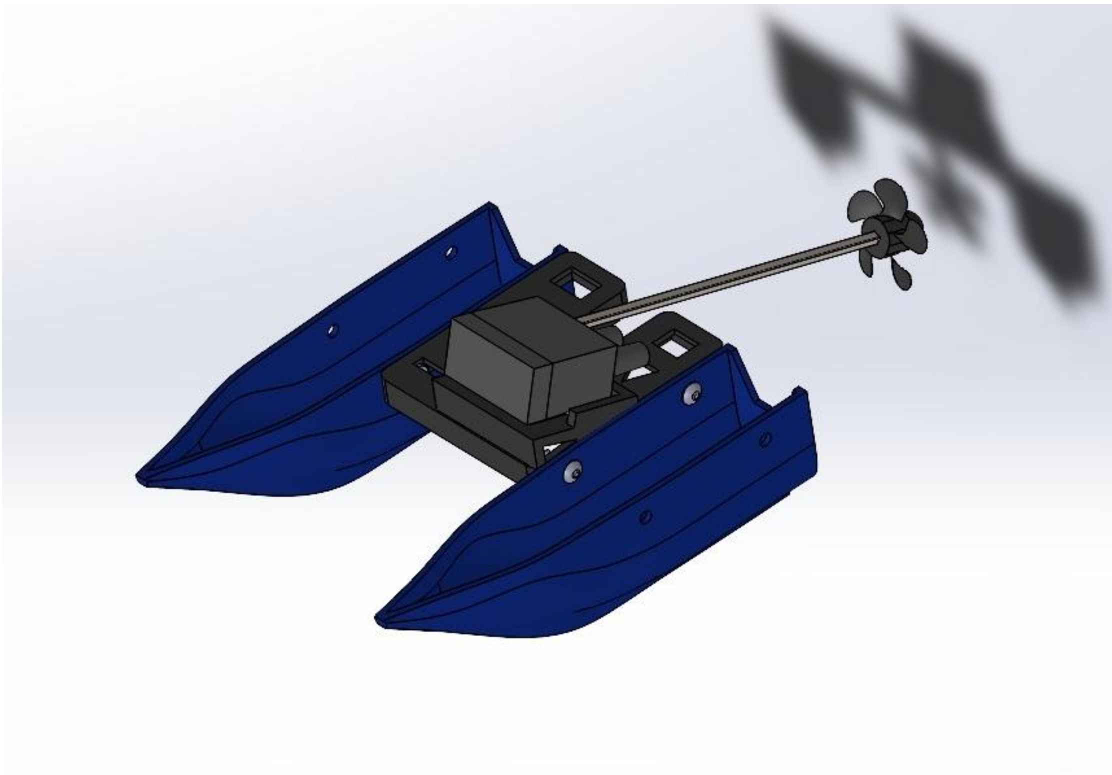

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EGNE 1210 Engineering Design Graphics

December 2022

Abstract

A miniature boat was asked to design with a group of a specification to be able to compete between couples of down-scaled boats. In the beginning, three concepts were suggested to work on. However, not all of them were selected. The first one was selected because of its perfectness of it. Nevertheless, it required a few developments. So, the design started to be simulated in solid works, and each part was assigned to a group member. The hulls were designed precisely because of their significant function. It was designed as a couple of sketches in different planes and then they were connected. Next, the platform was shaped and developed to carry the motor and connect the whole project together by a screw and kept nuts. Also, the propeller was constructed to allow the boat to negotiate rapidly through a 30-second time. Furthermore, the exact details of the holes, screws, kept nuts, and hulls were established in the assembly phase. After all, the floatability was verified exactly to prove its buoyancy. Finally, the boat was tested in the real life and floated over with a load of 50 grams. Also, it achieved the race of finishing the channel in 30 seconds.

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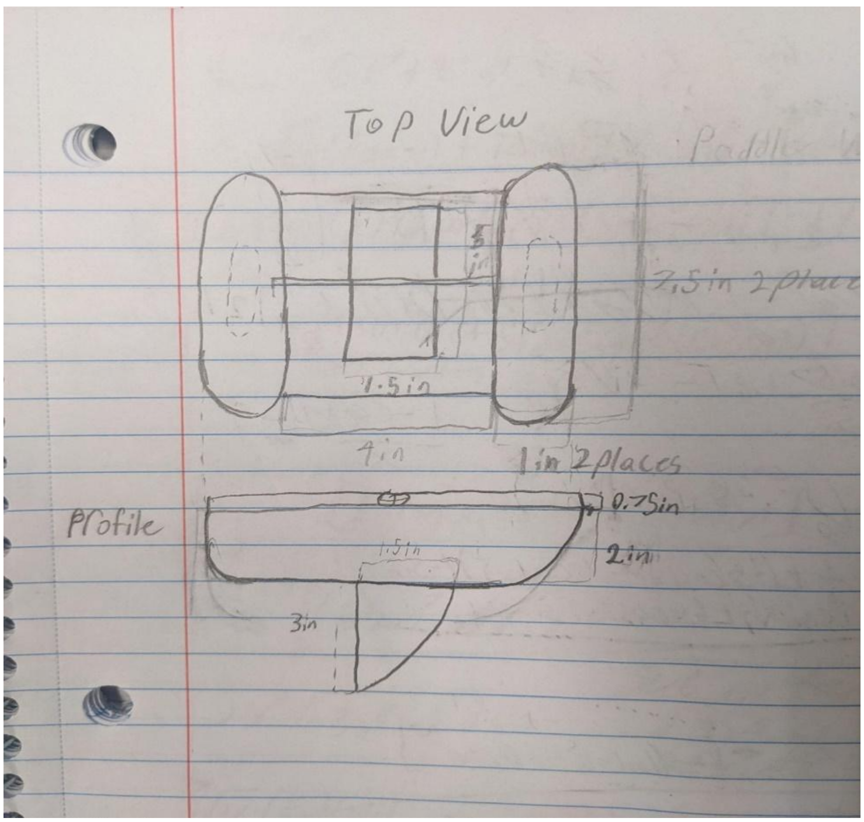
1.0 Introduction

