Motor Mount

A Baccalaureate thesis submitted to the
Department of Mechanical and Materials Engineering
College of Engineering and Applied Science
University of Cincinnati

in partial fulfillment of the
requirements for the degree of

Bachelor of Science

in Mechanical Engineering Technology

by

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April 20XX

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ABSTRACT

There was already an idea in my head to do this for my senior project because I made a wooden version for a family member. The purpose of taking this on was to take my original idea of a motor mount and make it adjustable for maintenance, but to also make it easier on people restricting them from hurting themselves. The concept of where we wanted to go with this project evolved over time. Constructive criticism from Senior design 2 presentation and barriers that we faced during manufacturing helped form our final product. This final project meets the goals of being lean, adjustable, and able to be stored. These were the keys things that were focused on during the design and manufacturing of the motor mount.

PROBLEM DEFINITION AND RESEARCH

PROBLEM STATEMENT

The outlook on this project is to make a Boat motor fully accessible when working on it. Usually, one will detach the motor from the tail of the boat and move it to a motor stand for the maintenance to be performed. This will be addressed by designing a slim but sturdy design for the stand while also giving it the ability to turn 360 degrees for easy access to the motor. A hydraulic system will also be implemented into the design giving the user the choice to increase the height of the motor.

RESEARCH

BACKGROUND AND SCOPE OF THE PROBLEM

From experience and reviews from personal references It is hard to access certain parts of the motor with the structure of the stand in the way. Height of the motor , complete access to the motor, 360-degree motion of the motor, load capacity, and a foldable structure for storage are all key factor in the design. When addressing the targeted age group of boat owners, the accessibility and mobility of the structure is key to accommodate any user. For example, a boater that has a health issue tied to his back and works on his motor at home would be more inclined to buy a stand that can be adjusted to their liking for easy access to cowl and propeller of the boat motor.

There are a variety of users this product would be affecting. There is a total of 17 million recreational boats—13 million registered plus 4 million unregistered—currently in use in the United States (3). According to the Statista research Department, the average age of use for an outboard boat is fifty-four years of age. Nevertheless, not all outboard motor stands work the same. While some are sturdy and appears to be built with a lot of passion, others are flimsy and are likely to make transporting motors harder than before (4).
The importance of this issue varies depending on the capability of the user working on their boat motor when maintenance is needed. The outboard boat motor stand that are in the market have a dolly like design with a cross bar that acts as a support bar. These stands average sixty to ninety dollars on the market. None of these designs have a 360-degree rotating feature. Some designs have addressed adjusting the height of the stand.

These current solutions are inadequate because of the dolly like design. The structure looks to be sturdy but when working on the motor while resting on one of those stands has blind spots the user would not be able to access. I also feel that transportation of the motor on these stands are dangerous due to the fact one must lean everything back to maneuver the motor, which can result in injury.

CURRENT STATE OF THE ART

When looking at the industrial pallet positioner, the 360 rotating surface is what sparked interest. The surface where the product is placed is a circular platform that can be rotated. This is not a boat motor stand, but the concept of being able to rotate the object that is being worked on is a huge part of the goal. The pallet positioner can be used as a prime example when the base of the boat motor stand is being designed. This is also a spring actuated positioner, which gives some relief to the structure from the weight of the motor.

When researching similar devices, there was a trifold like device used as a boat motor stand. It is a slim structure with three prongs to hold up the stand and the motor making it stable. The stand also has a platform at the very top of the structure that fits in the motors mounting bracket. This product is ideal when it comes to accessibility of the power head of the motor and being able to adjust the height for the specific user. The issue with this product is the mobility. Because it is a trifold like structure, ounce it is set up in one place it cannot be moved while the motor is attached. Also depending on the user's workspace, it can possibly be difficult to perform maintenance considering it is stuck in one position. This product depending on size, has a price range from $131-$166.

The next product is a Brownell Boat Stands which is rated five stars on its respective website. When looking at the structure of the product it seems to be very bulky which is the opposite of the goal. Also, it does not seem to have a steady platform for the motor bracket. The stand also has vertical feature, but the range for the feature seems to be limited. A positive that stands out about this product is the hydraulics feature. When dealing with heavy objects such as boat motors hydraulics system is an excellent feature.

The end user being targeting is the middle – class Americans which consist of 13 million registered boats. According to defining the middle class, the middle-class adults consist of people from ages 25-65. This is the targeted group, meaning the product must meet the demands of both ends of the age spectrum. Unique features from some products discussed above will be implemented to make sure the product is well rounded. With easy access and mobility this will ensure even the older part of the targeted group can use the product to its full capabilities.

END USER

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CONCLUSIONS AND SUMMARY OF RESEARCH

Unique features from some products discussed above will be implemented to make sure the product is well rounded. With easy access and mobility this will ensure even the older part of the targeted group can use the product to its full capabilities.

