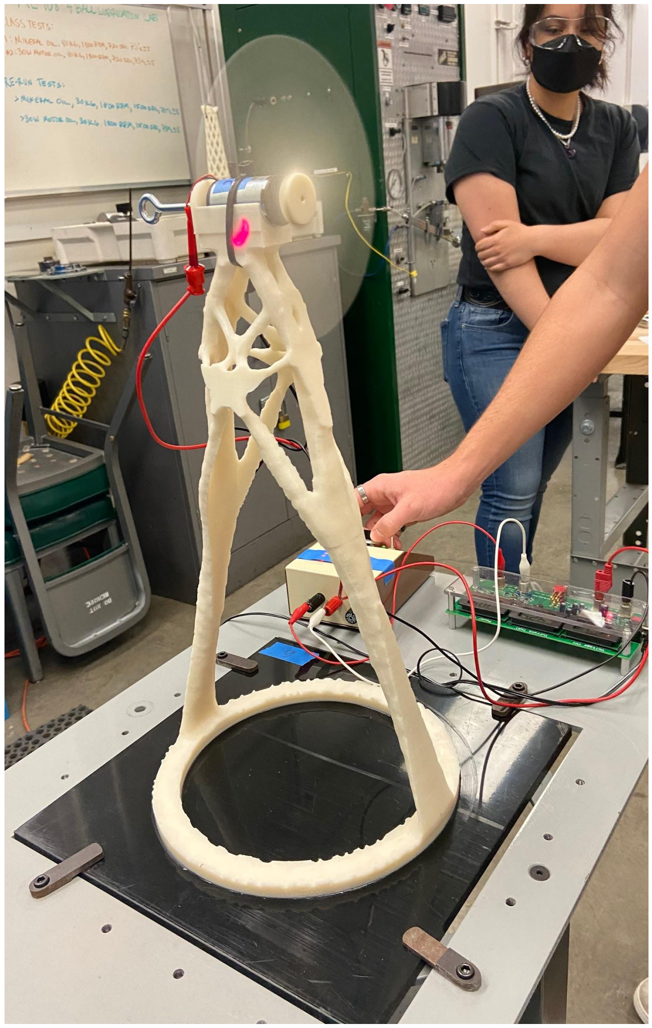
Design and Testing of a 3D Printed Wind Turbine For Optimized Power Generation and Stiffness



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Group #6

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Project Summary

This project explored the capabilities of wind turbine design. Our group was tasked with 3D printing a wind turbine that could hold a 1 kg load and generate the maximum power possible within an 18 in^3 volume and 16 in height constraint. Our group met frequently to brainstorm and research the expansive field of wind turbine design, and combine our researched knowledge with our Solidworks proficiency to create a product that maximized efficiency and stability. As a result, our group produced an organic model that strayed from industry standard but still successfully met the requirements of this challenge.

To start the design process our group researched the key aspects of the most efficient wind turbine designs and debated the pros and cons of each. We also expanded our turbine design vocabulary by researching the most efficient pitch, angle of rotation, aerofoil, and angle of attack of our turbine blade. After careful evaluation, we used experimental research to determine the best turbine blade, designed in Solidworks (shown in Figure 1).

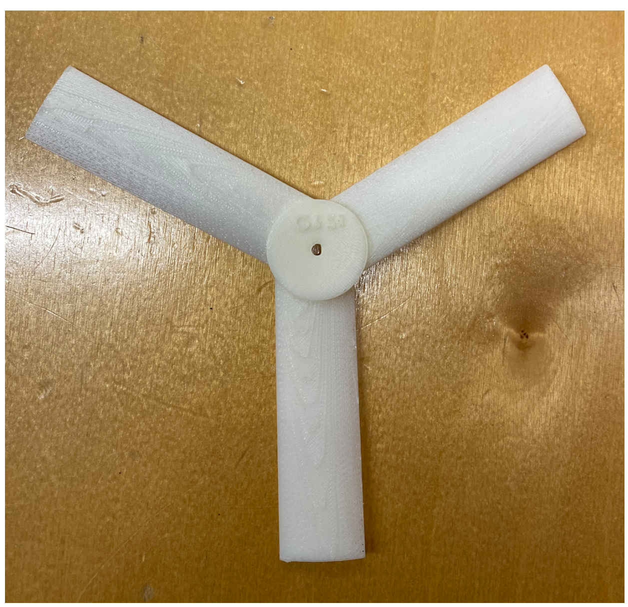

Figure 1) Turbine blade

Following the blade design was the tower structure. We found through research that multiple types of turbines are currently used (i.e. cross hatching towers and conical towers), however these are most efficient when scaled to real life size. Given the small volume constraint of the project, we decided a computer generated tower design would prove most efficient for our goals.

Using Solidworks, we produced a unique, organic model created from countless stiffness and efficiency tests done by a computer, which took the guessing work out of tower design. Its unique structure was designed specifically for the requirements of the project, and made use of the allotted height and volume. The program also created the design file.

With a blade and tower created, our team glued the tower together and later commenced a stiffness and power test. Our tower weighed in at 1325.3g, was 16 in tall, and had a maximum power of 1.21 watts. The tower successfully sustained the load of 1 kg with a deflection of .37mm. Our group added additional weight to a maximum of 9 kg with a deflection of 3.81mm—however the tower did not break under this much weight and we were not able to go to failure with the deflection test. Our turbine design went above and beyond and met the objectives of the project. The rest of this report will go into additional details about the inner workings of our tower design.

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Introduction

The Basics of a Wind Turbine

As global warming becomes a greater concern, many are turning to alternative energy sources to prevent it from worsening. Greenhouse gases emitted from burning fossil fuels for energy is one of the leading causes of global warming since they contribute to the greenhouse effect ("The Causes of Climate Change", 2021). Many that live in very windy places have turned to wind turbines since it's the most effective alternative for that area.

