Corporate F35 Model Plane

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ME1670 – Section A

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Project Description

In order to complete this project and challenge myself, I decided to design a model of an F35 plane. I tried to capture the essence of this beautiful plane while adding my touch to it.

The F35 is a fantastic piece of engineering, and many people regard it as the epitome of aviation; for this reason, I chose it for this project. I tried to keep the exact contours and shape. However, this didn't prove easy due to this plane's extreme engineering. Instead, I kept the basic features the same and created a version of the fighter jet that could be easily converted into use for passengers. Hence the project name “Corporate F35”.

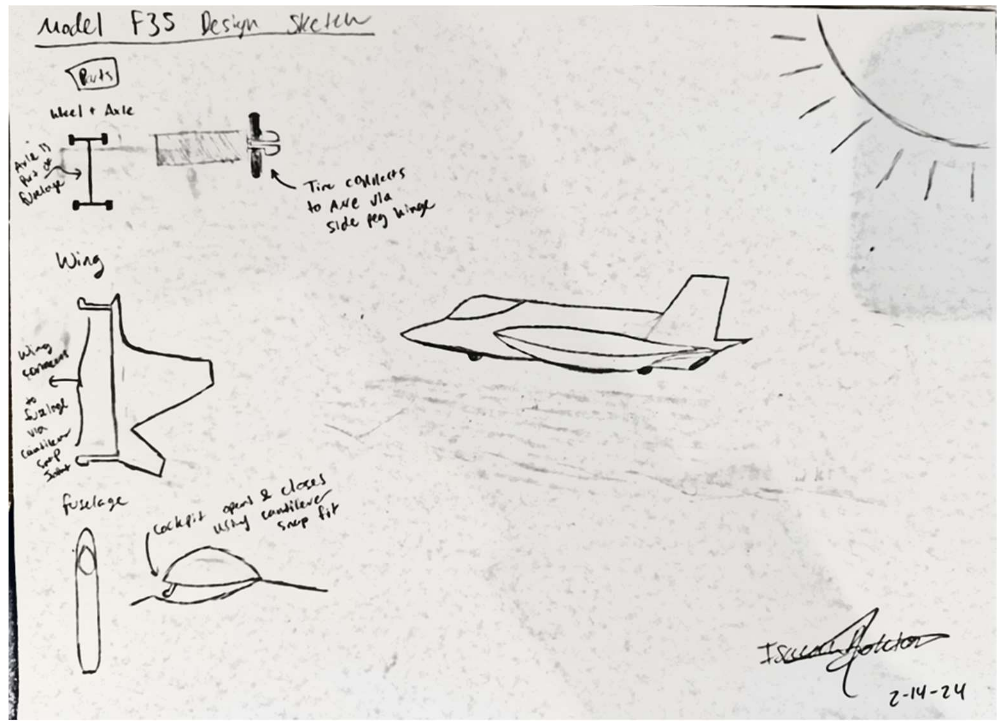


Figure 1: Original Concept Design

The F35 was made with a main fuselage bay and two wings that attach to the fuselage using snap-fits and wing insert holes to keep them secure.

Required CAD Features

Fuselage

1. Revolve: Chassis
2. Loft: Nose
3. Extruded Cut: Cockpit
4. Loft + Lofted Cut: Thrusters
5. Extrusion: Tail
6. Loft: Wing Stabilizer
7. Extruded Cut: Wing Slit
8. Extruded Cut: Cantilever Openings
9. Mirror: All elements

