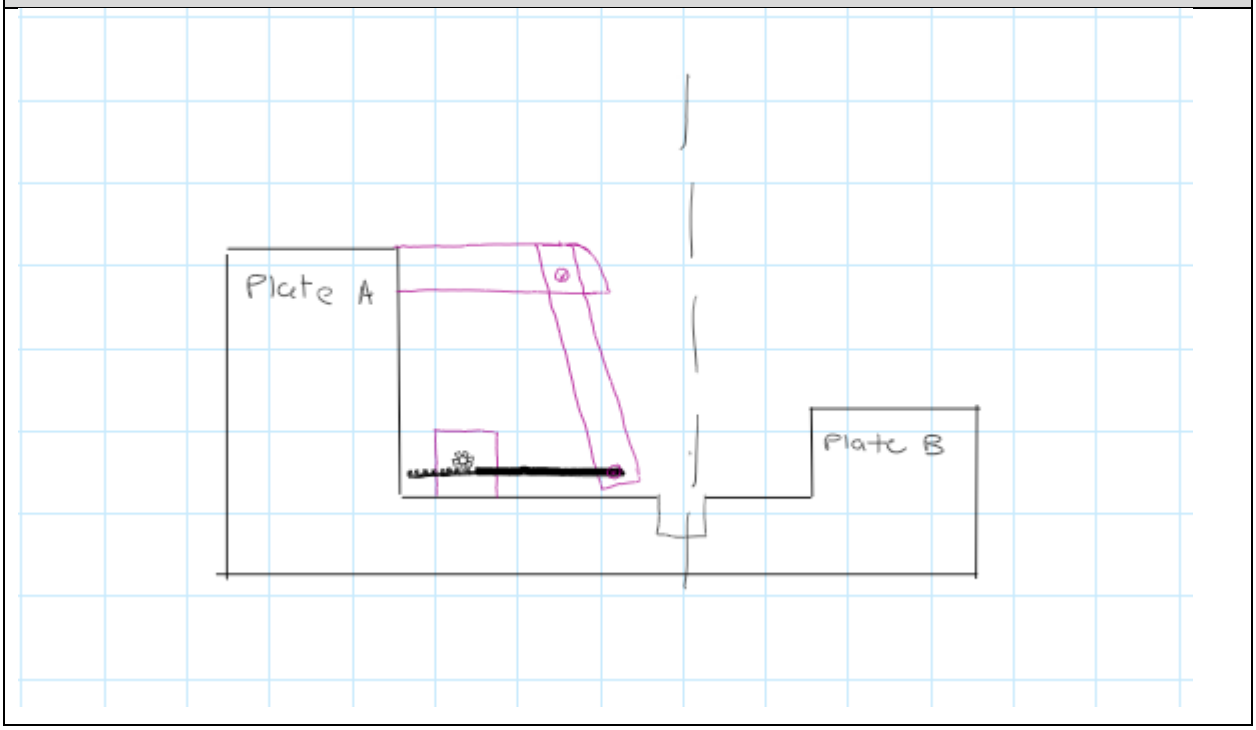
Team ID: Mon-46

Insert images of your initial mechanism sketches in the box below.

Linear Actuator Sketch



Rotary Actuator Sketch



MILESTONE 2 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

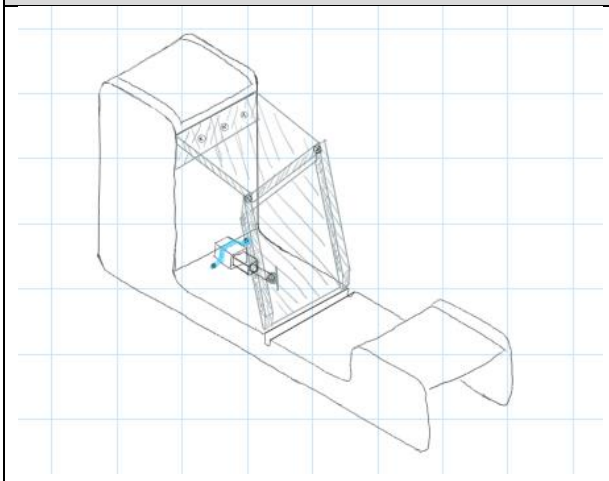
Full Name:	MacID:
Inaaya Lalani	Lalani4

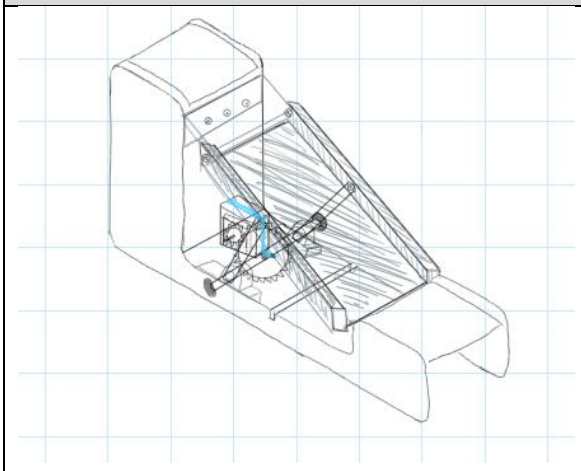
MILESTONE 2 (STAGE 1) – FINALIZED CONCEPT SKETCHES AND CAD MODEL WORKSHEET

Team ID: Mon-46

This is an individual deliverable and should be completed by each team member **prior** to Design Studio.

