Fidget Spinner Project Final Report

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EXECUTIVE SUMMARY

This report will describe the key information, materials, procedures, and processes used to design and manufacture a working fidget spinner. This project began with a simple 2D design on paper of the main body and bearing caps of a popular fidget toy, the spinner. The 2D design was then drawn into the CAD software, Solidworks, with provided dimensions to ensure proper size. The 2D drawing of the body and caps was then made into 3D models, and then the multiple bodies were assembled into one part. For this project, we decided to use injection molding, a manufacturing process that involves melting plastic into a mold to create a body. The software Fusion360 was used to create the CAM process for the main body mold. The mold was then manufactured by milling onto steel mold plates using the unique g-code procedure. An injection molding machine was used to pump melted polypropylene pellets into the mold, where the plastic hardened into the main body shape. The bearing caps were converted from Solidworks part files into .stl files and 3D printed, another process that uses a code provided on a specialized printer to create hardened plastic parts. The 3D printing software Cura was used alongside CraftBot printers and PETG plastic filament. Finally, using provided ball bearings, the bearings were press fitted into the main body. The bearings caps were also press fitted into the center bearing. The result is a working fidget spinner that spins around while being held from the center bearing caps

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DESIGN PROBLEM

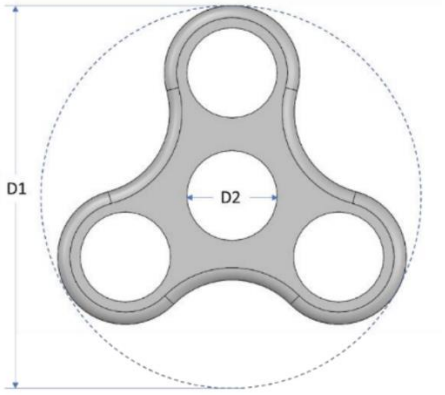
This project was assigned as part of the intro to engineering design course. This meant that I had no knowledge on the procedures and processes to create the final deliverable and had to follow closely to each weeks lecture and assignment to learn the necessary components for completing the project. Additionally, this project implemented working in a small group, which meant developing group skills to accomplish one shared result. With increasing numbers in the cases of ADHD, anxiety, autism, and sensory issues, toys that work to increase concentration such as the stress ball, pop-it, and fidget spinner have increased in popularity in the past decade. In this project, we were asked to create one of these toys, starting with just a simple 2D sketch. We were also presented with the option of creating a creative spinner, with a variety of design options that would make our spinner unique. These options included more than three “arms”, unique body shaped and others. As the designer, I had to make an executive decision based on given restraints as to what my spinner would look like. I also had to make an executive decision on who I wanted to work with, as parts of this project required group work.

DESIGN OBJECTIVE

This project was presented to me and assigned with the objective of creating a working, unique toy that spun in my hand using the required software, manufacturing processes and machines, and design restraints, shown in these tabled.

Required Software	**Purpose**
Solidworks 2021	CAD Design of main body and caps, drawings, drop testing, etc.
Autodesk Fusion360	CAM procedure for fabricating molds
Ultimaker Cura	Used to position bearing caps for 3d printing

Provided Machine	**Purpose**
HAAS Mini-Mill	CNC creation of mold
CraftBot 3D Printer	3D printing of bearing caps
Morgan Press IM Machine	Injection molding into mold



Dimension	**Range**
D1	<100mm
D2	22mm
OD of bearings	22mm
ID of bearings	8mm
Bearing Thickness	7mm
Stock dimensions of molds	100mm x 100mm x 12.7mm
Number of arms	2-5