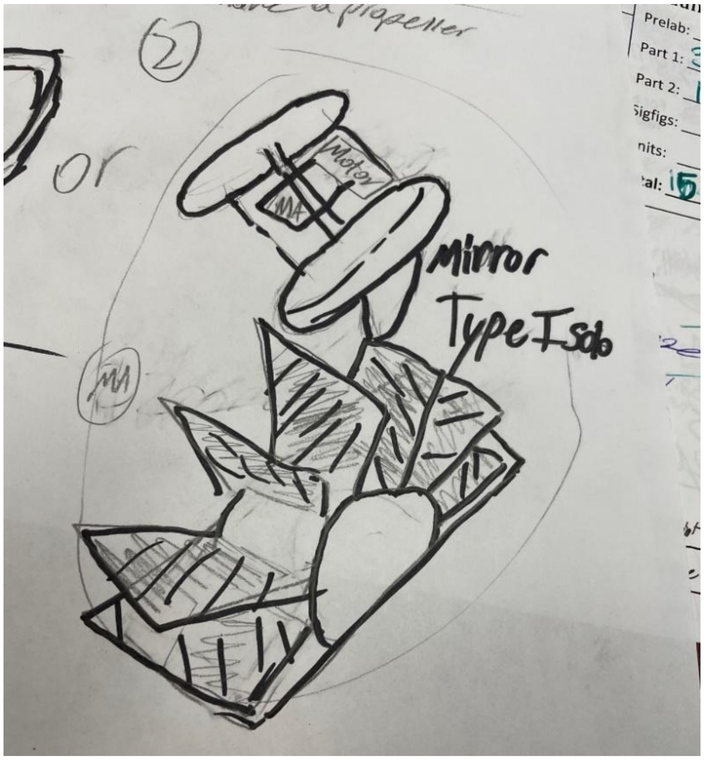
A scaled-down boat is designed to sail through the channel for a maximum of 30 seconds. At the beginning, the conceptualizing of what the boat will look like, the sketching, and the evaluating of the ideas occurred. Some specification regarding the project were given like it should consume no more than 200 grams into 3D printing machine, it must be able to carry about 50 grams, it has to be no more than 8 inches in the height or wide, it must not touch the channel which has 12 inches wide and 5 inches long. Each member came up with different ideas and design. These ideas were evaluated and discussed in terms of propulsion (whether it will sail or not), steering (whether it will go straight or not), stability (whether it will float over the water or not), floatability (whether it will be able to carry a specific load or not), and design (whether it will be easy to simulate in Solidworks or not). Basically, all the designs solved a specific problem or introduced a helpful suggestion regarding the required design. However, design number one was considered the best one because of its unique concept. This design has two hulls and a light platform to connect these hulls and carry the motor. Moreover, the motor with the vex parts were added together and examined to validate the speed and its function. Also, the drag force was in mind while designing and developing this concept therefore, the area was manipulated to allow the boat to negotiate easily and quickly as well. After that, the project was drawn in Solidworks, and the boat's parts (propeller, hulls, platform) were assigned to each member of the group and the details and dimensions were initially produced. Furthermore, the parts were assembled and Vex parts were added to the final assembly file. Next, the mass of the whole project was calculated, and the printed materials were determined by using Dremel. In addition, the buoyancy of the preliminary design was examined using physics laws and principles. For example, the buoyancy force in Centimeters cubed (upward force) must be at least equal to the weight in grams (down-ward force) of the boat to float over. Later, the waterline height was tested multiple times to find the level where it will not sink. The buoyancy force was set in the equation with the weight and the calculation steps were followed. Finally, the specific details of the hulls, propeller, and platform were shown exactly in the drawing sheets, the materials, and the dimensions were given as well. As shown so far, the boat was designed. Also, its additional and dynamic parts were determined after a series of testing its weight, stability, functionality, and floatability. Ultimately, the design is ready to be printed and checked in the real life.

2.0 Conceptual Design Phase

2.1 Concept 1

This design was made to eliminate the stability problem and to have a surface that makes it easy to build a propelling system off of it. The initial idea was for an extra-large paddle wheel in the centre but could be interchanged with a propeller without changing anything about the design. Fins were added to the design to help lift the boat out of the water more to lessen the chance of water intake and to help keep the boat moving in a straight path.