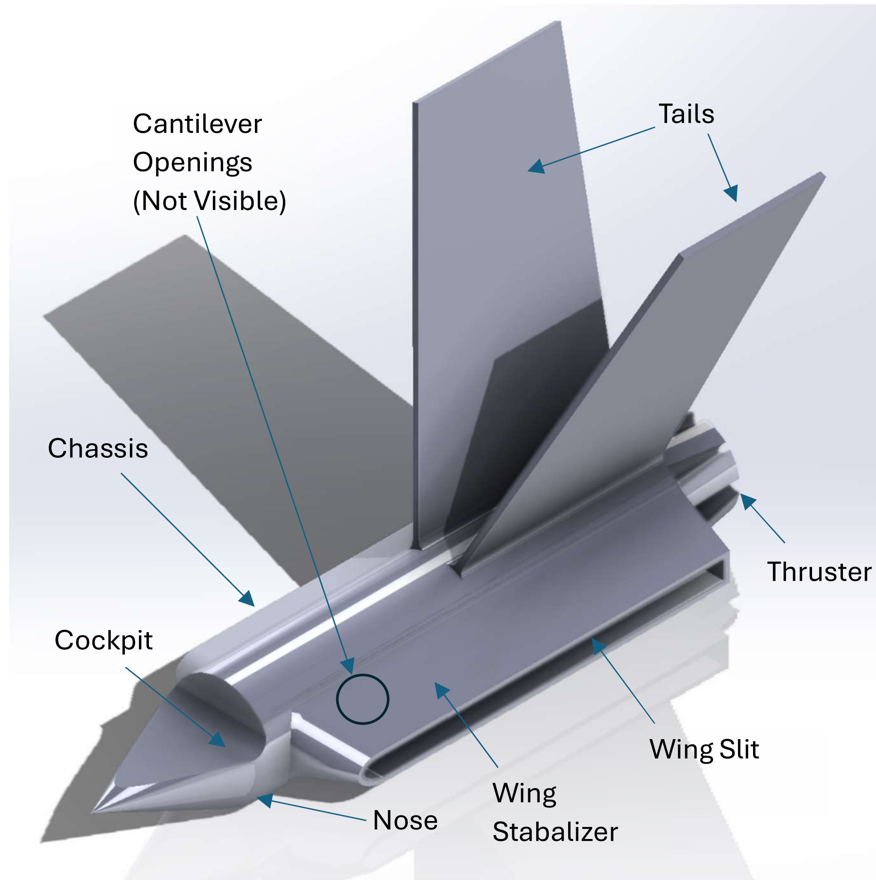


Figure 2: Fuselage Labeled CAD

Wing

1. Loft: Wing Body
2. Extrusion: Wing Insert
3. Extrusion: Snap-Fit
4. Lofted Cut: Airflow Fix

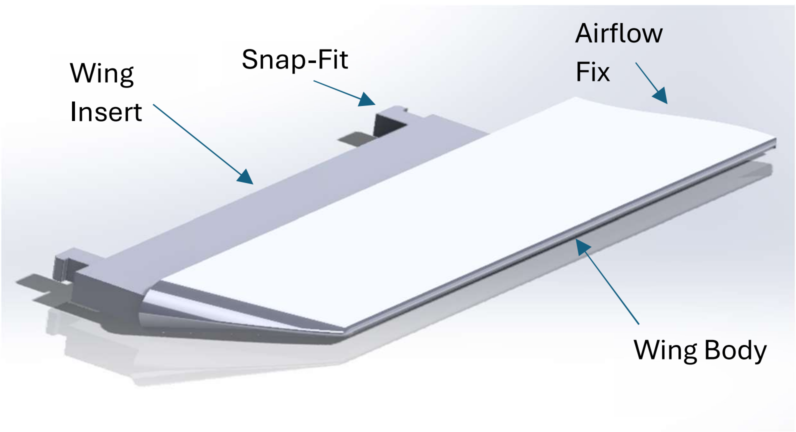


Figure 3: Wing Labeled CAD

Interlocking Feature

1. Cantilever Snap Fits: Snap Fit designs to keep the wings connected to the fuselage permanently. 2 for each wing facing opposite directions.

Figure 4: Cantilever Snap-Fits

Design for Manufacturing Considerations

This project had no moving mechanical parts, so there was nothing to consider regarding movement. However, I had to consider other things. The first thing I had to consider was thickness. To effectively create something that fits within the possibilities of the SLS printer, I ensured a minimum thickness of 1mm (0.039

in) throughout all parts except for the Vertical Stabilizers (Tail). The tail was listed at 0.03 in. (see the fuselage drawing below); the reason for this was to ensure that these could bend and to maintain the correct proportions to the original F35.