There are two types of turbines; a horizontal axis turbine and a vertical axis turbine. Horizontal axis turbines have a better energy output than vertical, which is why it's the more common configuration, but it has more constraints on the blades (Youssefi, Lecture 6). Regardless of the position of the axis, every turbine has the same basic parts. An average turbine consists of 1 or more blades, a rotor, a generator, and a tower with a hub on the top. Figure 2 gives a clear example of the basic construction of a turbine. The blades are a very important component as changing the blade number, pitch, length, profile, and material can cause drastic changes.

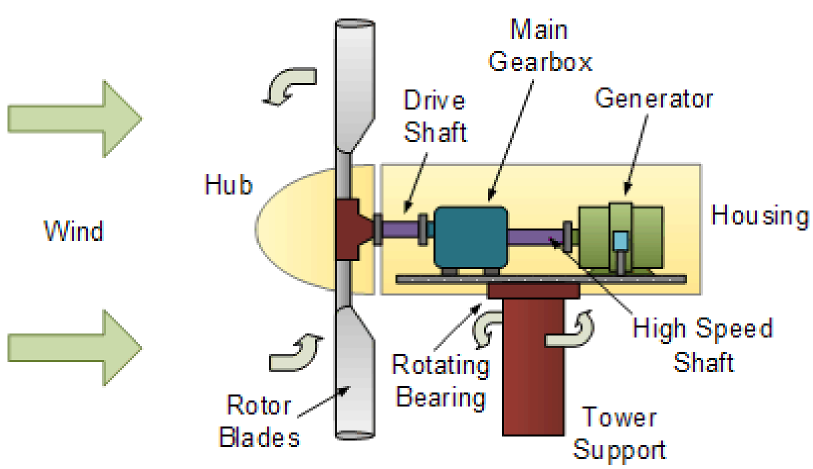


Figure 2) Construction of an Average Turbine Generator ("Wind Turbine Design for a Wind Turbine System", 2010)

Despite being a great alternative that is growing in popularity, there are still some issues with wind turbines. Wind turbines are only 20 - 40% efficient and only have a lifespan of about 20 years, even with routine maintenance ("Renewable Energy Fact Sheet: Wind Turbines", 2013). They are also very expensive, which makes them inexcusable to some, and some are worried about the safety of the turbines. Some turbine towers have collapsed at high wind speeds, as seen in figure 3 , which poses a major safety hazard.

Figure 3) Photo by Shawna Shoemaker Stowe ("Turbine topples amid high winds", 2019)

Project's Statement

The goal of the project was to design, build, and test a wind turbine tower and blade that would maximize power output and stiffness. The goal set for the wind turbine stiffness was a 1kg load applied horizontally from the rear of the motor casing. Along with these objectives, the project included several parameters and constraints.

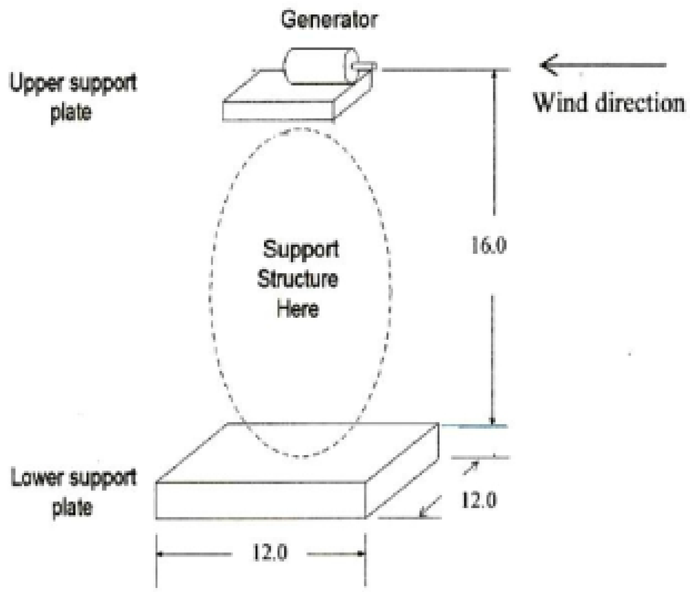


Figure 4) Turbine Set up from the “Wind Turbine Project Description F21”

The tower was required to be 16 inches tall with a tolerance of 1/16 inch and would be attached to a 12 inch by 12 inch platform. The top of the tower had to include a motor mount which fit the distributed motor (Figure 5) and contained a 3/16 inch hole to attach an eyebolt for stiffness testing. In addition, the tower was required to be radially symmetrical to prevent unidirectional wind targeting, as in real life applications wind rarely blows from the same direction constantly. The blade had a maximum swept diameter of 6 inches and had to be built off of a standard hub model (Figure 6).

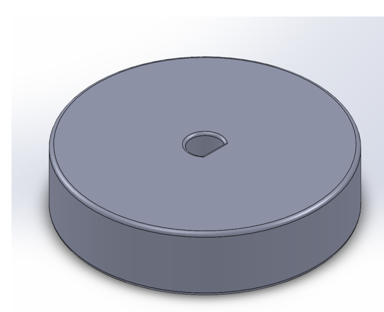


Figure 5) [left] Motor Specifications from “Wind Turbine Project Description F21”

Figure 6) [right] Hub Model from “Wind Turbine Hub.SLDPRT”

Both the tower and blade were printed with ABS plastic on a 3D printer with a build volume of 9x9x9 in. The tower therefore had to be printed in at least two pieces and glued together with a maximum total volume of 18 cubic inches. During the build process, a 12x12x⅜ inch ABS plate and Loctite 435 adhesive were distributed to securely attach the tower pieced together and to a uniform base.