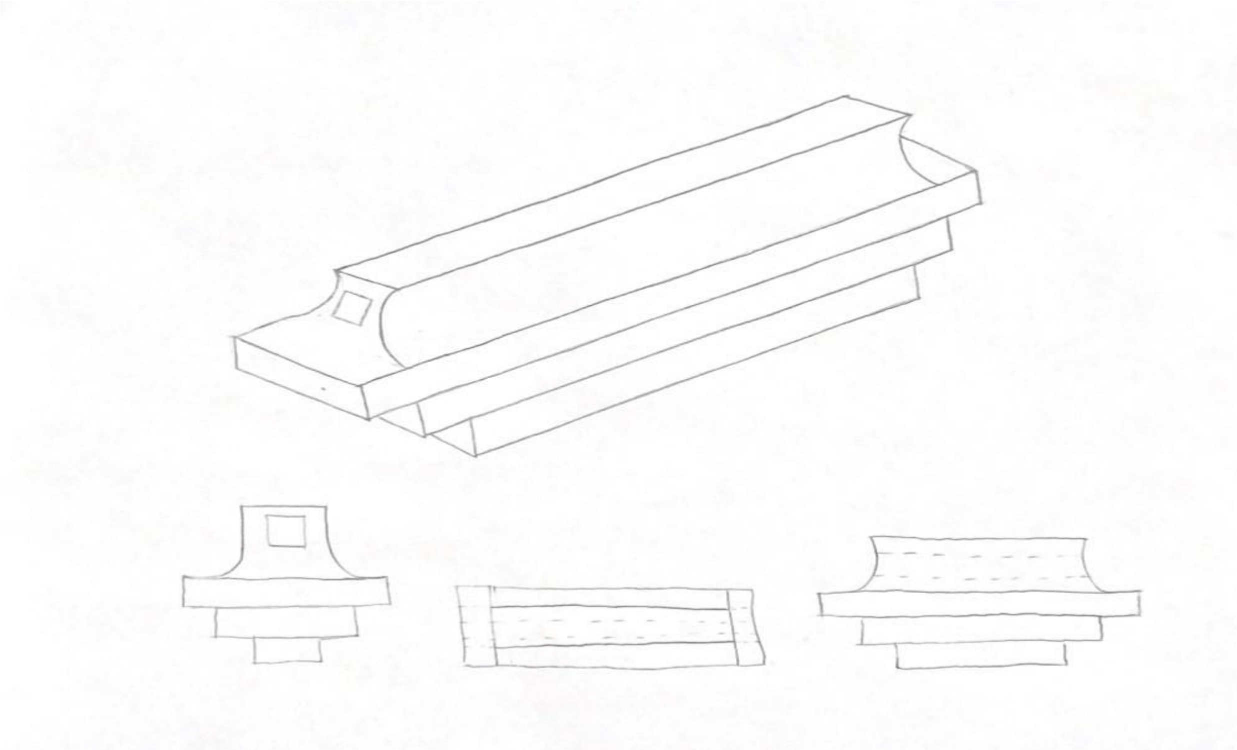


2.2 Concept 2

Concept 2 was inspired from a fast sea animal which called “Sailfish”. This animal has a kind of curved fin and a kind of pyramidal shape of its body. To serve the function of the project to be sailing fast, the design was designed as three empty layers with a little curvy and empty top as shown in figure 3. The ratio between the layers is determined to keep it steering and minimize the drag force from the water. Also, the gap on the top is to increase the rate of speed by allowing the air to go throw it and push faster. Finally, it is also easy to simulate using Solidworks.