ENGINEERING DESIGN DRAWINGS

1

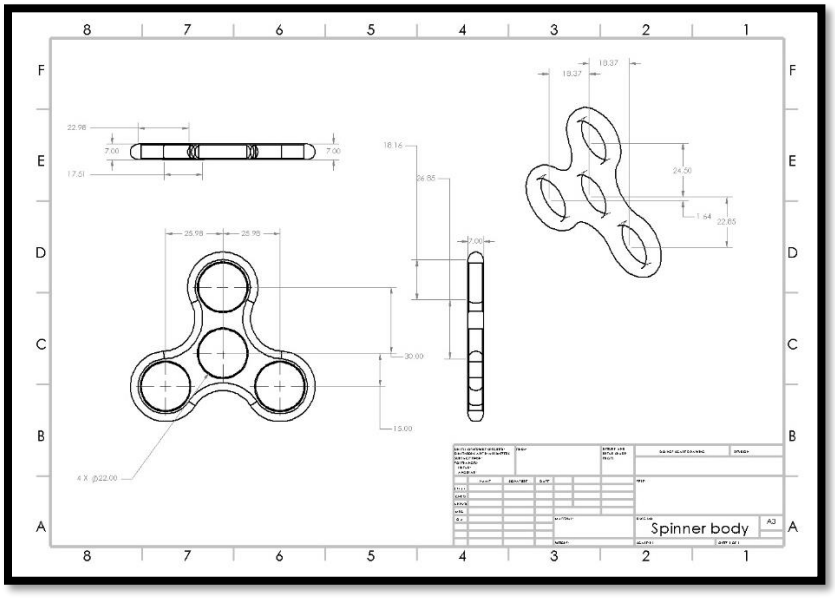


Figure 1. Dimensioned drawing of main spinner body. This drawing includes a 3-view.

2

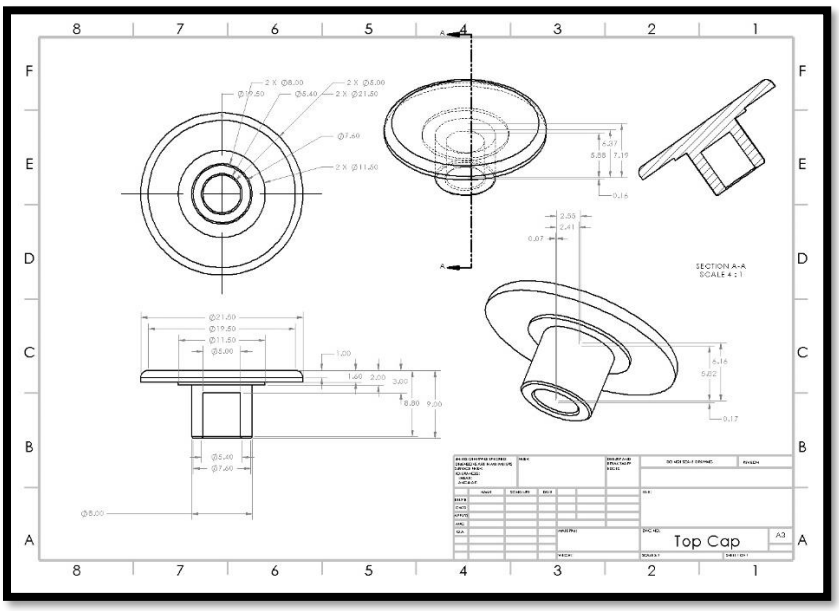


Figure 2. Dimensioned drawing of top bearing cap. This drawing includes a section view.

3

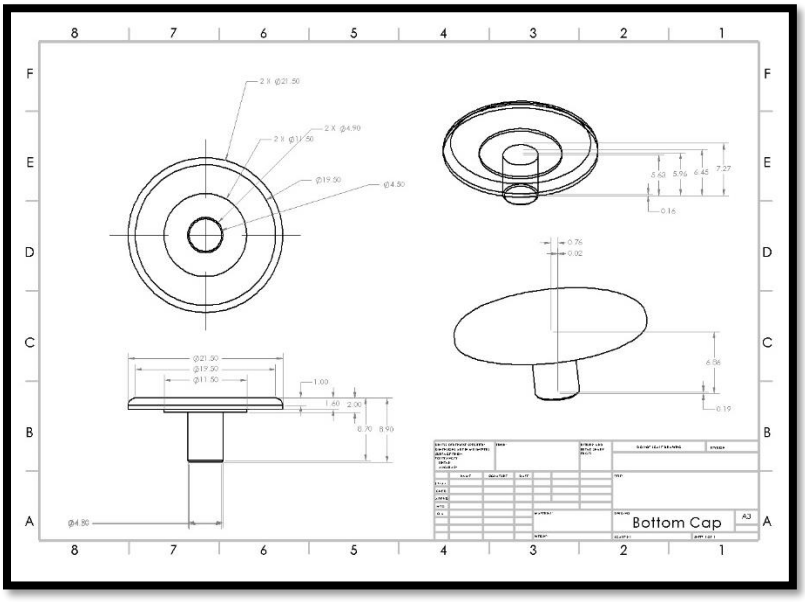


Figure 3. Dimensioned drawing of bottom bearing cap. This drawing includes a 3-view.