In addition to minimum thickness, another requirement was to ensure a minimum tolerance. Due to the desire to keep the wings in place and the lack of a need to remove them, I used a snap fit to attach the wings to the fuselage. According to the Clearance Detection tool, the tolerance within the CAD was listed at 0.308 in for each of the wings to the fuselage. This was done due to high confidence in the high-tech $1 million SLS printer instead of primitive FDM printers. If this project were to be done on an FDM printer, the tolerances would have to be much higher as the space for error would be multiplied.

My design was not based on any previous model. Rather, I used my understanding of the F35's structure and what we discussed in class to make a project that was both challenging and possible for the level of this class.

The last design concern was the material volume limit imposed on the project. Luckily, I was able to get this down the first time as my project had dimensions of 3" x 1.5" x 1.8" with a total material volume of 0.564 in^3. We also had to ensure that no powder would get trapped inside the model due to the expensive nature of the powder. To combat this, I cut a rectangular hole in the bottom of the fuselage to ensure no powder would be lost.

Challenges Faced in Manufacturing

There were a few challenges in manufacturing. For starters, my snap-fit parts came out bigger than the slots they were supposed to fit into, which led to issues when fitting. However, I was able to move past this and push my parts together to fit since they did not need to come apart at all. The good news is that this was the only issue faced by manufacturing.

In hindsight, the Snap-fits could have had higher tolerances to handle the possible manufacturing errors and ensure that the parts would seamlessly fit together instead of the struggle that ensued to have them fit.

Tolerance Analysis

Feature	**CAD Dimension (in)**	**Measured Dimension (in)**	**% Difference**
Full Length	3.000	2.996	0.133%
Fuselage Chassis Diameter	0.500	0.471	5.800%
Cantilever Width	0.100	0.107	7.000%
Wing Width	0.550	0.548	0.365%
Full Height	1.840	1.780	3.261%
Cantilever Length	0.091	0.089	1.111%
Booster Length	0.300	0.322	7.333%