Figure 3

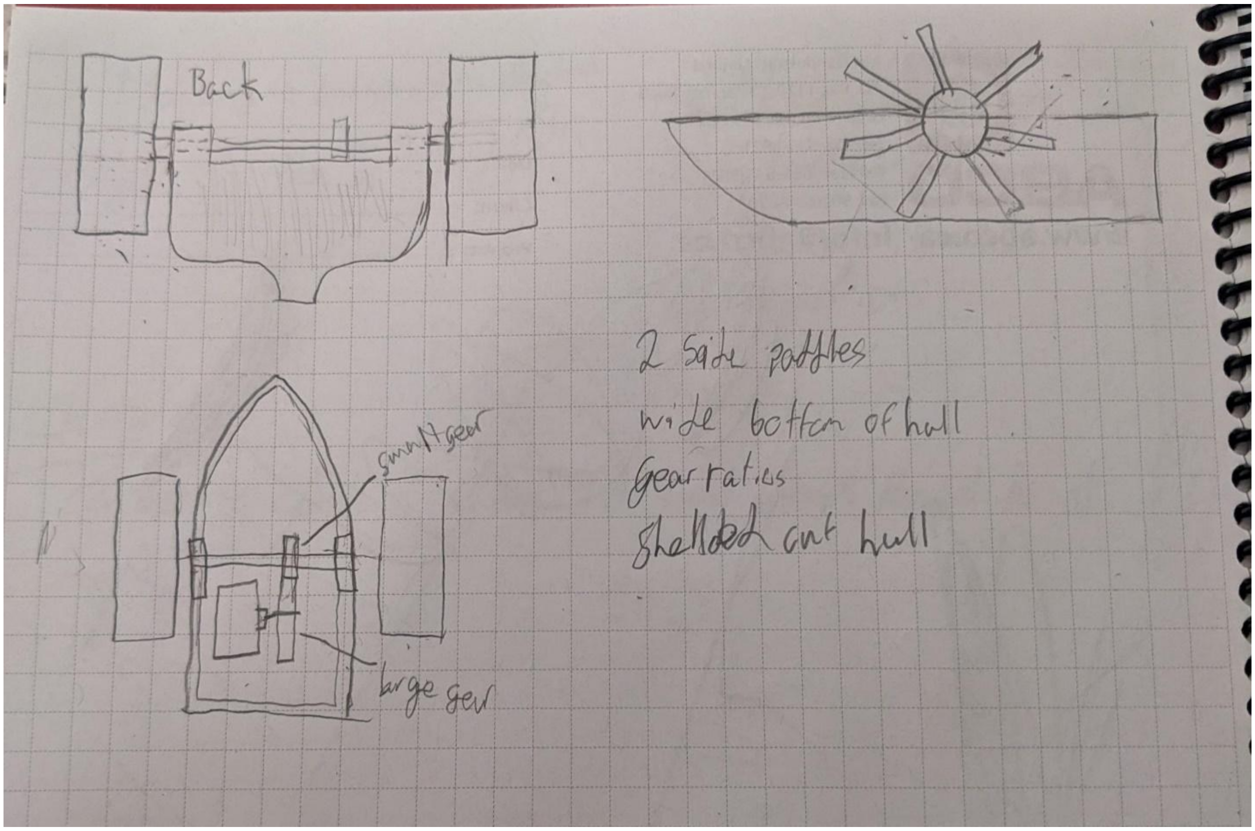
Second Concept of the Boat



Note. This design was conceptualized from the shape of the faster sea animal which called Sail-fish.

2.3 Concept 3

This design has a wide base for water displacement and surface area. The wider base allows for more mass within the boat. The keel like shape on the bottom allows for slightly more speed though the water and also a slight amount of stability. Paddle wheels on the side may work well for this small design and if built properly having one on both sides can help keep the boat straight. Use of propellers in this design would be more difficult due to the hull being shelled out and the possibility of taking on water. A gear ratio having a larger gear off the motor and a smaller gear attached to the paddles shaft should increase the speed of the paddles.


Back
small gear
large gear
2 Side paddles
wide bottom of hull
Gear ratios
Shellded out hull

3.0 Preliminary Design Phase

3.1 Evaluation and Selection

	Propulsion (Will it move quickly/well)	Steering (Will it move straight?)	Stability (Will it tip over easy?)	“Floatability” (Will it stay above water?)	Design (Will it be easy to model in Solidworks?	Total
Design 1	5/5	5/5	5/5	4/5	5/5	24/25
Design 2	0/5	3/5	5/5	5/5	5/5	18/25
Design 3	3.5/5	3/5	5/5	5/5	3.5/5	20/25

Design 1 was rated 24/25 because, with the one large paddle wheel in the centre of the boat all the power will be focused on the one wheel to make sure the torque is strong enough for the water. Dual hulls make it difficult to turn so in this case where we must stay straight, this is ideal. Having two hulls will eliminate any roll, and most yawing potential. With the thin-shelled walls of the two hulls, it should optimize our buoyancy. For the design aspect, it involves basic shapes to extrude and some use of revolving shelling and or cut extrudes.

Design 2 was given 18/25 because it was given a 0 for Propulsion and steering due to the lack thereof of a propulsion system. The boat itself is symmetrically built so it should not rock too much although with the abrupt change of depths in the hull it may experience some turbulence. This design was given a 5 for being highly simple to design in solid works.

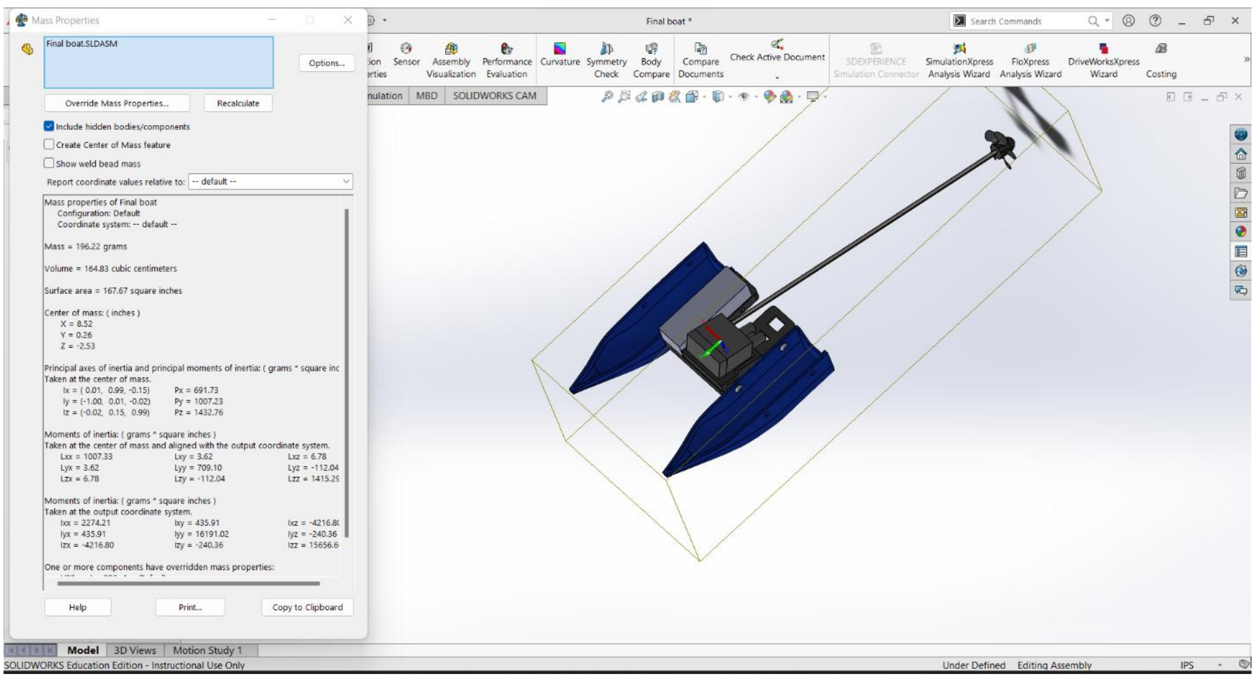
Design 3 was ranked 20/25. A 3.5 for propulsion because the paddles were believed slow compared to a propeller, but the gear ratio was a good idea. 3 for steering as the keel shape is helpful and the two paddles help but catamaran is very good. 5 for stability for wide transom. 5 for floatability because of wide base. The design gets a 3.5 because it should be easy with reference planes to get good curves.