QUALITY FUNCTION DEPLOYMENT

CUSTOMER FEATURES

Aesthetic

Cost

Safety

Ease of Use

Maneuverability

Overall Size

ENGINEERING CHARACTERISTICS

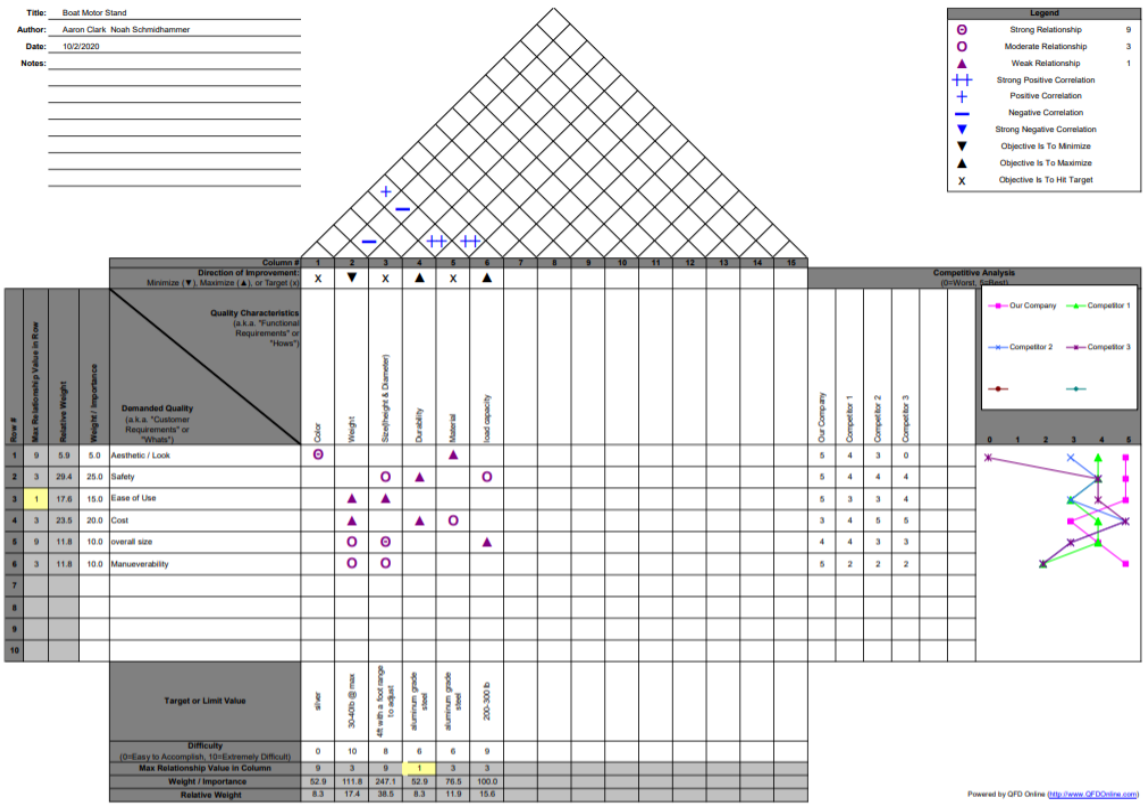
Low in weight

Durability

Load ability

Material

House of Quality



(Figure 1)

Product Objectives

Aesthetic - (5.9%)

This feature has to do with the final "look" of the product, and how the system's appearance is, as a whole.

Cost - (23.5%)

The amount of money a new boat motor stand technology should cost. The cost should be kept as low as possible while supporting the other features required.

Safety - (29.4%)

The boat motor stand will be safe to use in any conditions.

Ease of Use - (17.6%)

Instruction manuals as well as design orientation will affect the ease of use the end user has.

Maneuverability - (11.8%)

Wheels and a collapsible design will make the stand very maneuverable.

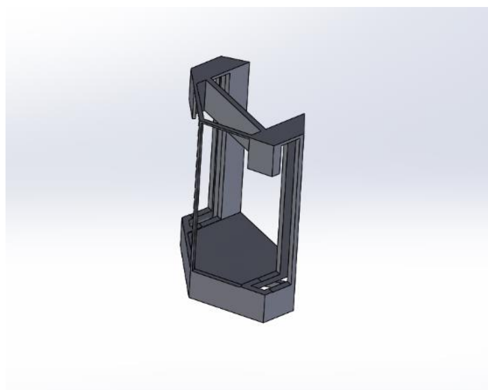
Overall Size - (11.8%)

The size of the stand will be proper to that of the size of the motors they carry. The material choice and design will affect the overall size of the stand.

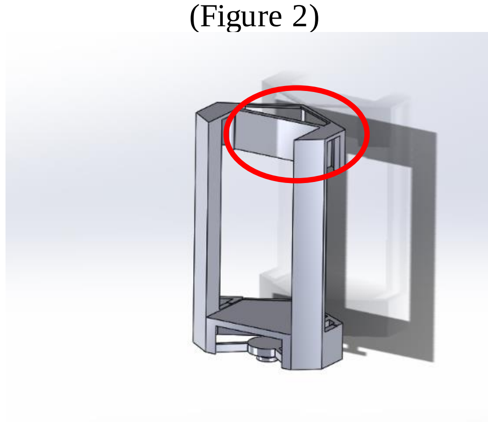
DESIGN

DESIGN ALTERNATIVES AND SELECTION

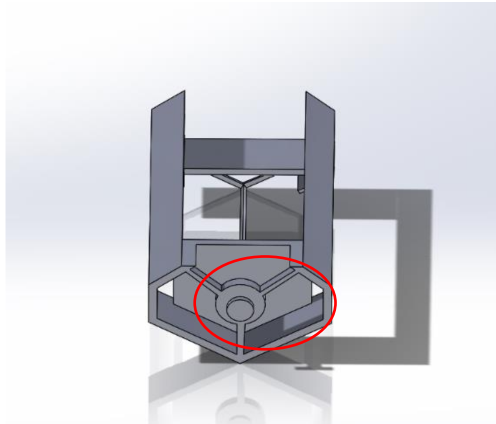
Concept Designs:



(Figure 2)

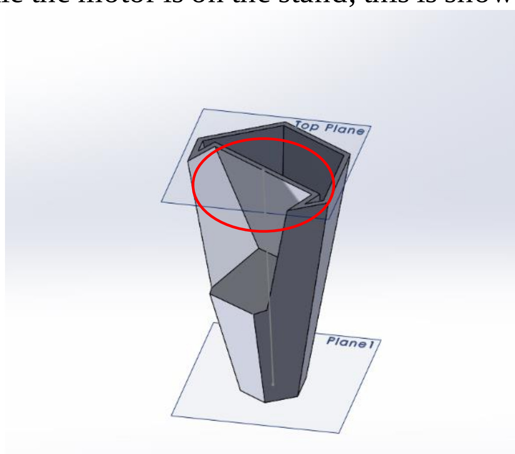


(Figure 3)

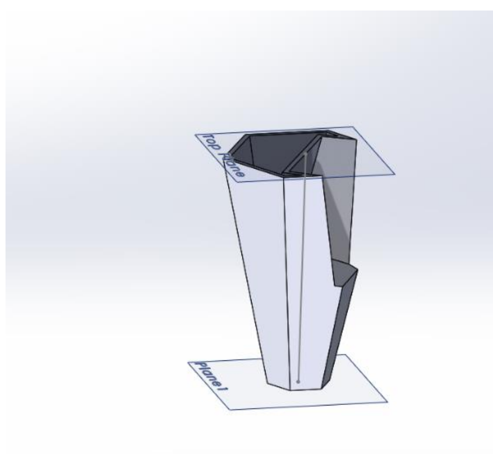


(Figure 4)

This first design consists of a shelled frame with an open back for accessibility. The motor latches onto the stand, this is sown in Figure 2. The platform is on a rotating axis with that allows it to be rotated while the motor is on the stand, this is shown in Figure 3.