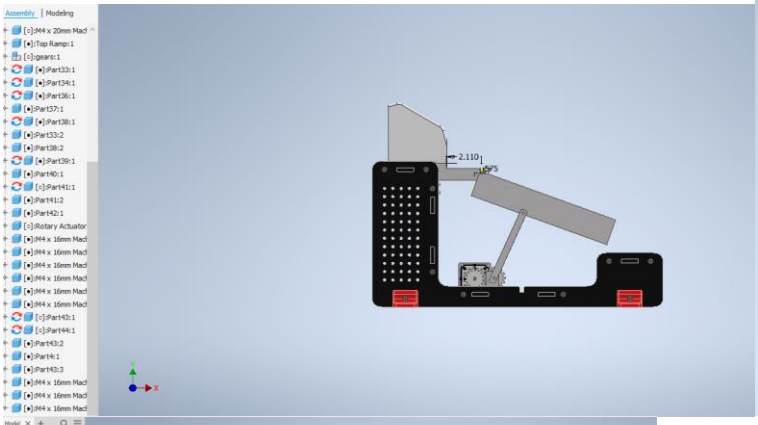
Attach images to the following three boxes of your mechanism sketch concepts and ideas.

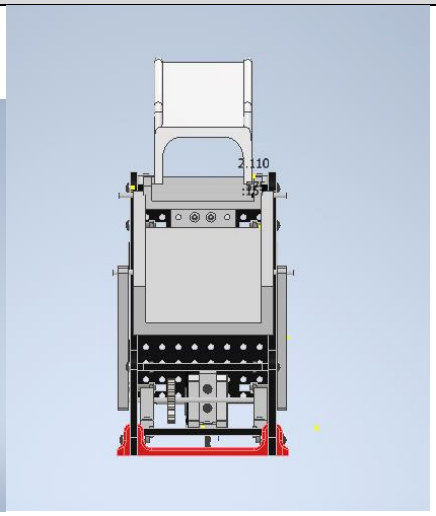
Refined Linear Actuator Sketch


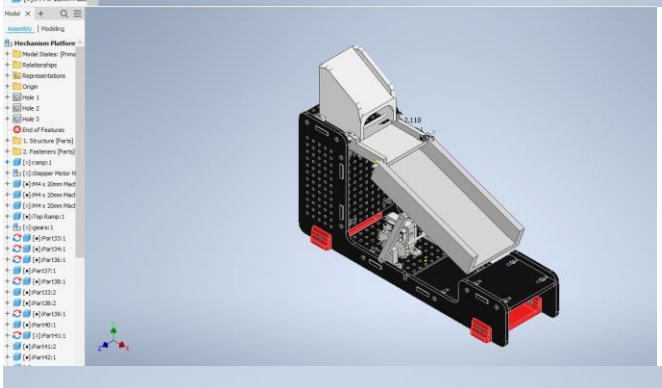
Refined Rotary Actuator Sketch


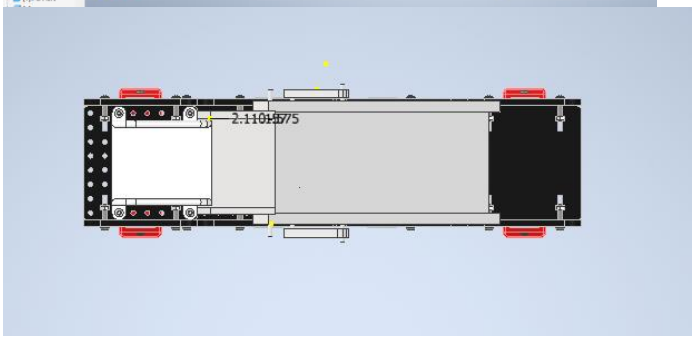
CAD Model Screenshots

Include screenshots of the top, front, right and isometric views of your CAD model. All design features of your CAD model should be visible.









MILESTONE 3 (INDIVIDUAL) – COVER PAGE

Team ID: Mon-46

Please list full name and MacID.

Full Name:	MacID:
Inaaya Lalani	Lalani4

MILESTONE 3 (STAGE 2) – FLOWCHART

Team ID: Mon-46

Insert an image of flowchart in the box for your assigned function. Also change the name of the function to match your assigned function.

oversold()