3.2 Buoyancy Calculations (for selected design only)

After finishing the modulation of the design, a buoyancy calculation was checked carefully. First, the assembly of the total project was ended up and the vex parts also was added to collect the total mass. Meanly, the total mass of the project was 196.2(G) as shown in figure 4. Later, to verify if it will float or sink, the buoyancy force (volume * gravity acceleration) must equal the weight (mass * gravity acceleration) of the whole project. By equaling the two laws (W= FB) it was found that the gravity acceleration is in both sides of the equation so they will be canceled out. At the end, the mass of the project in gram must at least equal the volume of the cutting hulls at a waterline of 0.7 inches from the top. After that, the volume of the two hulls was 206.52 (cm^3). So as a result, the total mass is less than the volume of the cutting hulls which demonstrated that the project will not sink into the water.

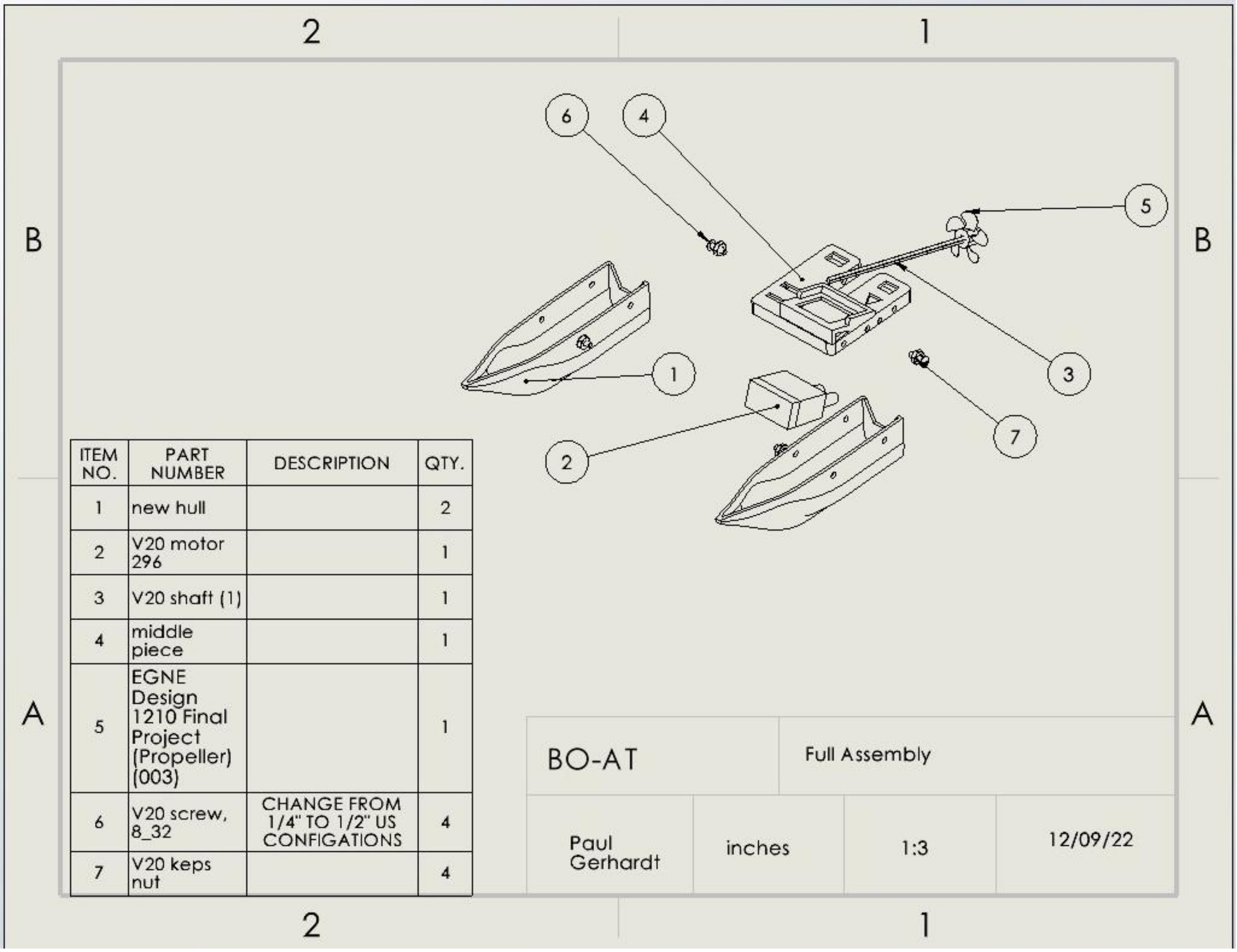
Figure 4

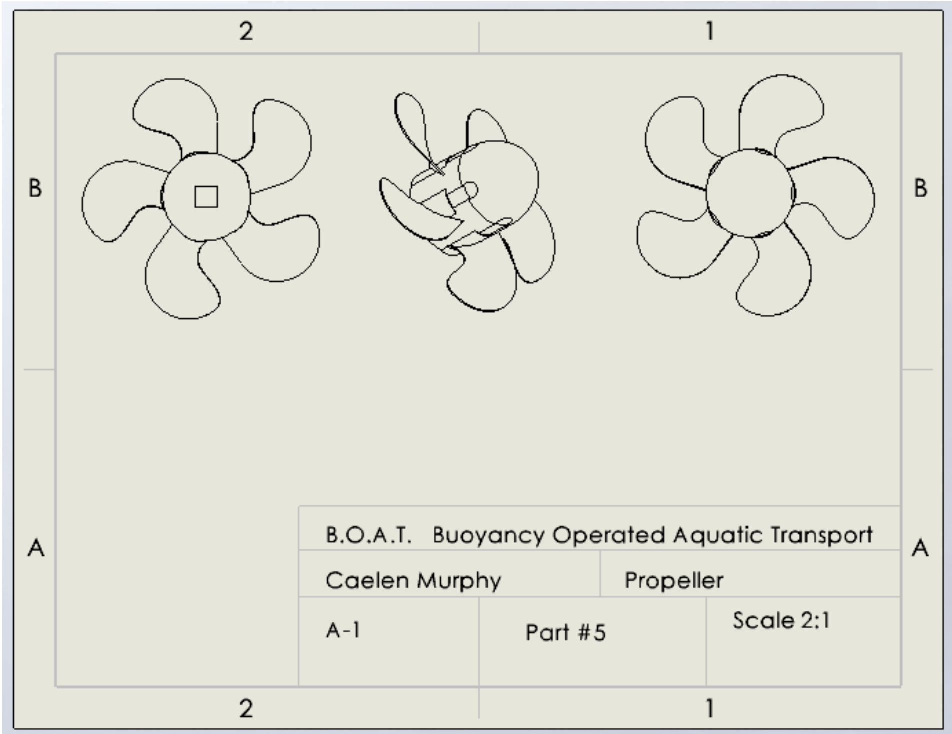
The mass of the project



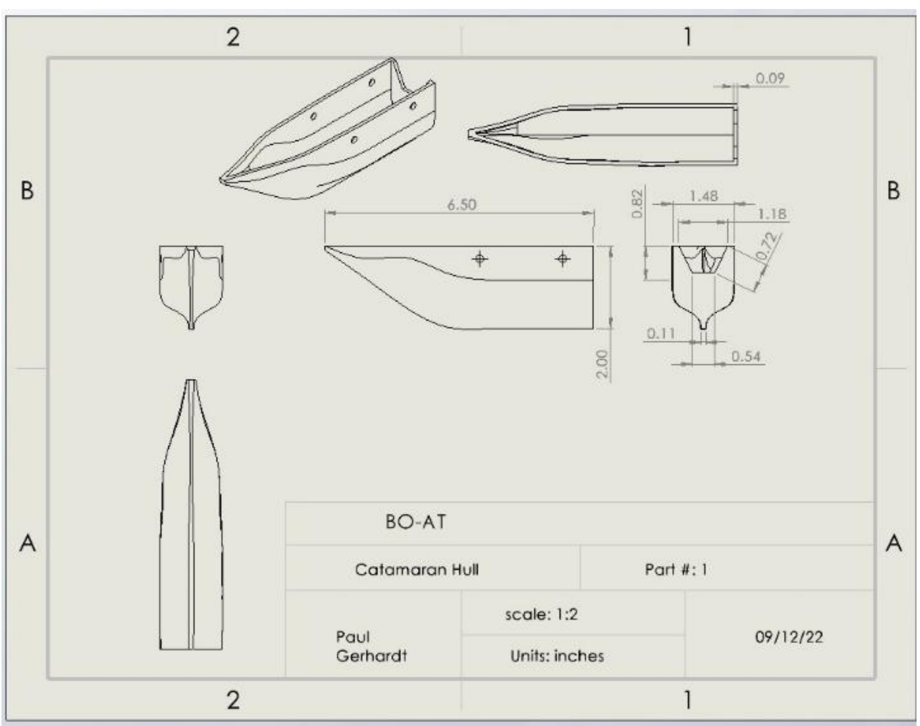
Note. The total mass of the project with the vex parts and the motor is shown as a part of the buoyancy calculation.