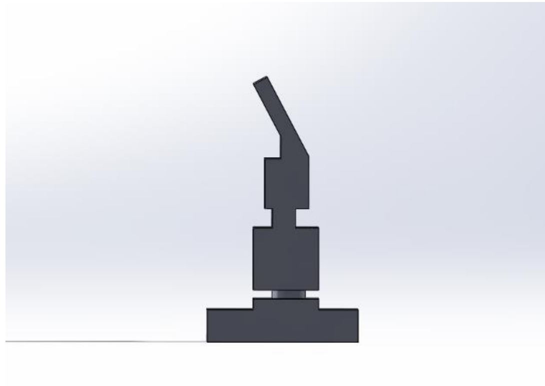


(Figure 5)



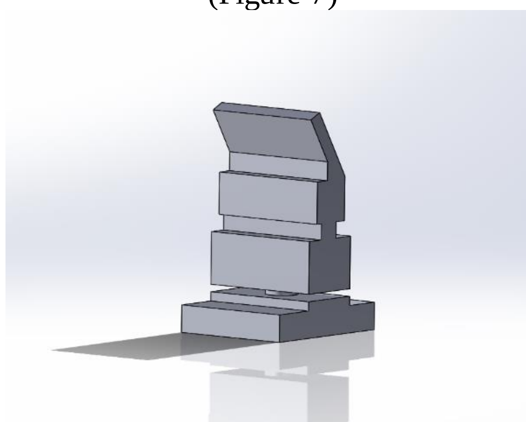
(Figure 6)

Design two has a cone like shape that also has a rotating axis much like design one. The motor would be in the area shown in Figure 1. The space behind the insert is for the top cowl

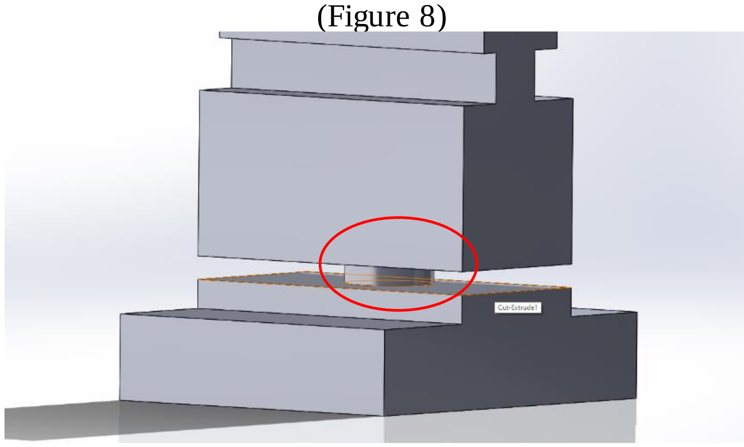


to rest.

(Figure 7)



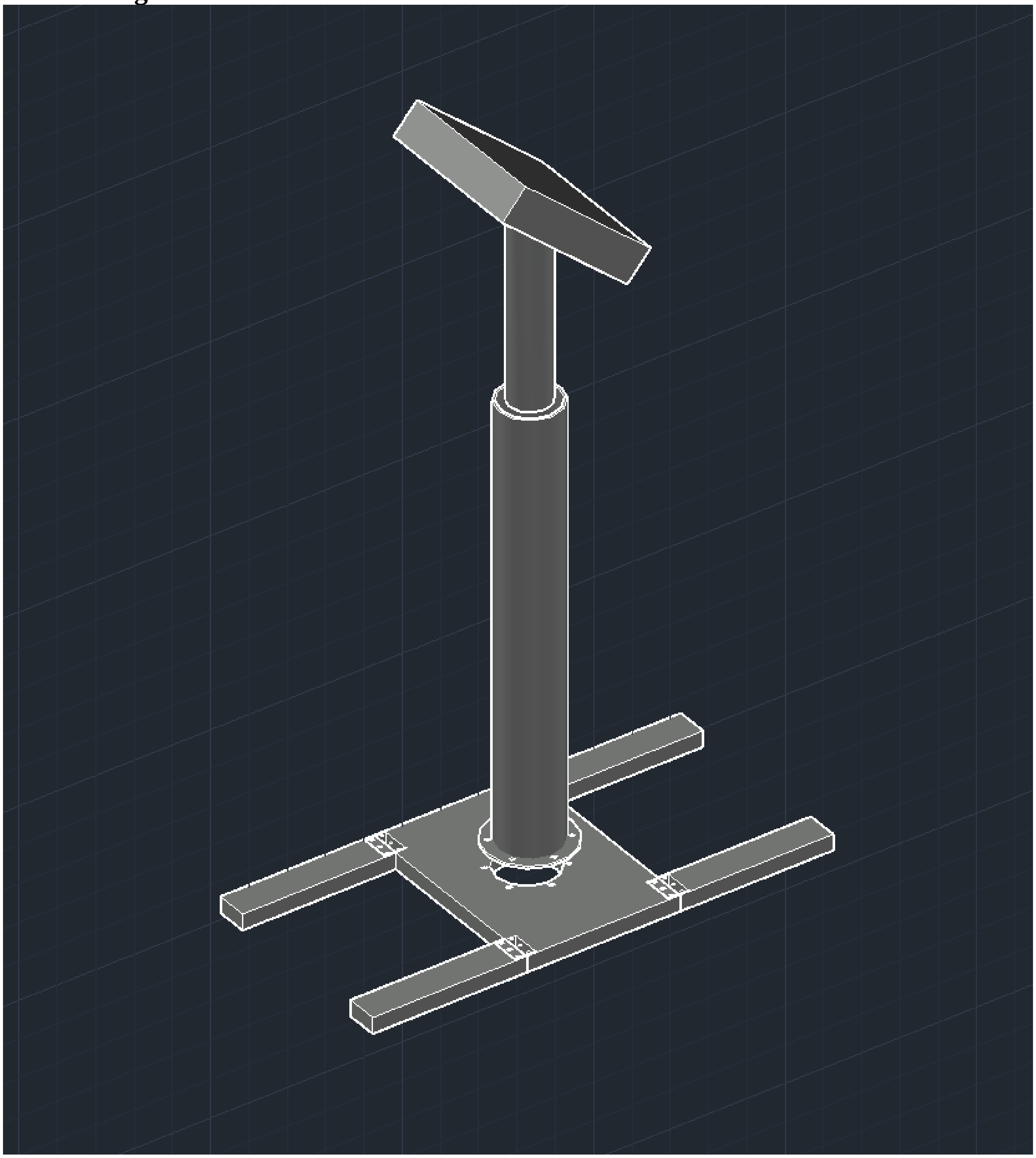
(Figure 8)