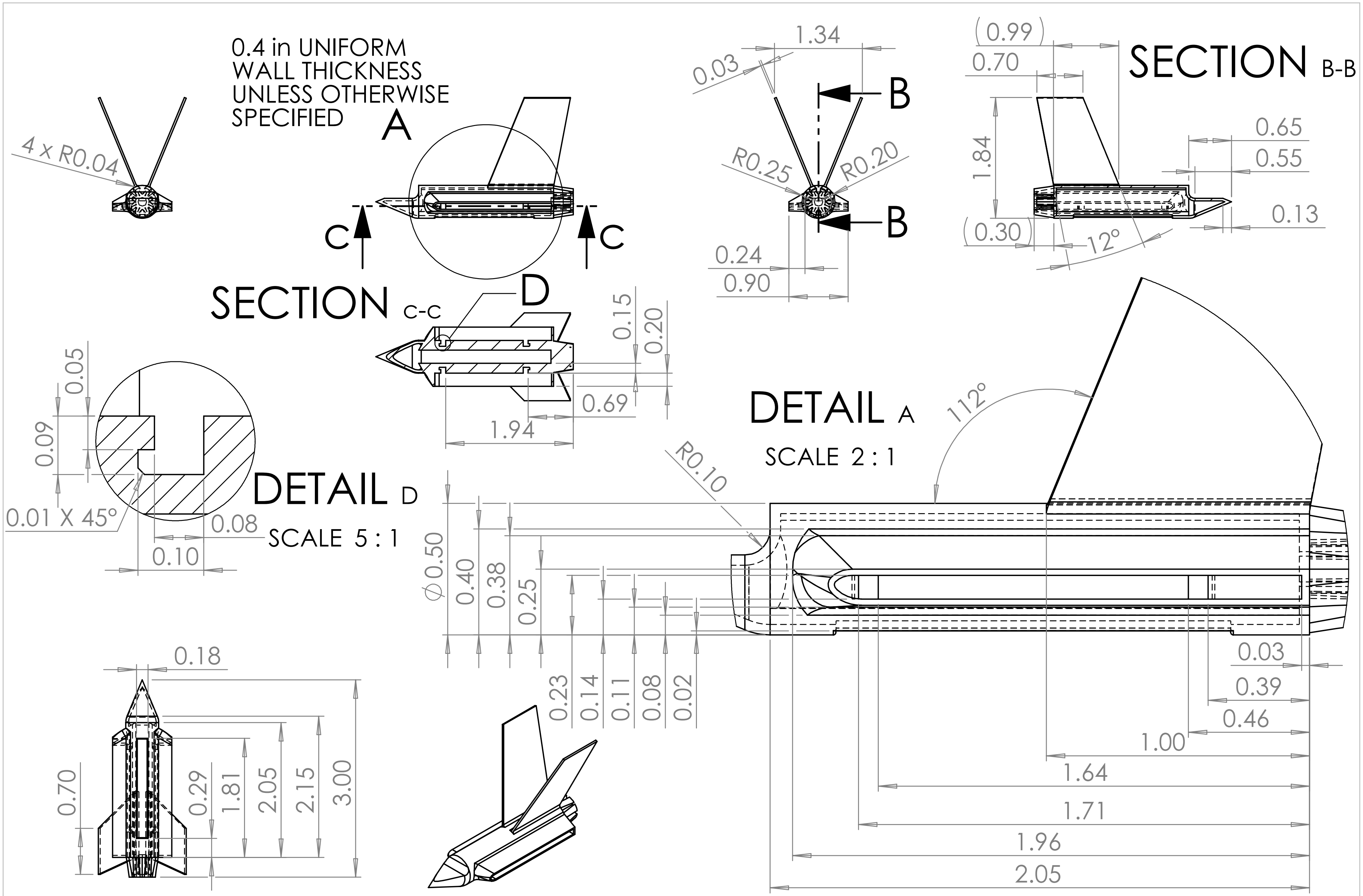
Fuselage Width	0.900	0.889	1.222%
Powder Drop Length	1.520	1.489	2.039%
Length b/t two tails	1.337	1.414	5.759%

The measured dimensions are very close to the CAD dimensions, with the largest difference being 0.40 in and the average being less than 0.07 in. However, the extremely small nature of my parts led to considerable differences in percentages—especially in the snap-fit parts. As mentioned in the Challenges of Manufacturing, these differences in the snap-fits exceeded the clearance designed for them, making the fit a struggle.

It seemed that the smaller the dimension, the less precise the machinery was. More contoured edges also seemed to be worse than basic geometries. However, other than that, there were no trends of what features would be larger and/or smaller and by how much. Therefore, having the correct tolerances and clearances is extremely important to ensure all errors are accounted for.

Conclusion

The process of working through this project this semester has proved to be challenging but doable. As my idea of the F35 developed, so did my designs. I used the skills I had built up from this class, from the mere thumbnail sketches to the culmination of the final ceded model and this document. Explaining the journey from an idea to a full-fledged design. My design fits all the criteria, and it was a great experience. However, it could have been done better, just like any project once completed.



Georgia Institute of Technology

TITLE	DATE	NAME
FUSELAGE	4/18/2024	BOKTOR ISAIAH

COURSE	SEMESTER	SECTION	LAB	ACTIVITY		SIZE
ME 1670	SPRING 2024	A		INDIV PROJ	DIMENSIONS ARE IN INCHES ANGLES ARE IN DEGREES SCALE 1:2 SHEET 1 OF 1	A