4.0 Detailed Design Phase

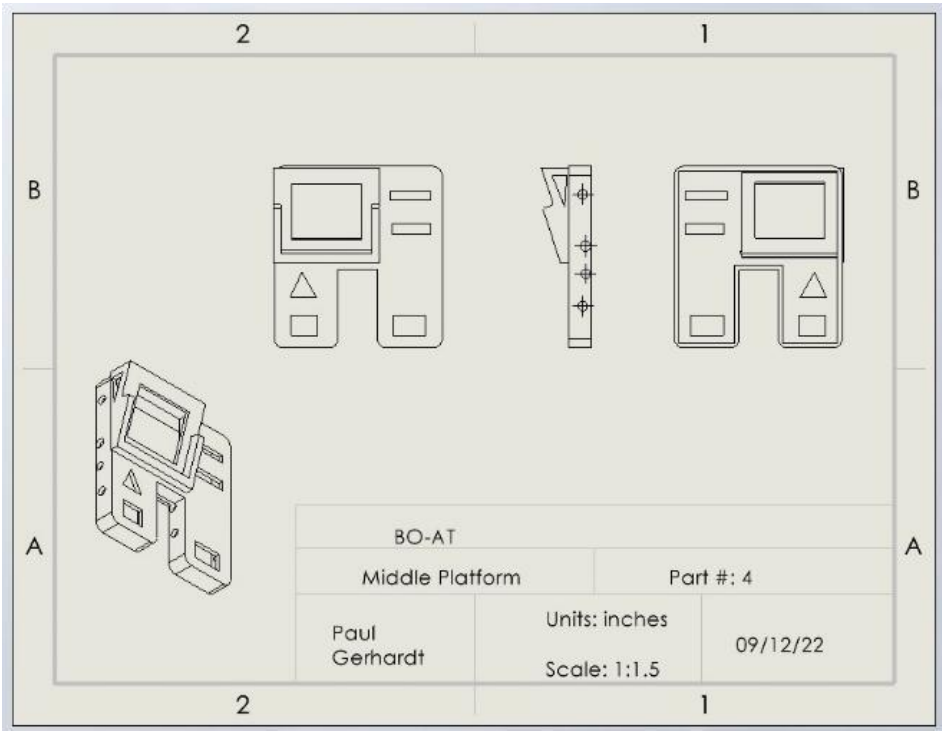


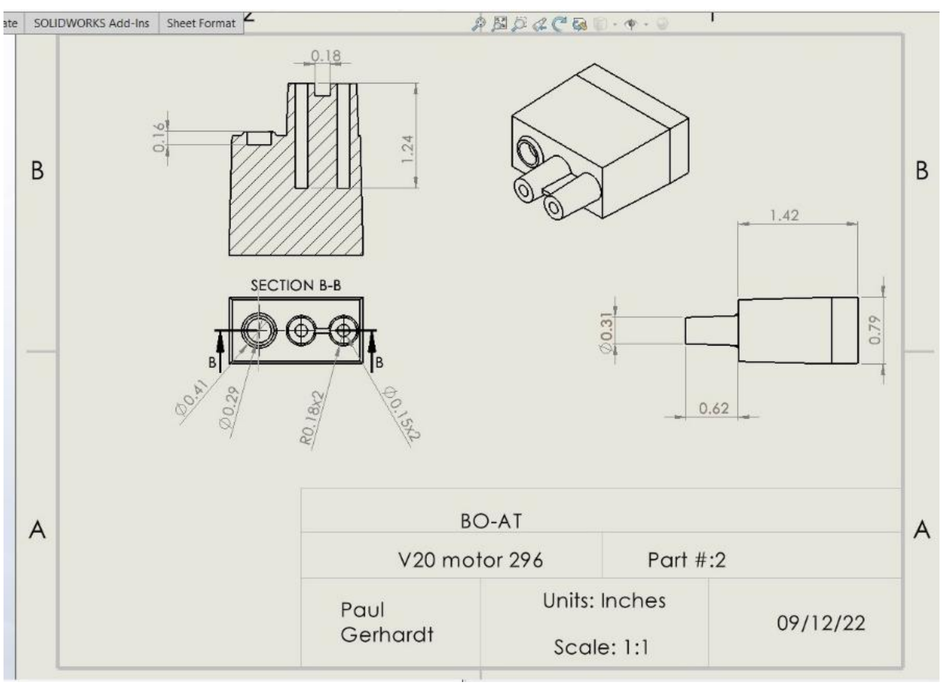


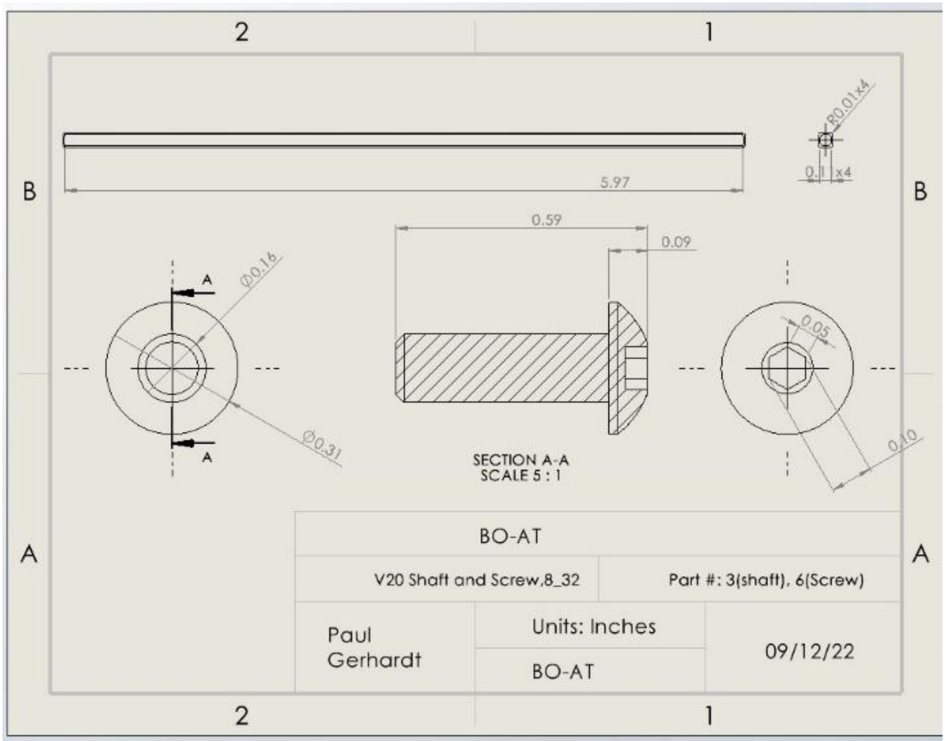
2
1
B
A
B.O.A.T. Buoyancy Operated Aquatic Transport
Caelen Murphy
Propeller
A-1
Part #5
Scale 2:1