(Figure 9)

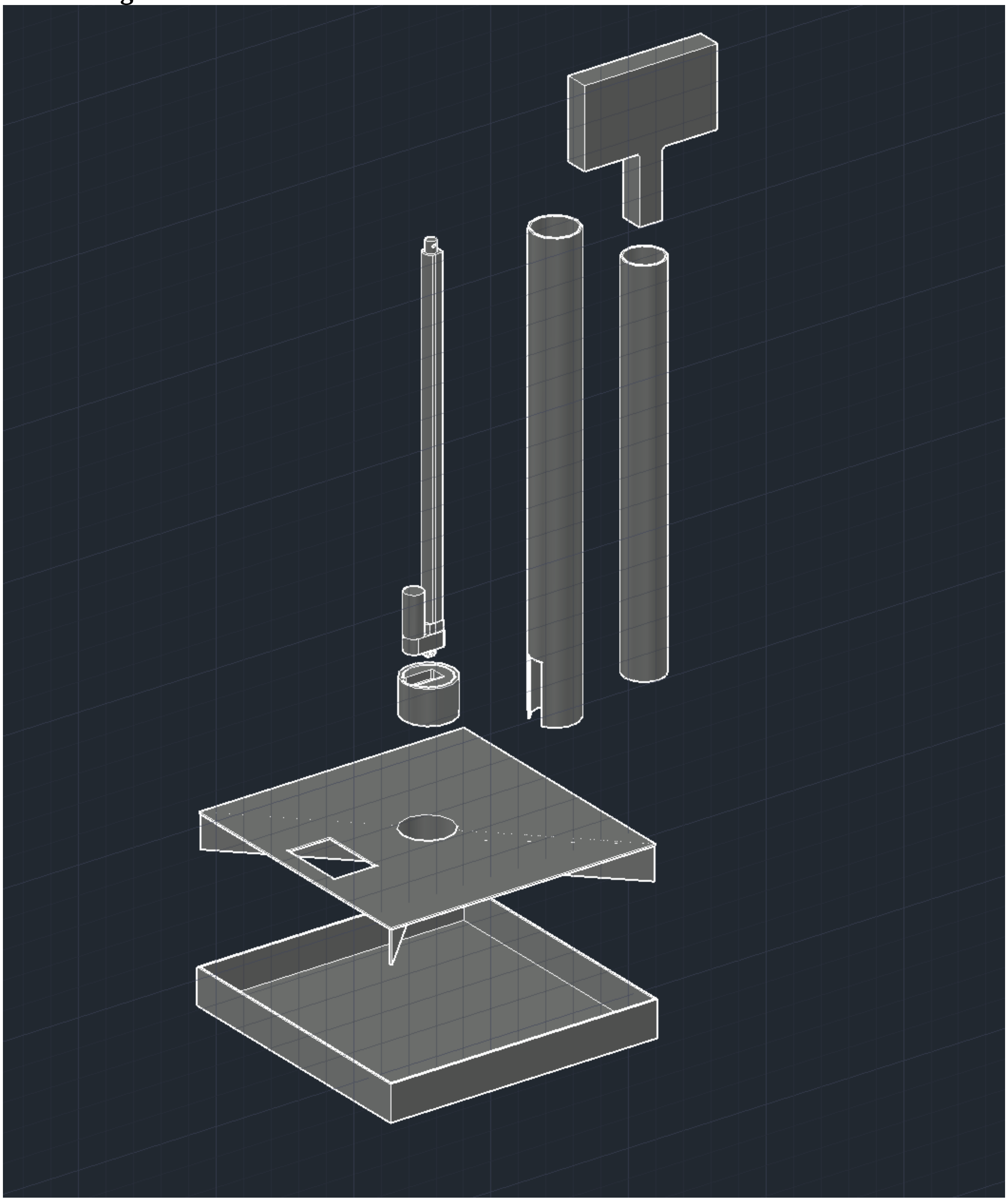
Design three is a less mobile design overall but also much steadier looking. The square base and wide body give it a bulky look. The rotating axis in this design is found between the body and base of the boat motor stand. This gives it the ability to maneuver and rotate. This is shown In Figure 8.

Initial Design:

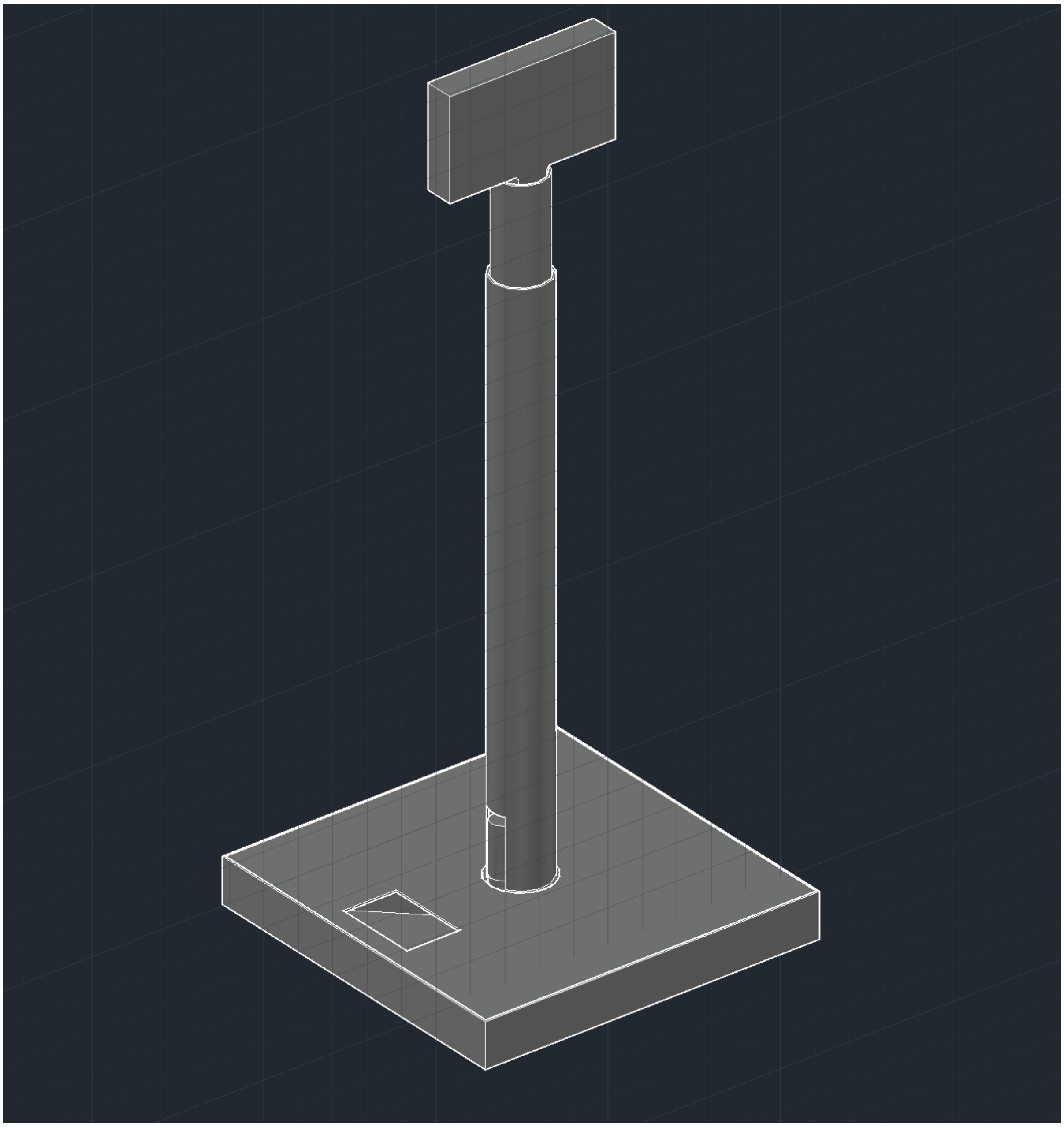


(Figure 10)

Final Design:

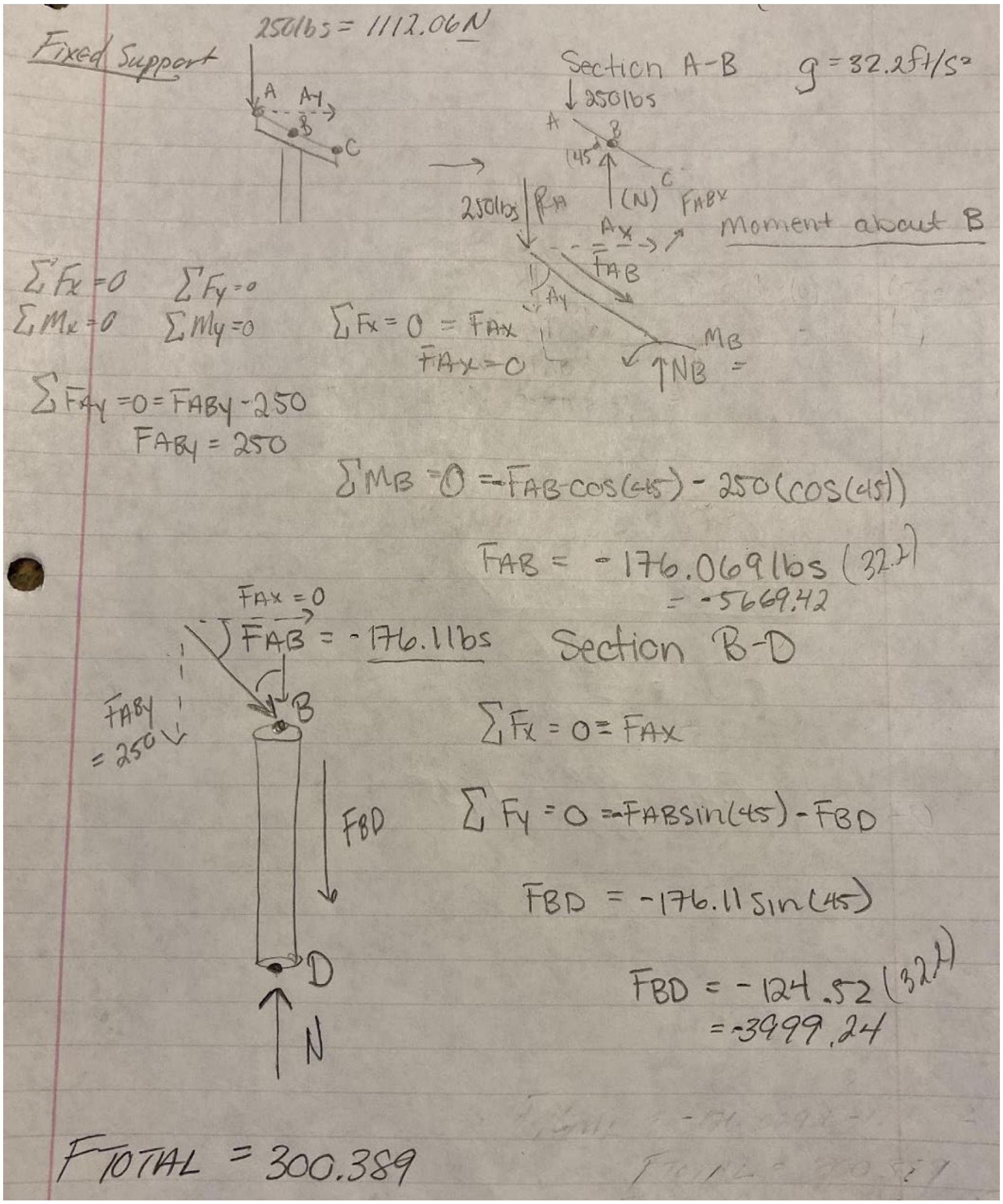


(Figure 11)