Theory

In understanding our design choices, it is first necessary to understand the underlying theories behind them which are laid out below.

Airfoils and Lift:

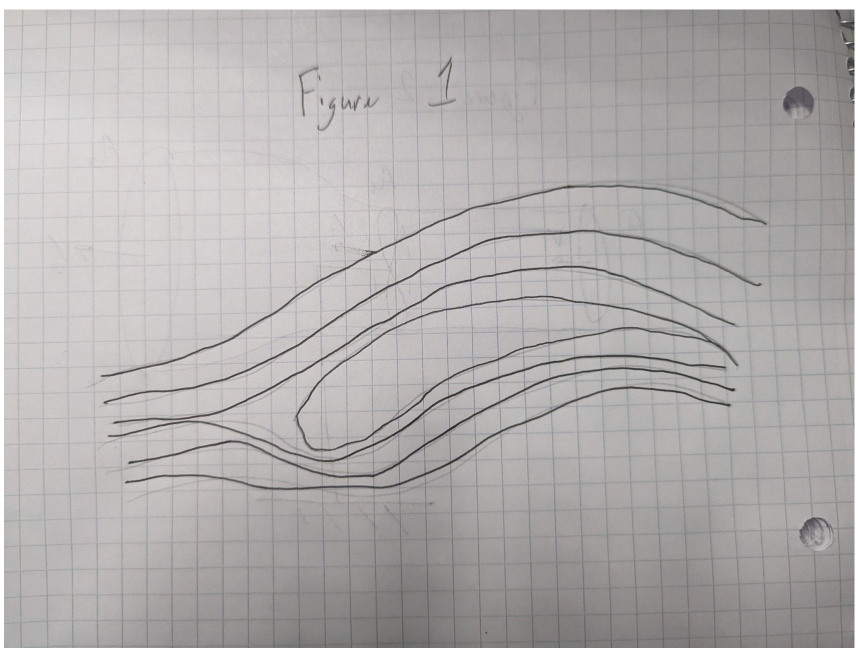


Figure 7) Airfoil diagram

Airfoils produce lift when air at some relative velocity passes over them. This occurs due to the curvature they create in the air. Consider steady, inviscid, homogeneous, incompressible 2D flow over some airfoil as in figure 1. In such a flow, we can apply Euler's Equation as in (1)

$$(1)\ \rho\vec{a} = -\vec{\nabla}P - \rho g\hat{k}$$

With a=acceleration, rho = air density, P=pressure, g = gravitational acceleration and k= the unit vector parallel to the direction of gravity. In our 2D flow, we can define a coordinate system with basis vectors s and n where s is always parallel to the velocity and n is always perpendicular and facing towards the center of curvature. In such a coordinate system, the acceleration in the n direction is given by (2) with R=local radius of curvature.

$$(2)\ \vec{a} = \frac{v^2}{R}\hat{n}$$

If we solve Euler's equation using (2) we arrive at (3) (noting that $\hat{k}\cdot\hat{n} = \frac{\delta z}{\delta n}$)

$$(3)\ \rho\frac{v^2}{R} = -\frac{\delta}{\delta n}(P + \rho g z)$$

From (3), we can reasonably assume that the change in the effects of gravity over our small distance are negligible thus leaving us with (4). In equation 4, it is clear that for any non-infinite

$$(4)\ \rho\frac{v^2}{R} = -\frac{\delta P}{\delta n}$$

radius of curvature (any streamline that is not straight) and non-zero velocity, the change in pressure approaching the local center of curvature is negative (being that rho, v, and R are all positive). This effect produces a decreasing pressure approaching the airfoil from above (in the same direction of the radius of curvature) and it produces increasing pressure from below (in the opposite direction of the radius of curvature). The resultant pressure differential causes the lift observed in airfoils.

Betz Limit and Power from Flow:

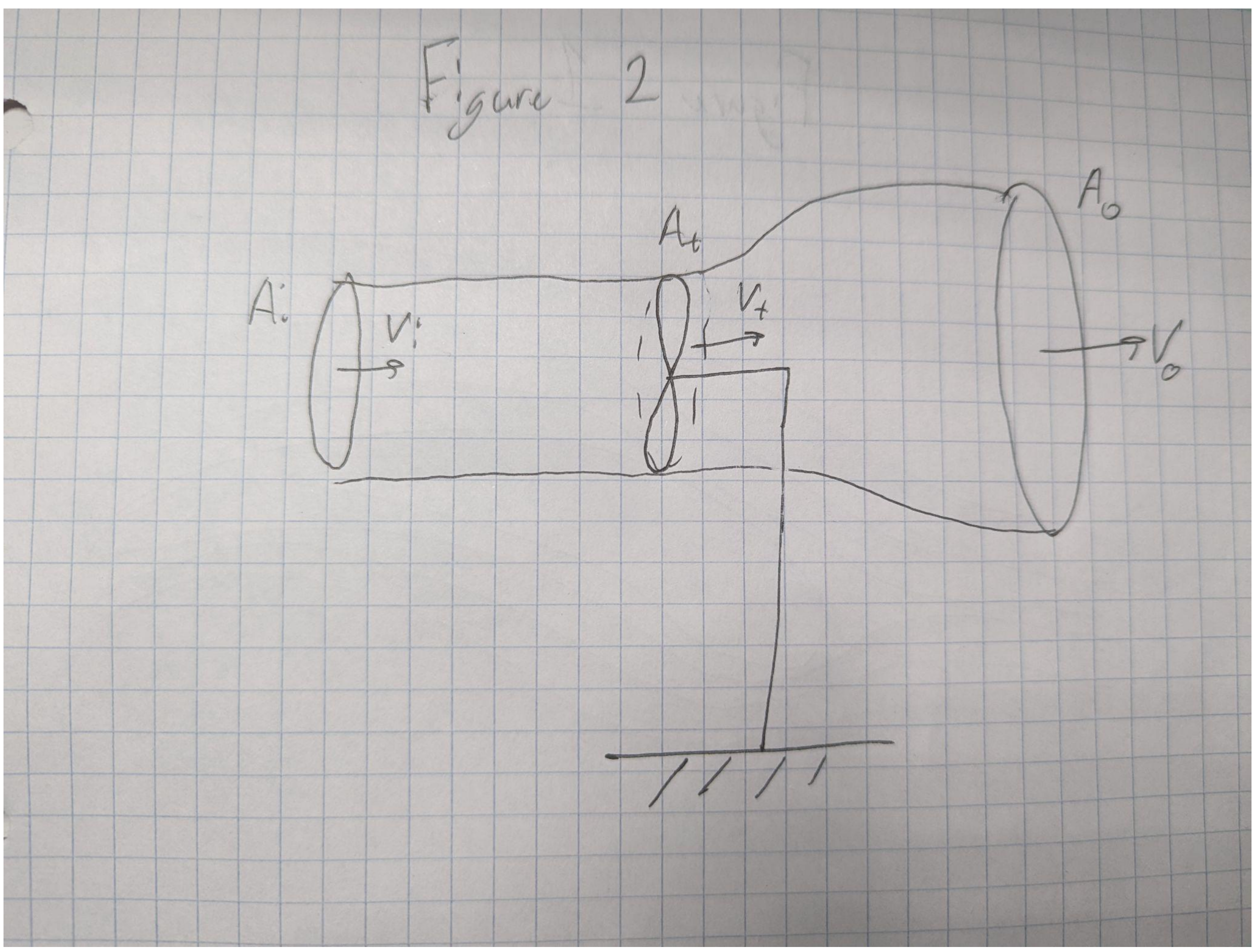


Figure 8) Diagram

Now that it has been established that airfoils can generate lift from fluid flow over them, one must now consider how much power can then be extracted from this lift. Assuming that this process is an adiabatic one, we know that the only energy exchanged in the process of creating lift is kinetic energy given by (5). Taking (5), dividing by time to get power, and splitting mass

$$(5)\ E = \frac{1}{2}mv^2$$

into volume times density gives (6) with V=volume and t=time. From (6) volume splits into the

$$(6) P = \frac{1}{2t}\rho V v^2$$

cross-sectional area of the turbine and the length of the flow. This length of the airflow taken over some time is the velocity of the flow and gives the expression for power carried by the flow in (7) with A_t=cross-sectional area of the turbine blades and v_i being the incident velocity.

$$(7) P = \frac{1}{2}\rho A_t v_i^3$$

The power of the air given by (7) may appear a good target for wind turbine energy but it runs into a problem: if we designed a highly-efficient wind turbine, it would have to reduce the air velocity to near zero which would not allow air to flow through the turbine. This issue demands further analysis and produces the Betz limit.

Consider steady, incompressible, isothermal, adiabatic flow neglecting gravity over figure 2. Immediately by conservation of volume, we obtain (8). Over figure 2 we now apply Reynold's

$$(8)\ A_i v_i = A_t v_t = A_o v_o$$

Transport Theorem for steady flow which is written in (9) with B=the target property,

$$(9)\ \frac{DB_{C.M}}{Dt} = \oiint_{C.S} \rho b \vec{v} d\hat{A}$$

b=the massless target property, C.M=controlled mass, C.V=controlled volume, and C.S= controlled surface. For the remainder of the derivation, we take the volume between A_i and A_o in figure 2 to be our controlled volume. We now take B to be our energy, yielding (10).

$$(10)\ P = \frac{DE}{Dt} = \oiint_{C.S} \rho(\frac{1}{2}v^2)\vec{v} d\hat{A}$$

Given that v is perpendicular to the area vector on all parts of our controlled surface apart from A_i and A_o and using (8), we arrive at (11). Using (8) again and making B momentum gives (12).

$$(11)\ P = \frac{1}{2}\rho v_i A_i (v_i^2 - v_o^2)$$

$$(12)\ F = \rho A_t v_t (v_i - v_0)$$

Given that force times velocity is power, we multiply (12) by v_t to get (13). Now that we have

$$(13)\ P = \rho A_t v_t^2 (v_i - v_0)$$

two expressions for the power, we may set (11) and (13) equal to give us (14) which we plug into (13) to give (15). In the expression for power given by (15), the power is only dependent on the

$$(14)\ v_t = \frac{1}{2}(v_i + v_0)$$

$$(15)\ P = \frac{1}{4}\rho A_t (v_i + v_0)^2 (v_i - v_0)$$

density of the fluid, the cross-sectional area of the turbine blades, the incident velocity, and the outlet velocity. For a given turbine design, we can only affect change in the outlet velocity. Thus we take the partial derivative of (15) with respect to v_o and set it equal to zero to give the condition of maximum power output in (16) and the maximum power in (17). Finally,

$$(16)\ v_o = \frac{1}{3} v_i$$

$$(17)\ P_{max} = \frac{8}{27}\rho A_t v_i^3$$

dividing (17) by (7) gives the maximum theoretical efficiency in (18) known as the Betz limit.

$$(18)\ \frac{P_{max}}{P_{fluid}} = \frac{16}{27}$$

Reynold's Number and the Laminar Bubble:

In fluid dynamics the quantity known as Reynolds Number is given by (19) where rho= density,

$$(19)\ Re = \frac{\rho u L}{\mu}$$

u= flow speed, L= characteristic length (turbine blade length for our application), and mu= the dynamic viscosity of the fluid. Reynolds Number measures the ratio of inertial forces to viscous forces within a fluid. For low Reynolds Numbers, the fluid is in a laminar flow where it flows in sheets. For high Reynolds Numbers, the flow is turbulent and much more chaotic. Laminar vs turbulent flow is important for airfoils due to the laminar separation bubble. From the previous discussion of airfoils, we know that their lift comes from their bending of the streamlines of a fluid. This bending only occurs if the flow over the airfoil actually sticks to the curvature of the airfoil. In low Reynolds Number scenarios, as the laminar flow goes over the blade, it creates a vacuum over the back end of the blade because it cannot adhere to the blade perfectly. This vacuum is filled with turbulent backflow and is known as the laminar separation bubble. The presence of the laminar separation bubble adds a great deal of drag to the blade and thus is often avoided in blade design.