4

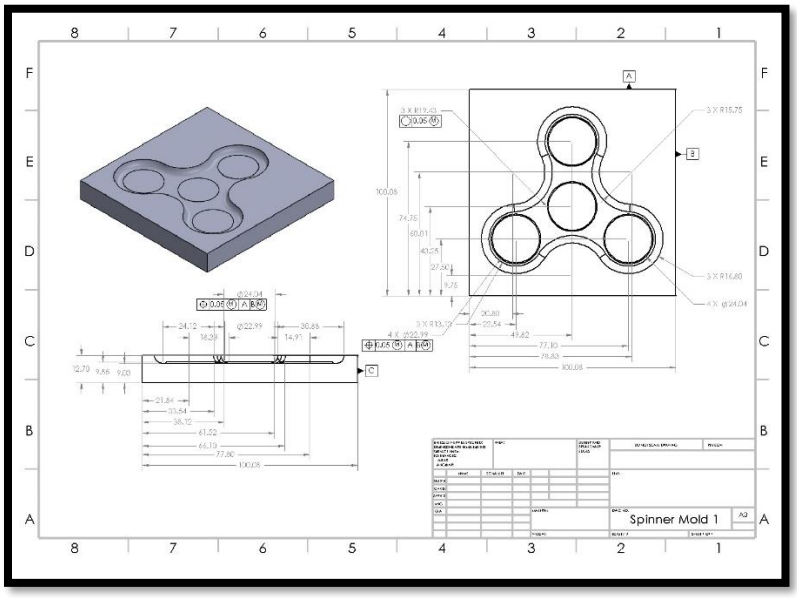


Figure 4. Dimensioned drawing of spinner cavity mold. This drawing includes a colored isometric view and GD&T callouts.

5

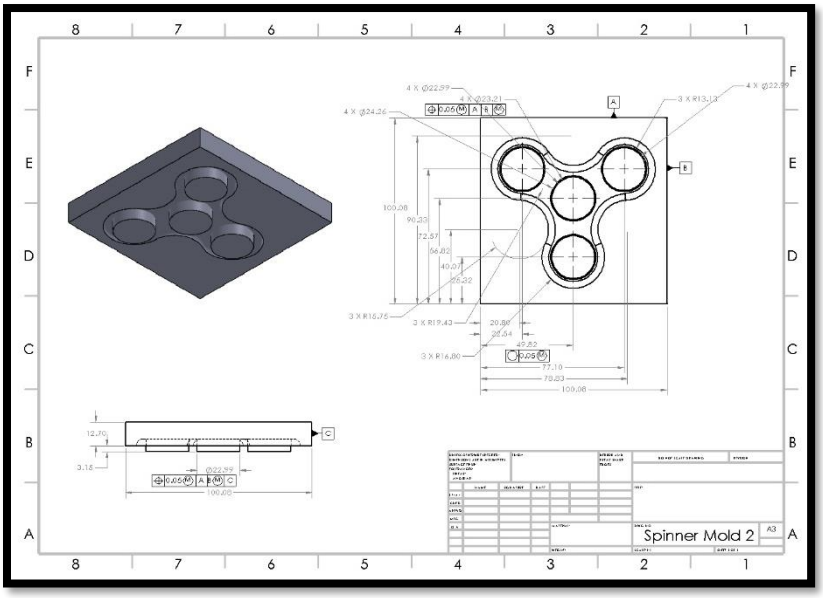
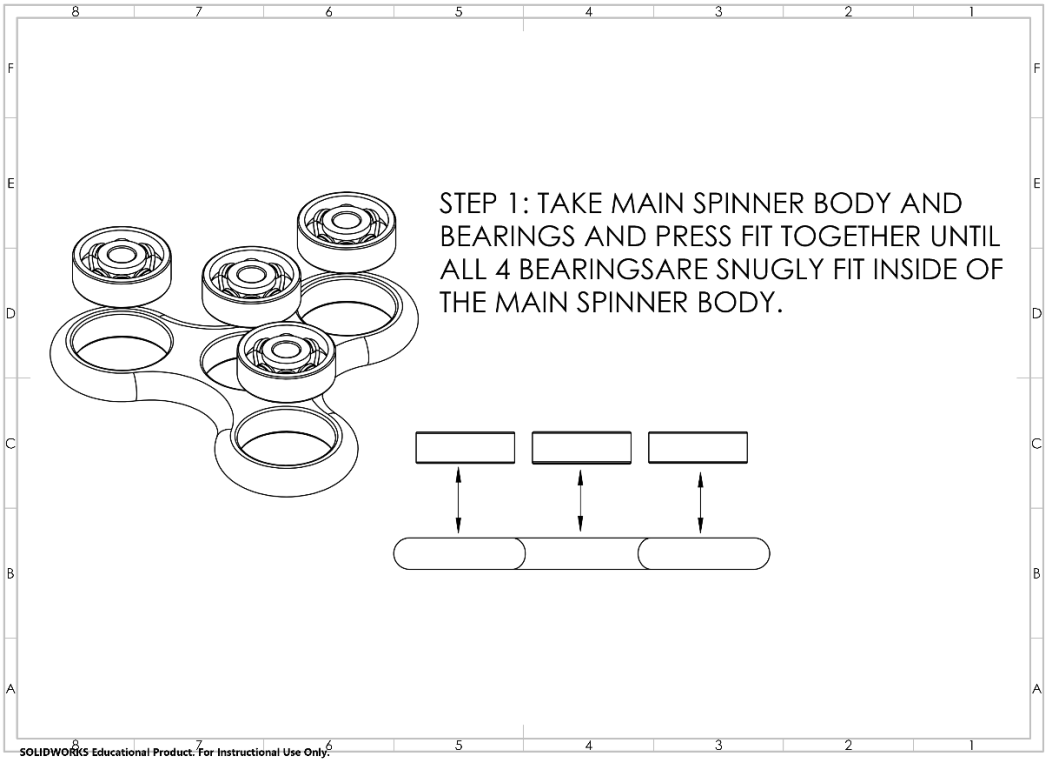