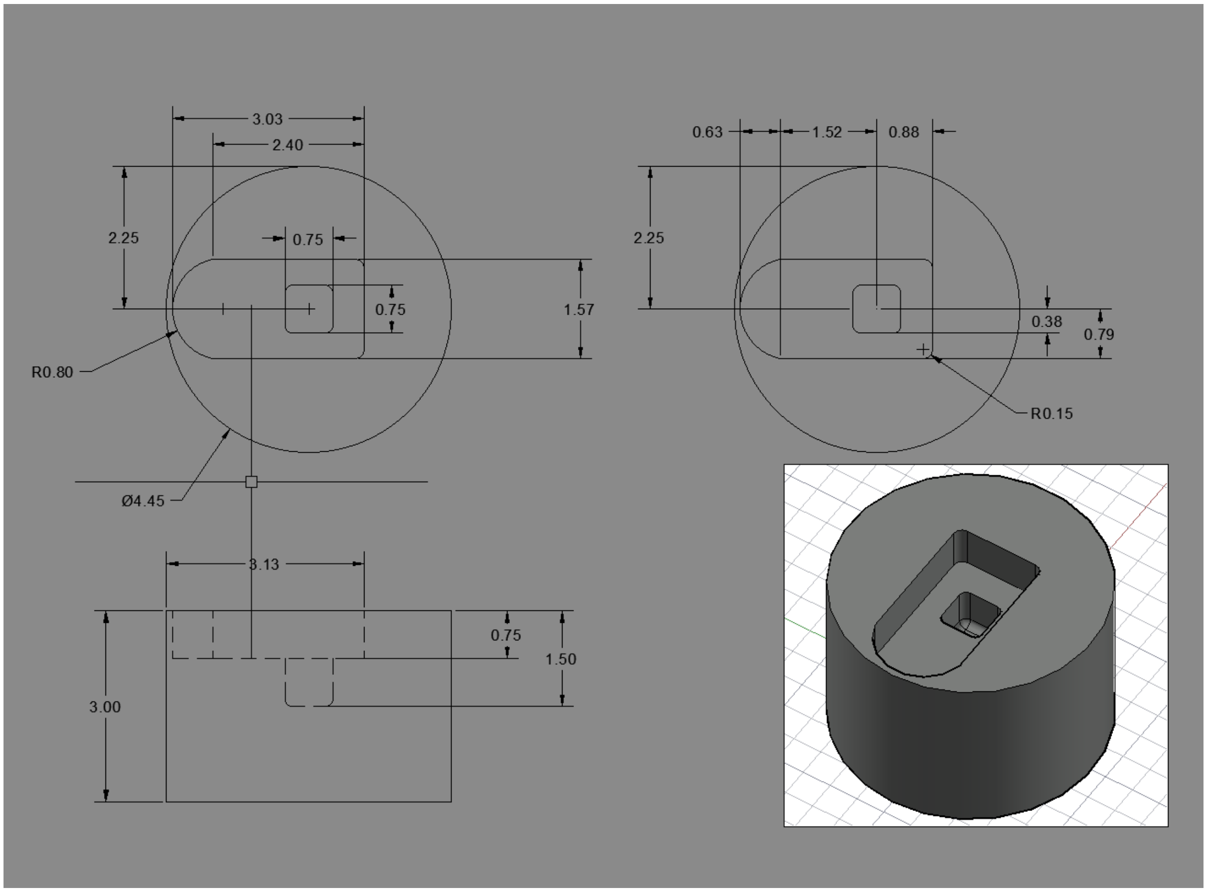
(Figure 12)

ENGINEERING CALCULATIONS

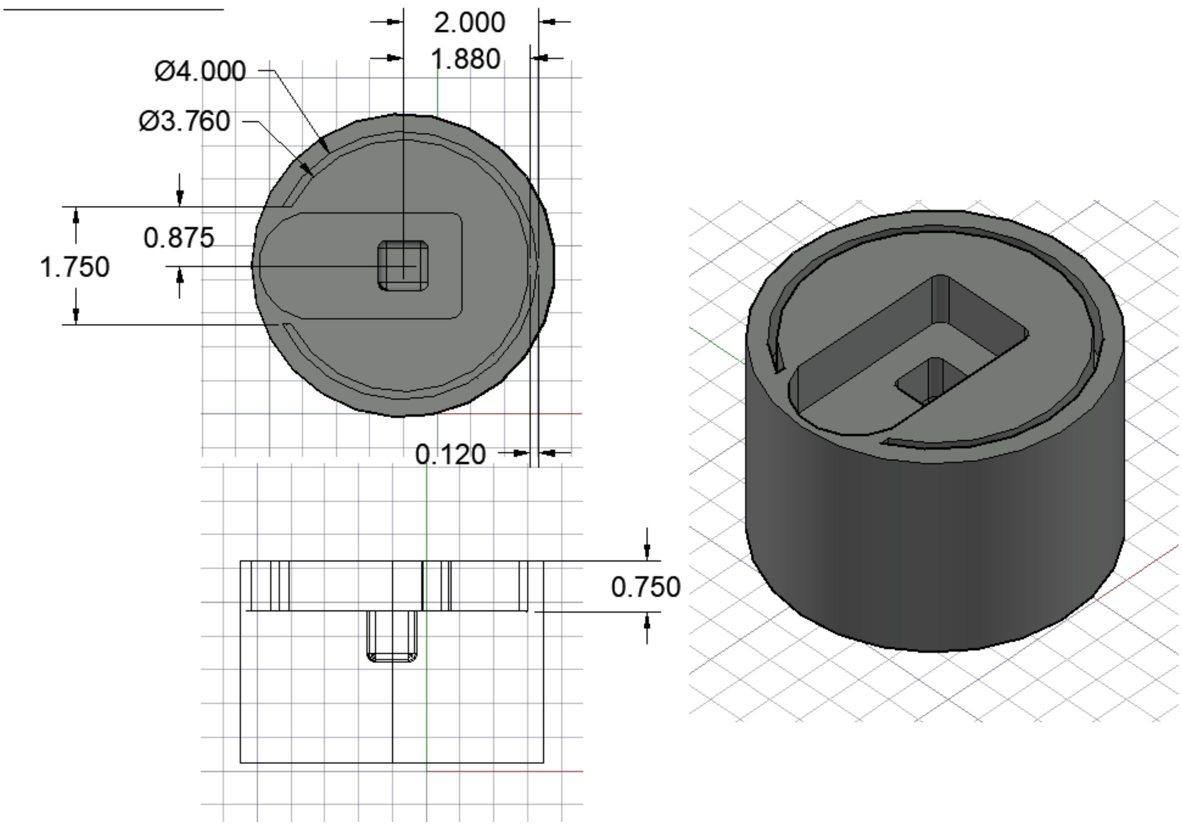


(Figure 13)