Design - Build - Test

Design

The course of our design for the wind turbine was broken into two parts: the blades and the tower. This decision was made because so long as the tower met the 16 in height requirement and was stable enough to hold the blades and motor it would not in any significant way interfere with the performance of the turbine blades. For the design of the turbine blades, we began by finding an adequate airfoil profile. Through our research, we decided on using the SG6043 airfoil profile (Figure 9) as it was designed to perform well in low Reynolds number scenarios which our small scale mandated.

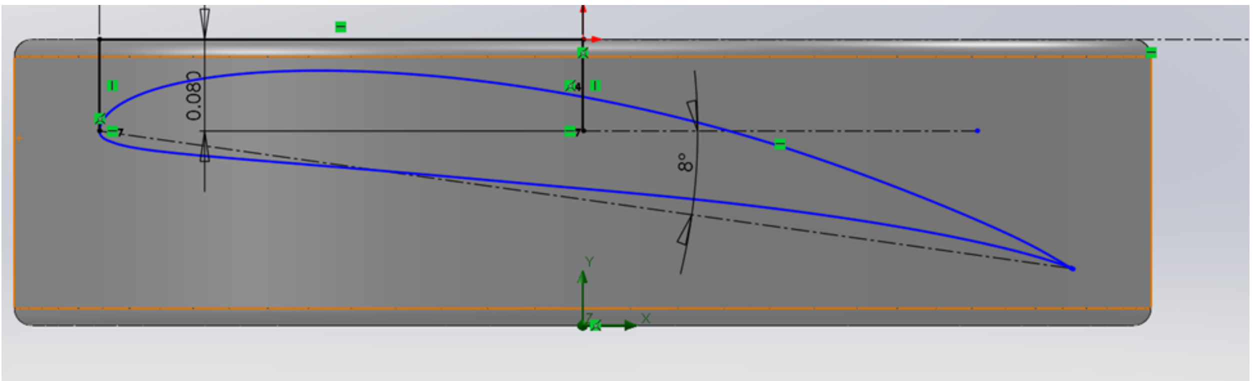


Figure 9) SG6043 Airfoil Profile

From there, we decided to use three blades as that was the most efficient design and was commonly used. With the profile and number of blades decided we then had to decide on the angle of attack and blade profile twist. We decided on an 8-degree angle of attack because the SG6043 airfoil at low Reynolds Numbers achieves its peak lift to drag ratio at 8 degrees which we also confirmed via fluid simulation in Solidworks. As for the blade profile twist, our research as well as Solidworks fluid simulation indicated that a 15-degree twist from 8 degrees to -7 degrees would be ideal. The final design decision we had to make was that of chord length for our blades. Given that chord length directly correlated to lift generated, we maximized our chord lengths while staying within the width constraints of the pre-designed blade hub. Given all those design decisions, we arrived at our final blade hub pictured below (Figure 10). The final blade and hub design was 3 in. in diameter and ¼ in. tall.