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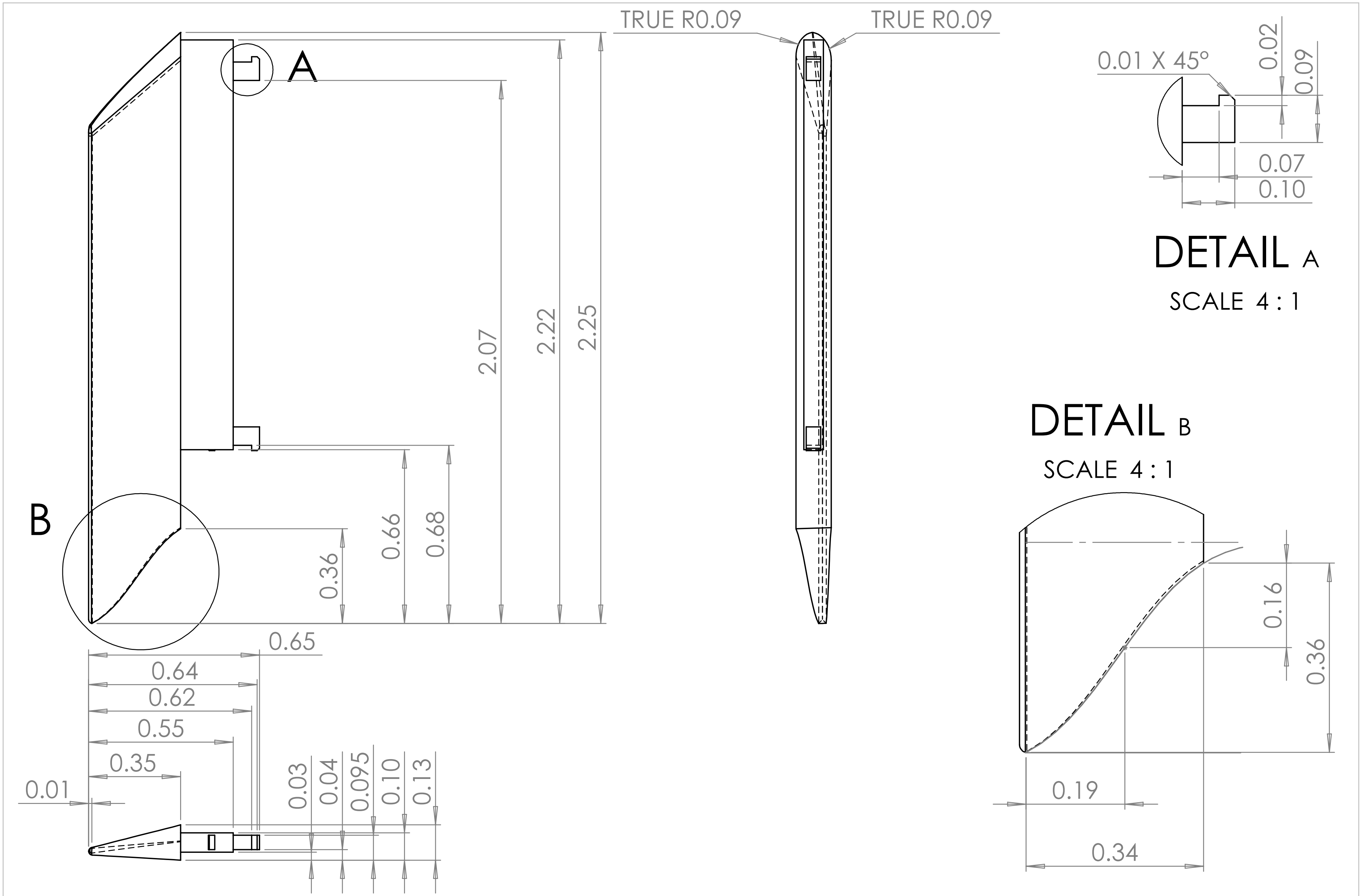

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	COURSE ME 1670	SEMESTER SPRING 2024	SECTION A	LAB	ACTIVITY INDIV PROJ	DIMENSIONS ARE IN INCHES ANGLES ARE IN DEGREES SCALE 2:1 SHEET 1 OF 1	SIZE A