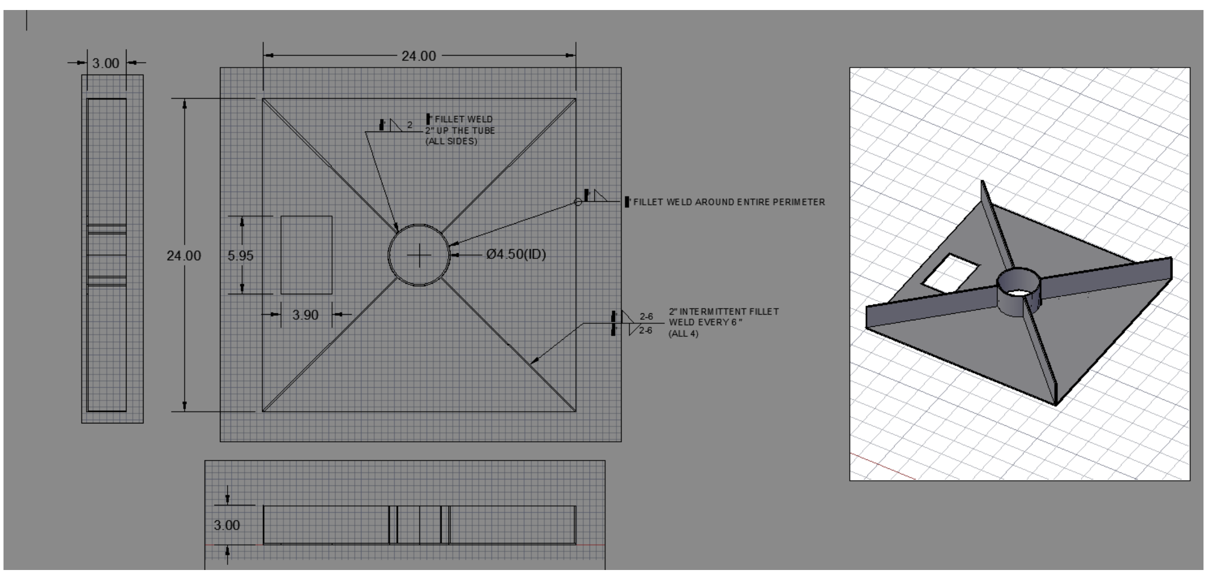
MANUFACTURING DRAWINGS



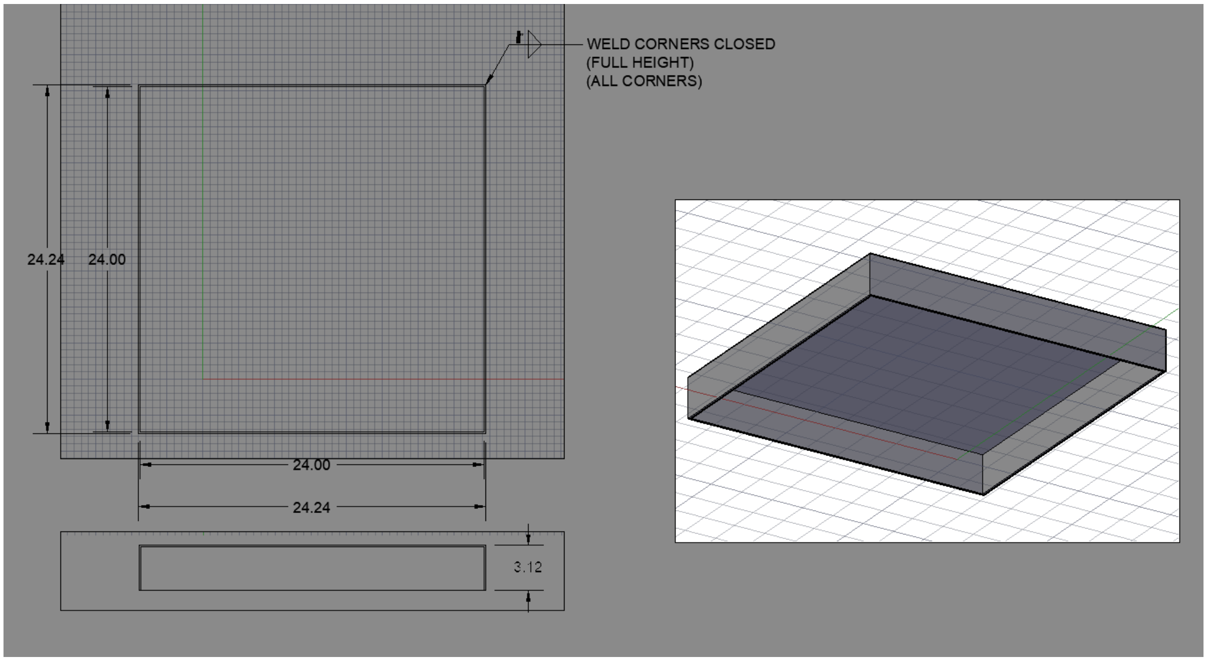
(Figure 14)



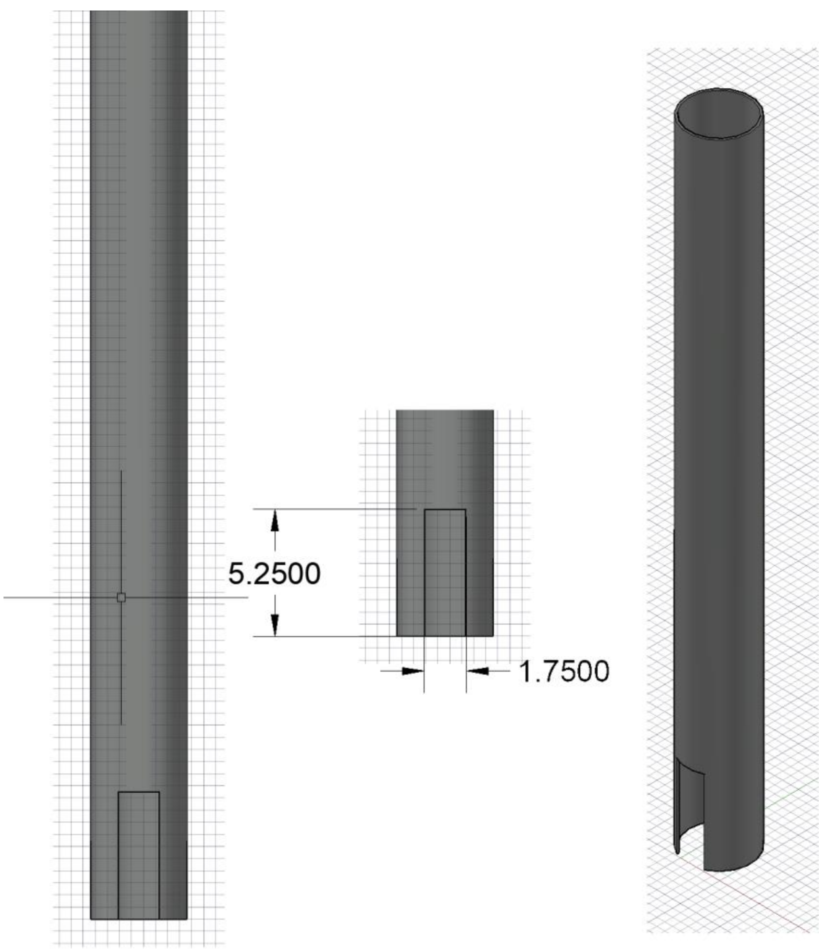
(Figure 15)