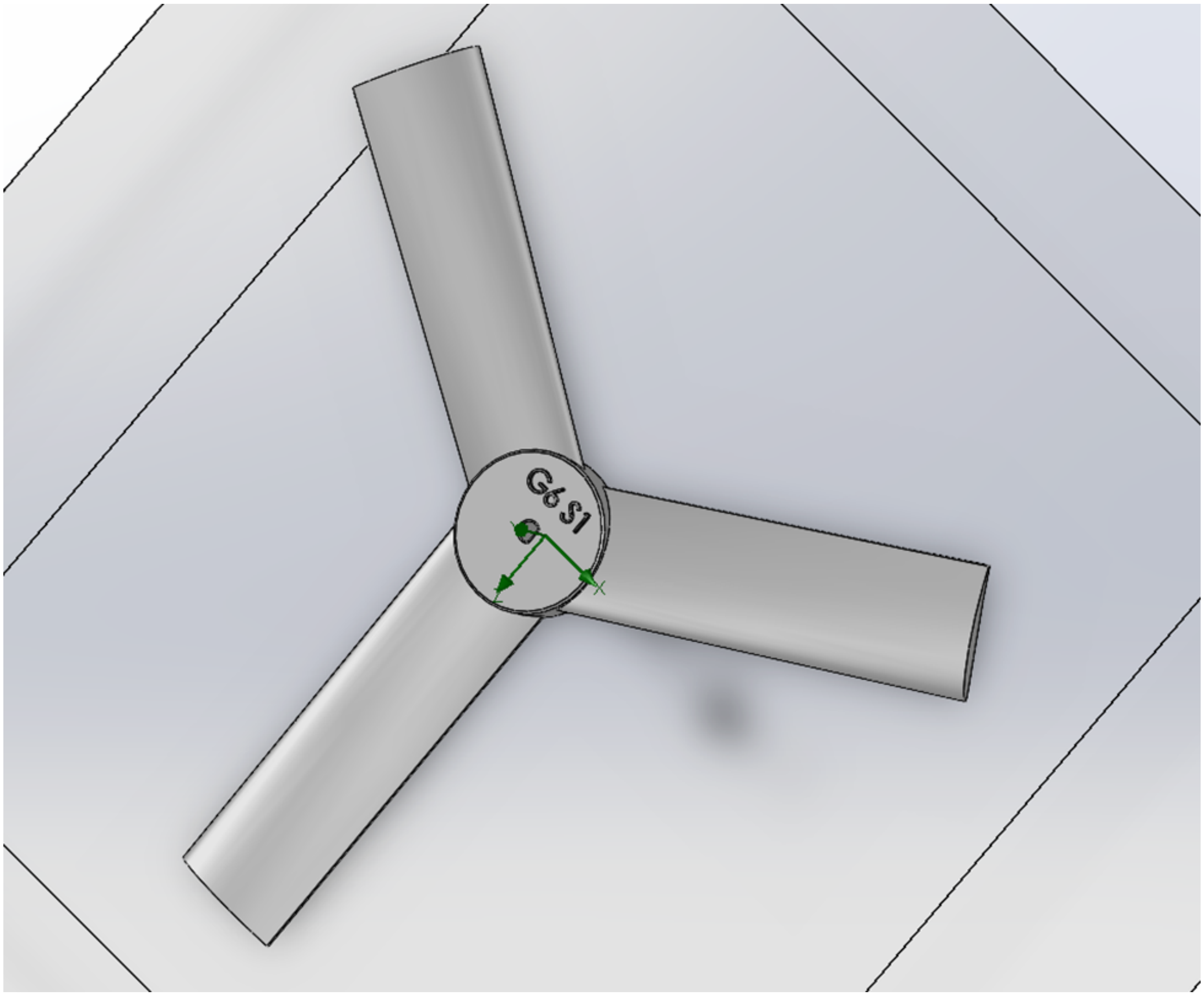


Figure 10) Model of Blade

For the design of the tower, the process was more straightforward. Tasked with maximizing our stiffness to mass ratio, we employed topology optimization to maximize the strength of our tower. Starting from a generic rectangular prism matching the tower build dimensions (sans the motor hub which we designed separately and simply to fit dimensionally with the motor) we used the Topology Study feature in Solidworks and the loading scenario given in the testing procedure (discussed later) to create a model that fit within the 18 in^3 limitations which yielded the design pictured below.

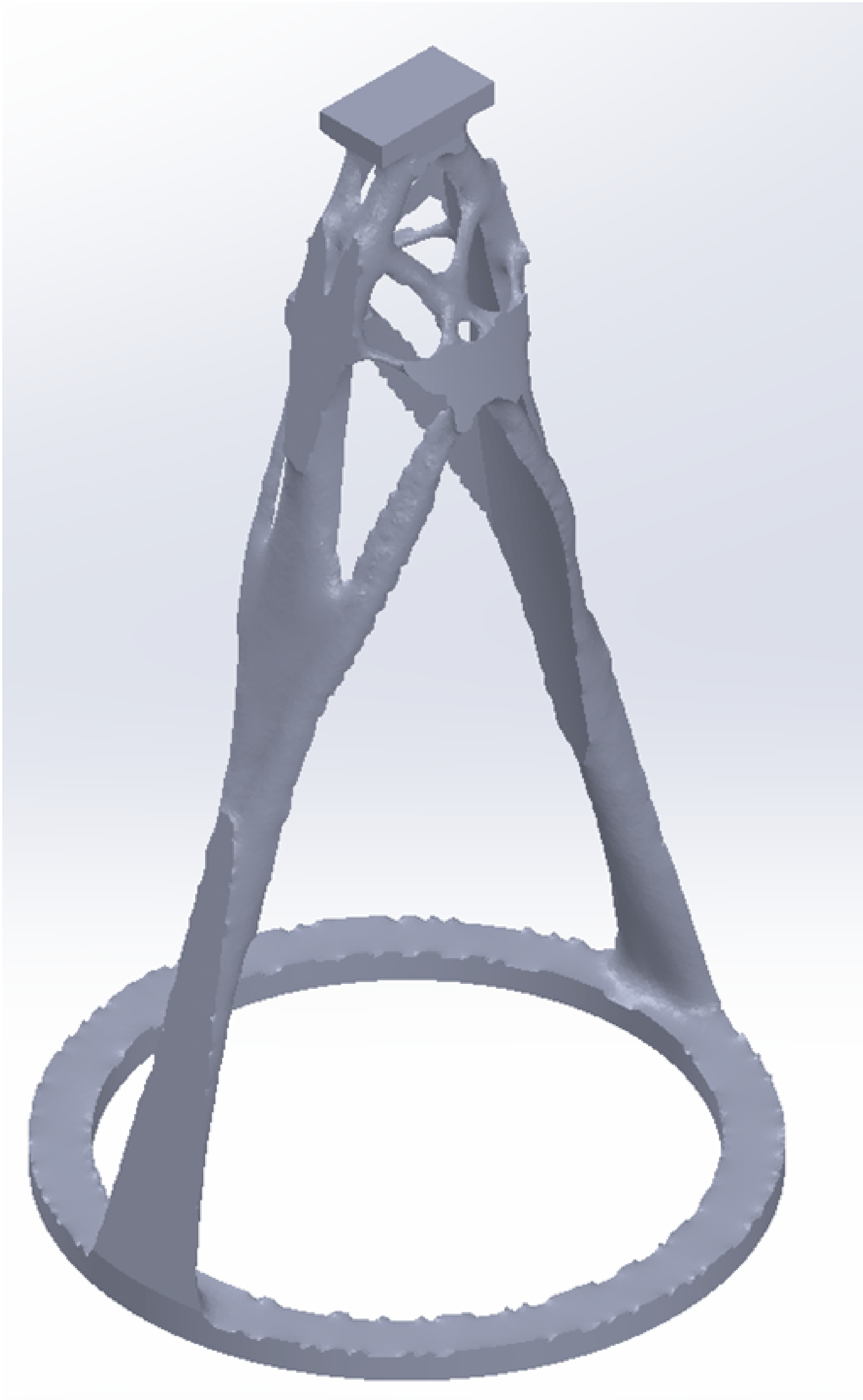


Figure 11) Model of Tower

The hub which was designed separately and added to the top of the tower is pictured below.