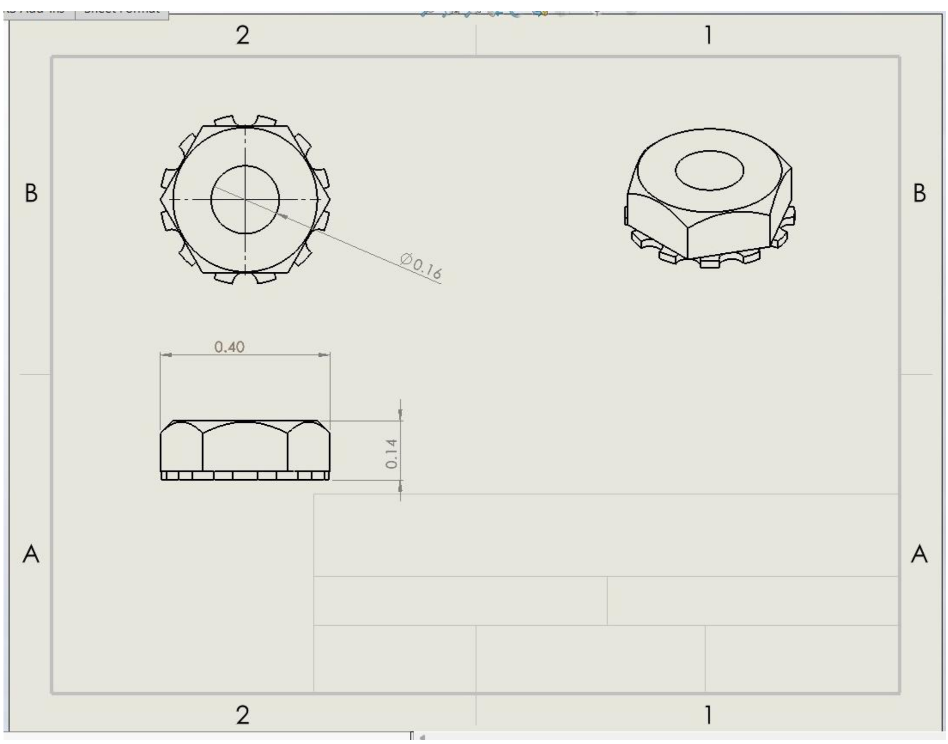
2
1
B
A
0.09
6.50
0.82
1.48
1.18
0.72
0.11
0.54
2.00
BO-AT
Catamaran Hull
Part #: 1
scale: 1:2
Paul Gerhardt
Units: inches
09/12/22


2
1
B
A
BO-AT
Middle Platform
Part #: 4
Paul Gerhardt
Units: inches
Scale: 1:1.5
09/12/22


SOLIDWORKS Add-Ins
Sheet Format
0.18
0.16
1.24
SECTION B-B
Ø0.41
Ø0.29
R0.18x2
Ø0.15x2
1.42
Ø0.31
0.79
0.62
B
A
BO-AT
V20 motor 296
Part #:2
Paul Gerhardt
Units: Inches
Scale: 1:1
09/12/22



2
1
B
A
R0.01x4
0.1
x4
5.97
0.59
0.09
Ø0.16
Ø0.31
0.05
0.10
SECTION A-A
SCALE 5 : 1
BO-AT
V20 Shaft and Screw,8_32
Part #: 3(shaft), 6(Screw)
Paul
Gerhardt
Units: Inches
BO-AT
09/12/22



2
1
B
A
Ø0.16
0.40
0.14

5.0 Conclusions

To conclude, the concepts were illustrated and evaluated in very specific detail to find out which one is the best one and start developing it. Then, concept one was selected because of its perfect rate among the rest of the designs in terms of propulsion, steering, stability, floatability, and design. It was thought that it will perfectly achieve a straight sailing in 30 seconds. Another factor that was taken into consideration is the drag force which basically relates to the area of the boat when it is in contact with the water. From this point, the hulls were modeled carefully to fulfill the least amount

of prevention. After that, all the boat parts were ready to combine. In this stage of assembly, the areas and locations of the platform, motor, and holes were exactly specified. In addition, the buoyancy force was set in comparison with the total weight of the project and proved that the boat will float over the water with all the added masses. Ultimately, the project was tested in the real life and shown proof of the correctness of the work that has been done. However, there are some improvements that could be done to eliminate the problem of buoyancy. For example, the hulls could be designed in a different way to minimize the materials and give more flexibility to the project. Also, the motor should be put inside a platform instead of on the top so there is no doubt that it might slide down but the specification in the amount of the material was a barrier.