(Figure 16)



(Figure 17)



(Figure 18)

BILL OF MATERIAL

Heavy duty Linear Actuator

Wireless controller kit

12V Battery

Needle roller thrust bearing.

4.5’’ diameter rod, 3’’ long

4.5’’ diameter rod, 3’’ long

4’’ diameter pipe, 6’ long

3.5’’ diameter pipe, 6’ long

12 ga carbon steel sheet

5/16’’ diameter rod, 12’’ long

2’’ thick wood, cut to size/shape

BUILD AND TEST

DISCUSSION OF THE MANUFACTURING PROCESSES UTILIZED

Manufacturing included a few processes performed in the UC facility. The Parts Machined and cut include the center mount, piping, the base, and the top piece which the motor is placed on. The base was manufactured using 2 sheets of 12 gage carbon steel that were cut down to size. We also bought the metal for the fins and cut them down to size to then be welded to the top sheet. For the top piece, a hand wheel was used to cut the slot for the battery. Each sheet was bent and welded to one another to complete the base. The center mount was manufactured using the CNC mill cutting the insert for the actuator. A CNC mill was also used to cut out the insert for the 4 in diameter tubing. For the body of the mount, we used a 4’’ diameter and 3 ½ ‘’ diameter low carbon steel tubing, these pieces were cut down to 34’’ and 36’’ using a band saw. A hand saw or wheel was used once again to cut the insert out of the 36’’ tube for the actuator to fit. To connect the 34’’ pipe to the actuator, a 5/16’’ low carbon rod was inserted through a milled hole and the actuator. It was then tig welded to insure it stays in place. There is also a top piece to this design that was made from a 2’’ x 11’’ x 5’ piece of treated wood. This was done using a table saw and a hand saw. It was cut down to 2’’ x 11’’ x 6’’.

TEST PROCEDURE AND CRITERIA

Testing was performed with an old outboard motor that weighed 110 pounds. The testing consisted of 6 trials. The thing we were looking for during testing is the functionality of our product and whether it meets load requirements that where calculated. Functionality included the motor mount rotation with the motor in position. The weight was incremented by 20 pounds maxing out at 210 pounds during the sixth trial. During each test, the actuator was fully extended to with the motor attached to make sure it can also endure the load at max extension. Our design and product met every aspect of the goals of being able to adjust the motor to your liking and being able to store the product sufficiently.

TEST RESULTS AND FINDINGS

Test #	Weight added (lb.)	Total weight Held
Test #1	0	110
Test #2	20 lb.	130
Test #3	40 lb.	150
Test #4	60lb.	170
Test #5	80 lb.	190
Test #6	100 lb.	210

(Table 1: The results recorded during Testing)

Project management

BUDGET, PROPOSED/ACTUAL

Proposed:

Item	Cost
Long stroke Electric Actuator	$160
12v Battery	$35
Aluminum Tubing	$160
Custom Manufactured parts	$200
Hardware and Tools	$20
Misc.	$50
Total:	$625

(Table 2: The proposed budget for the motor mount)

Actual:

Item	**Cost**
Long Stroke Electric Actuator	$130
Wireless controller + Battery	$40
Sheet Metal + welding	$240
Piping	$180
Center Piece	$50
Misc.	$30
Total:	$670

(Table 3: The actual budget for the motor mount)

SCHEDULE, PROPOSED /ACTUAL

Proposed:

Date:	**Action Completed:**
December 15	Begin order sheet metal and hardware
January 15	Configure actuator battery and controller
January 29	Begin assembly
February 8	Trouble shoot
February 19	Complete final assembly
March 5	Testing

(Table 4: The proposed schedule)

Actual:

Date:	**Action Completed:**
January 3	Began ordering Sheet Metal and Pipes
January 29	Configured actuator and wireless controller
February 16	Machining / working with welder
March 24	Final assembly
April 5	Testing

(Table 5: The actual schedule of the motor mount)

SUSTAINABILITY AND MATERIAL USAGE

When it came to material there was a challenge with cost and getting enough money to buy the material that would be better. We bought low carbon steel for the tubing and carbon steel for the base. This material does not do well when it comes to weathering and erosion. 316 stainless steel would have been the best option considering it three percent more nickel than 304 stainless, which helps it repel salt and ultimately makes it perfect for corrosive environments. When it comes to other features revolving around material like weight, there is not much of a difference. Even with a switch to 316 stainless steel, it still would have had a similar weight.

CONCLUSIONS

The outlook of this project was to make a project was to make a motor mount that would give the user complete accessibility to the motor while performing maintenance. The slim but sturdy design was what we were striving to carry out. This goal was based off the existing products on the market today and the bulkiness of those designs. Those motor mounts serve a purpose but are inadequate when it comes to being able to adjust the engine to your liking. Safety and ease of use where two things that we focused on when designing the motor mount based on the QFD. We carried out ease of use through using an electric actuator as our driving force the adjust the height and using a remote to adjust the height. The user can be up to thirty feet away and still use the motor mount.

Building the product was the most challenging part during this process because of the current situation the university is in. Because of covid and restrictions everywhere, we could not just go to the lab at our convenience. This Caused us to put an emphasis on our project management. Scheduling to get machining done played a huge part during the construction of the motor mount. When it came to manufacturing the parts to assemble, everything went smooth. There were not too many mishaps during manufacturing because we plan well and made sure everything made sense before starting that process.

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APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D