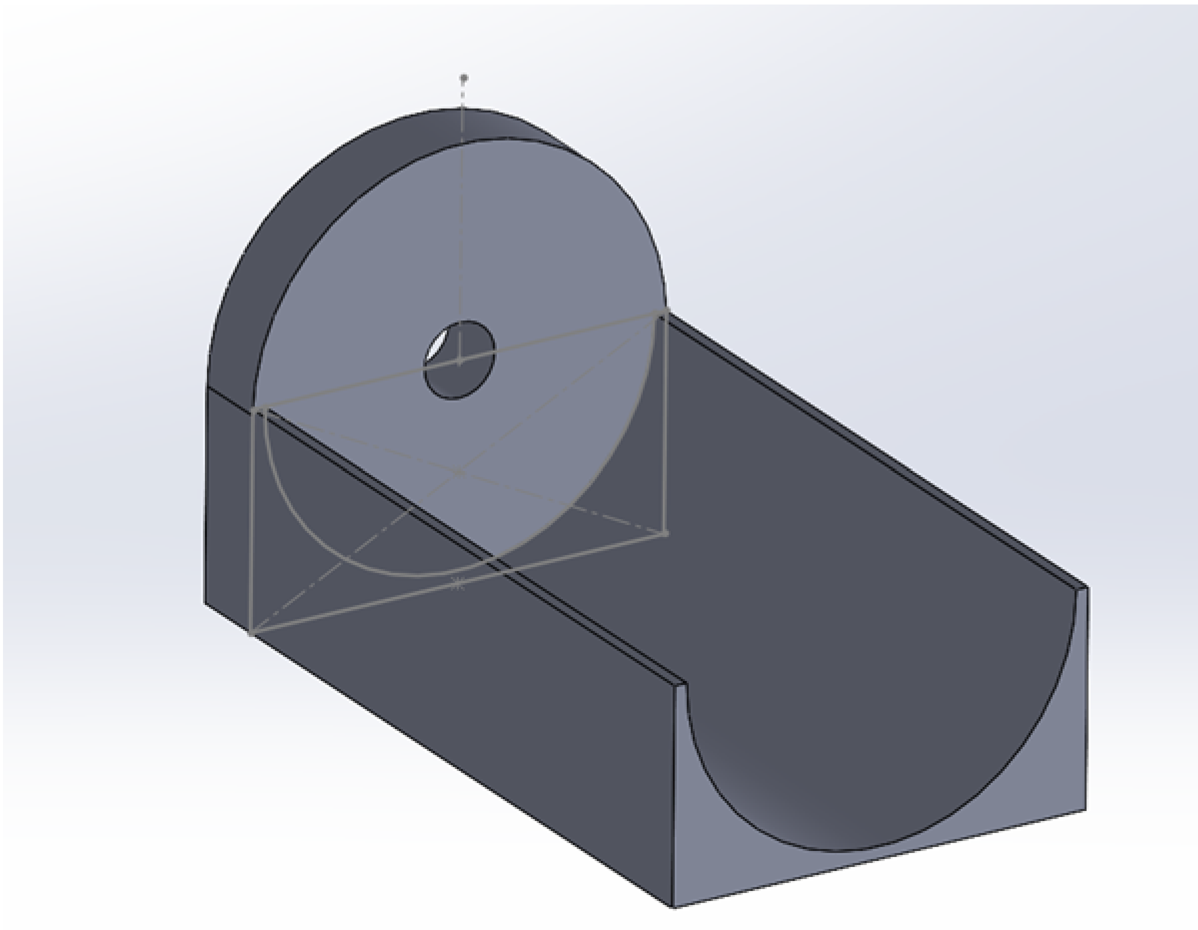


Figure 12) Model of Motor Hub

The final design for the tower was 9 in wide and long and was 16 ¼ in tall.

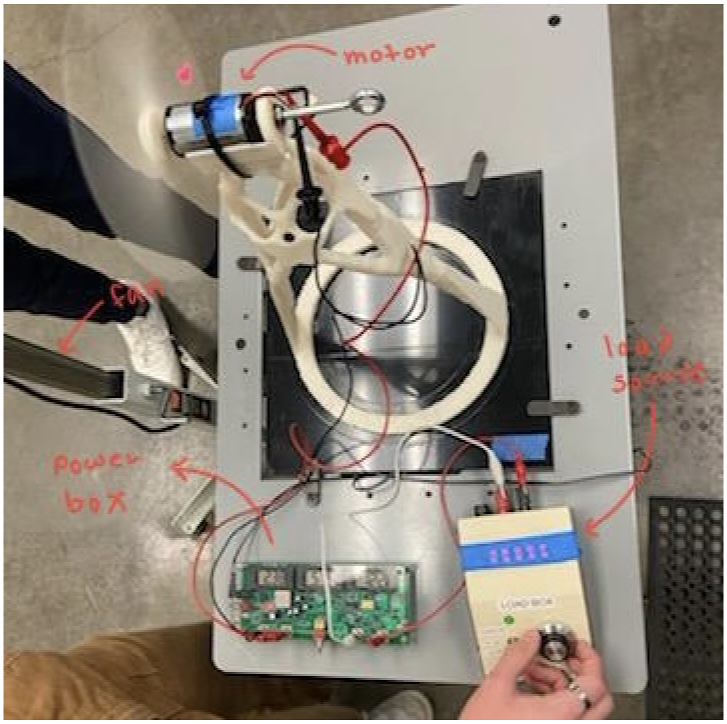
Build

The most significant tool used in the fabrication of the turbine was a 3d printer which additively created our designs. About 235 grams of ABS plastic was used in this step which printed the design in three parts: the blades and hub, the bottom half of the tower, and the top half of the tower. The amount of ABS plastic used costs about 10 USD. After the designs were printed and the supports removed, the top and bottom half of the tower were glued together using a small volume of the ethyl-based adhesive Loctite Super Glue. Finally the entire tower was glued to the base plate using the same glue.