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ITEM NO.	PART NUMBER	QTY.
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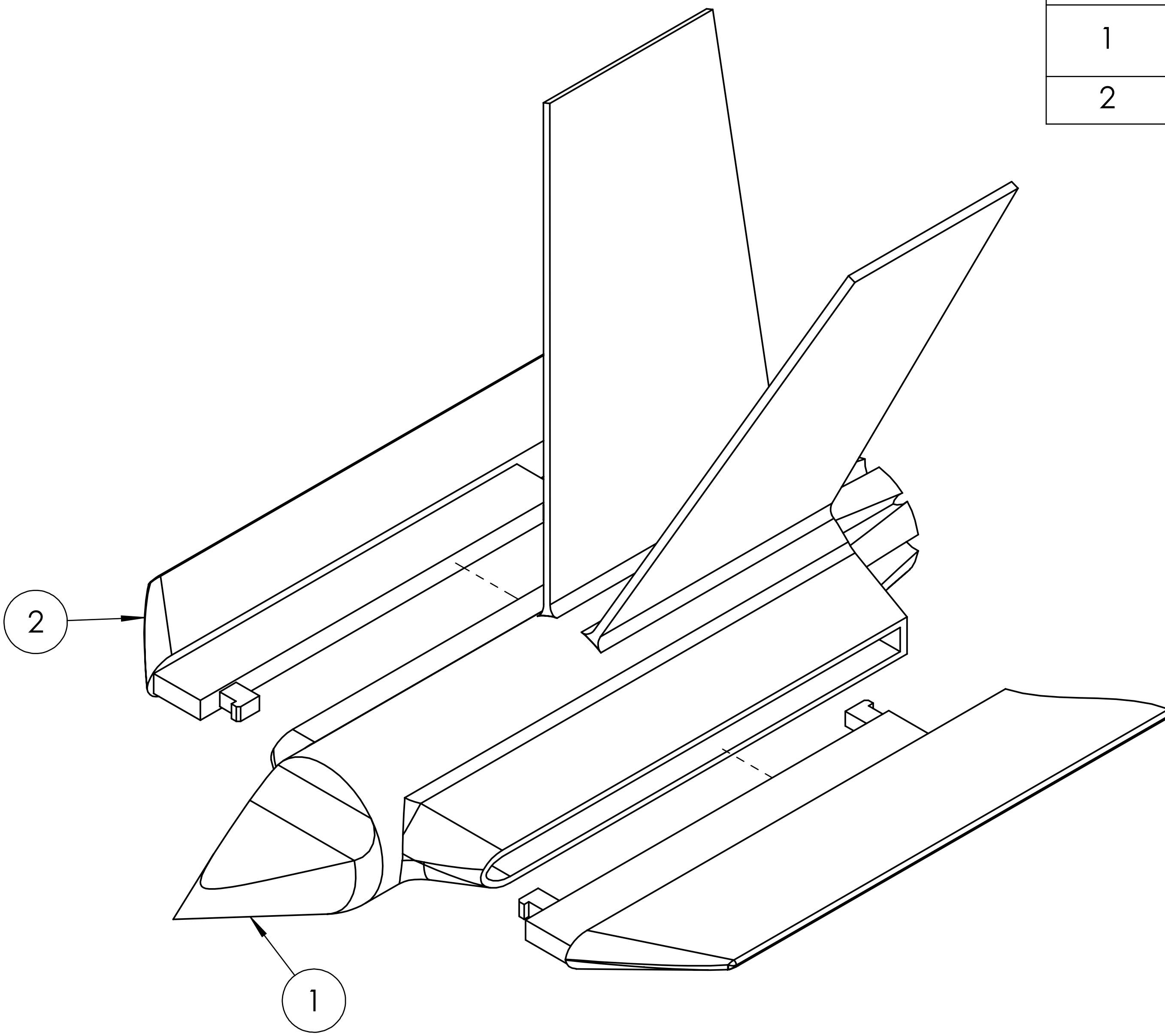
2	Boktor_Isaiah_Wing	2



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Georgia Institute of Technology	EXPLODED VIEW		4/18/2024	BOKTOR ISAIAH		
	COURSE	SEMESTER	SECTION	LAB	ACTIVITY	DIMENSIONS ARE IN INCHES ANGLES ARE IN DEGREES	SIZE
	ME 1670	SPRING 2024	A		INDIV PROJ	SCALE 1:2 SHEET 1 OF 1	A

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