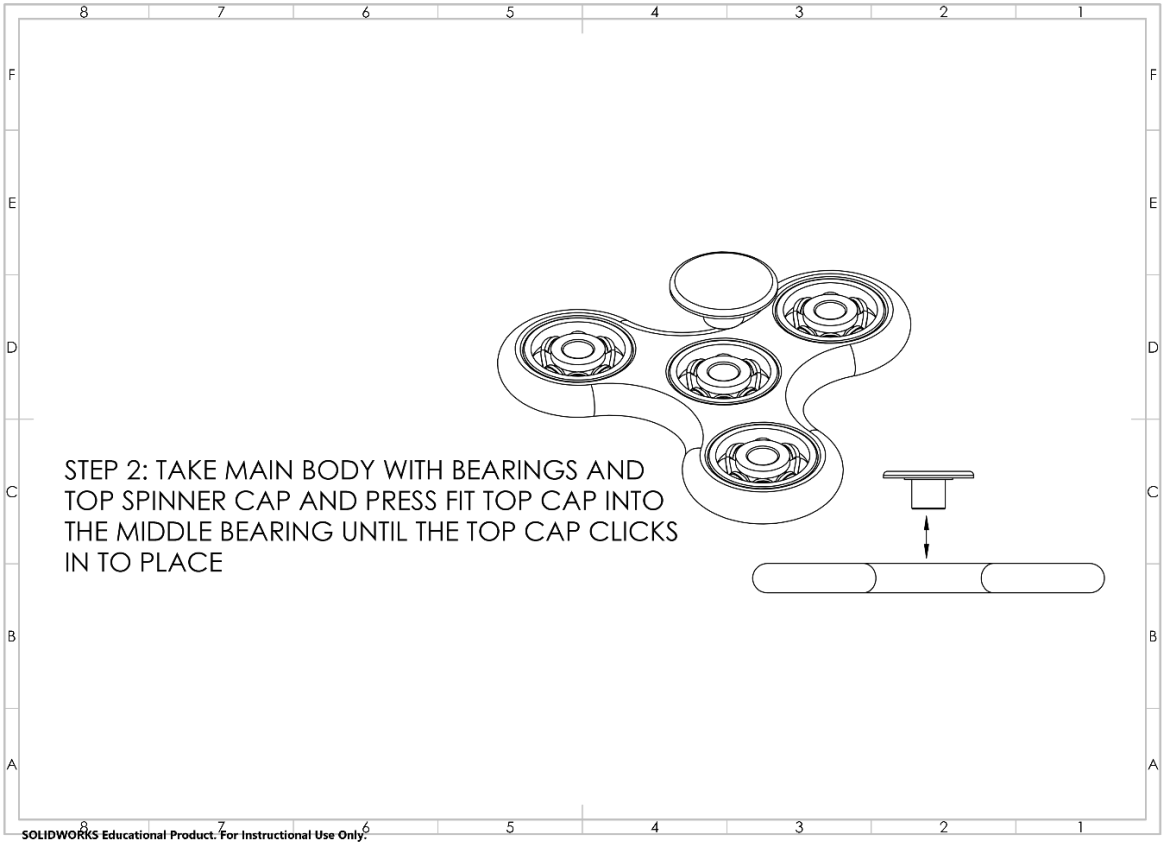
Figure 5. Dimensioned drawing of spinner core mold. This drawing includes a colored isometric view and GD&T callouts.

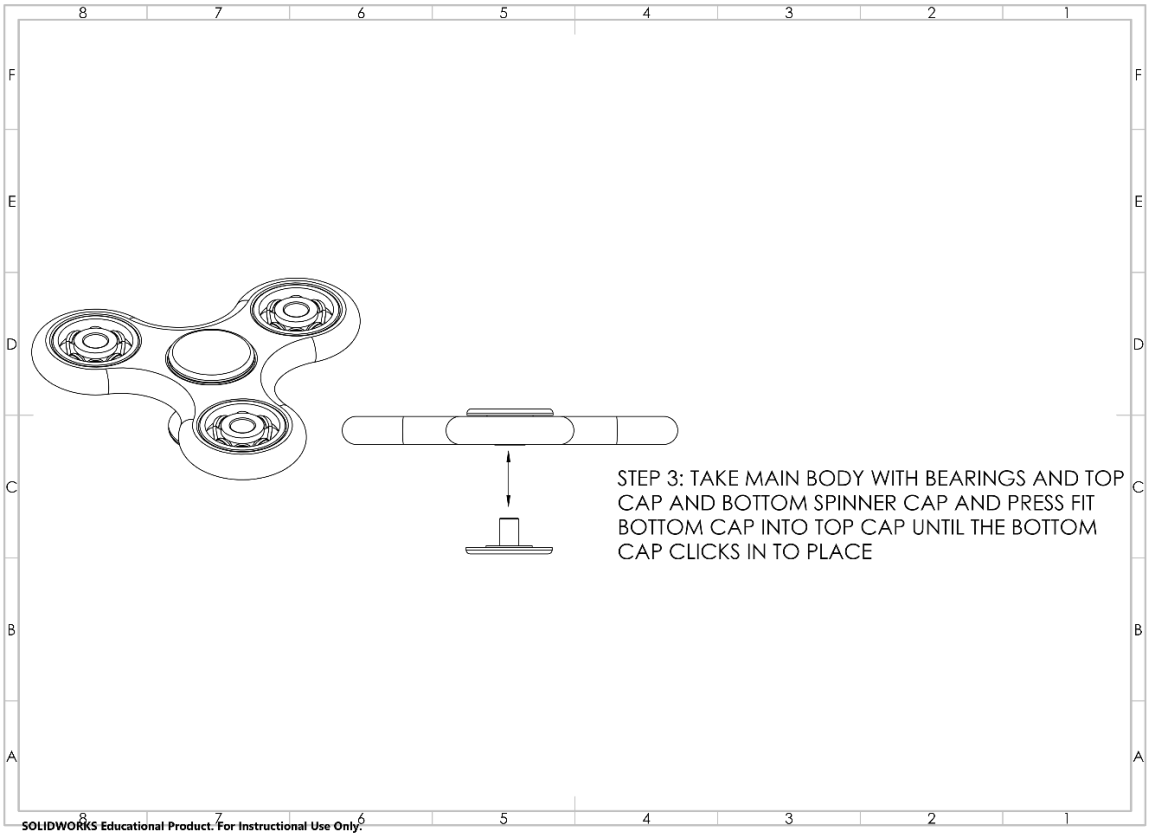
BILL OF MATERIALS

Part #	Name	Quantity	Description	Man. Pro.	Material	Supplier
1	Spinner Body	1	Main body of toy where bearings and caps are press fit in to.	Plastic injection molding on Morgan Press IM	Polypropylene	UT Machine Shop
2	Ball bearings	4	Bearings used to spin toy around center and provide weight to arms.	Automatic lathing to cut steel parts into ball bearing.	Alloy steel	Amazon
3	Spinner top cap	1	Cap used to hold center bearing by.	3D printing with PETG filament.	PETG	TIW
4	Spinner bottom cap	1	Cap used to hold center bearing by.	3D printing with PETG filament.	PETG	TIW

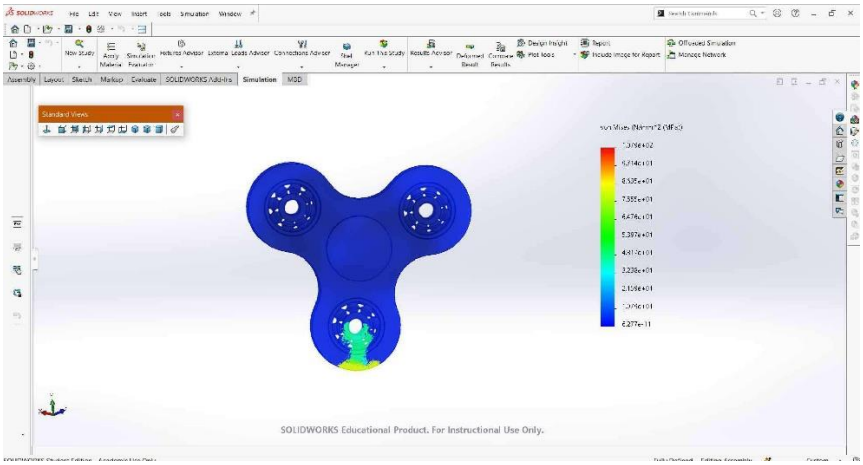
ASSEMBLY PLAN




STEP 2: TAKE MAIN BODY WITH BEARINGS AND TOP SPINNER CAP AND PRESS FIT TOP CAP INTO THE MIDDLE BEARING UNTIL THE TOP CAP CLICKS IN TO PLACE
SOLIDWORKS Educational Product. For Instructional Use Only.


STEP 3: TAKE MAIN BODY WITH BEARINGS AND TOP CAP AND BOTTOM SPINNER CAP AND PRESS FIT BOTTOM CAP INTO TOP CAP UNTIL THE BOTTOM CAP CLICKS IN TO PLACE
SOLIDWORKS Educational Product. For Instructional Use Only.

COMPUTATIONAL MODEL



FEA DROP TEST CONDITIONS:

1. Drop height: 2 meters

2. Rigid floor

3. Position at impact: vertical with one arm of main body contacting perpendicular to floor

RESULT: PASS

PHYSICAL MODEL

MANUFACTURING PROCESSES

Machining the mold -

Our unique g-code created for our mold core and cavity was inputted into a HAAS Mini-Mill. Aluminum plates were then milled out according to said g-code. 3 bits were used, a 2mm ball-end mill, 2-inch face mill, and a 4mm square-end mill.

Injection molding main body -

After our molds were milled, we joined the 2 mold halves and an adapter plate with steel screws. Using a Morgan Press IM machine and polypropylene pellets, we injection molded our spinner main bodies.

Additive manufacturing of bearing cap -

Using our CAM for our bearings caps, .stl files were created and opened in Ultimaker Cura where a g-code was created. We used CraftBot 3D printers and PETG filament to create the top and bottom bearing caps.

CONCLUSIONS

In conclusion, this project aided in my abilities to design, manufacture, problem solve, and work with a team. Throughout this project I learned and realized a few main concepts and points:

- The simpler your design, the better
    - While tempting to create an over the top and extremely unique design, sticking to a simple, more basic one helped me yield the greatest results
- To design, think 2D to 3D
    - Even the most complex designs begin with a 2D sketch. If you can create a quality one, you will create something that is effective.
- Always reference your project outline
    - Never guess on something. Always recheck references, required materials, etc.

If I had to redo this project, there are several things I would do differently. I would begin by ensuring that my 2D sketch was dimensioned properly and did not contain any irregularities or things that made it unsymmetrical. Secondly, I would organize the files on my computer properly in an ordered fashion that makes it easier to find the things I need when I need them. Lastly, I would have selected a different group to work with, one that contained a better overall design. By implementing these three things, I would have saved myself from a lot of unneeded stress and saved hours of time.

REFERENCES

All project documents, videos, lectures, and other help was acquired from www.canvas.utexas.edu under Dr. Rylander's ME302 course page.