Figures 13 & 14) Glued tower and base

Test

The two tests that are performed on the wind turbine are the power generation and the stiffness measurement. The power generation test is performed to test the efficiency of the rotor blade and its design and profile. It's performed using the blower as a wind source, the wind speed measuring meter to calibrate wind speed, the tachometer to measure rotations per minute (RPM). The stiffness measurement is performed using the dial indicator to measure deflection and various weights are hooked onto the string that's connected to the eyebolt to put loads on the tower. The desired outcomes of the power generation and deflection test respectively is the stiffness constant and the maximum power generated by the wind turbine.



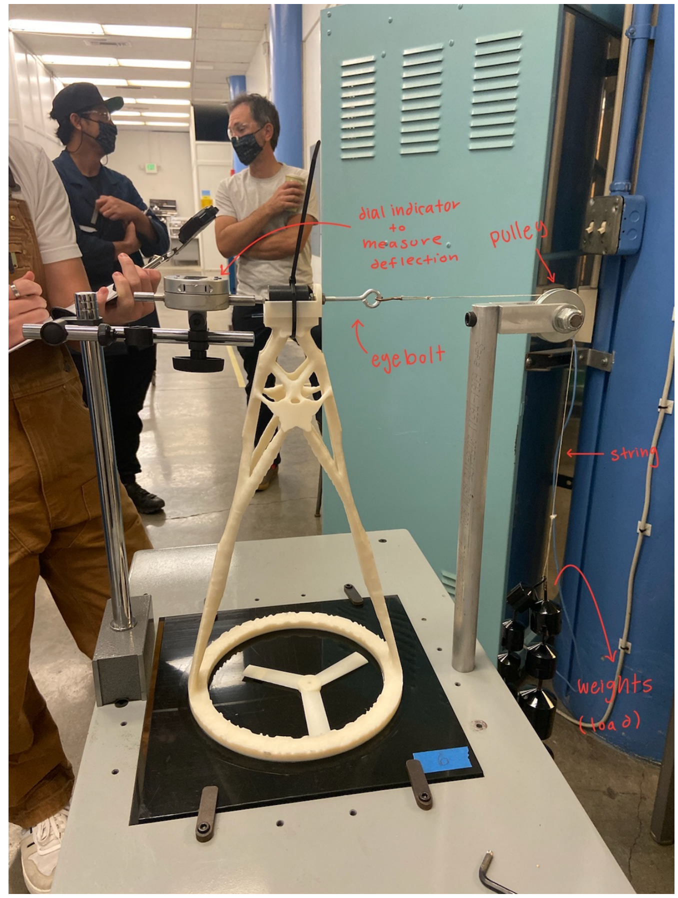


Figure 15) Set up of Power Test

Figure 16) Set Up of Deflection Test

The potentiometer is used to draw power from the motor. The energy generated by the rotor blade is transferred to the motor and then is directed to the potentiometer where power (mW), current (mA), and voltage (V) can all be read and recorded. The wind speed measuring meter was used to calibrate the wind speed at the front of the rotor blade to 25 mph ± 1 mph. This meter is used to determine whether the fan should be moved closer to the wind turbine to increase the wind speed or whether the blower should be moved further from the wind turbine to decrease the wind speed. The tachometer is used continuously during the power generation test to measure the RPM of the wind turbine. The tachometer tracks the RPM throughout the duration of the test as the potentiometer knob is turned clockwise at small intervals.

Test 1					
blade to fan distance : 11in					
wind speed : 25.5 mph					
data points	voltage (volts)	current (mA)	power (watts)	blade speed (rpm)	notes
0	33.8	0	0	5330	
1	3.62	13	0.04	5270	
2	3.58	23	0.08	5250	
3	3.54	32	0.11	5230	
4	3.5	42	0.14	5203	
5	3.48	53	0.18	5165	
6	3.47	68	0.23	5145	
7	3.41	103	0.35	5070	
8	3.35	130	0.43	5028	
9	3.3	150	0.49	4978	
10	3.26	172	0.55	4952	
11	3.06	266	0.8	4740	
12	2.83	353	1	4400	error(?)
13	2.59	445	1.15	4230	
14	2.31	520	1.21	3941	
15	1.95	550	1	3336	redid to check

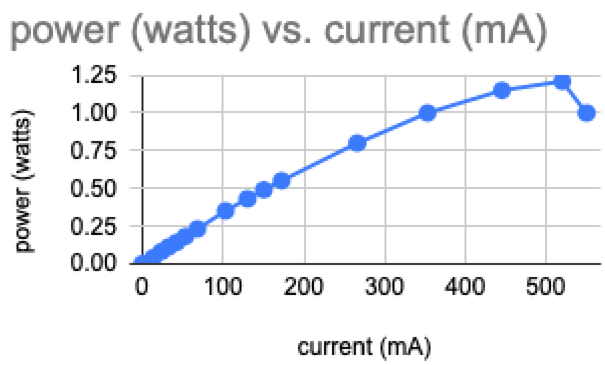


Figure 17) Data Table for Power Test

Figure 18) Graph of Power vs. Current Measured

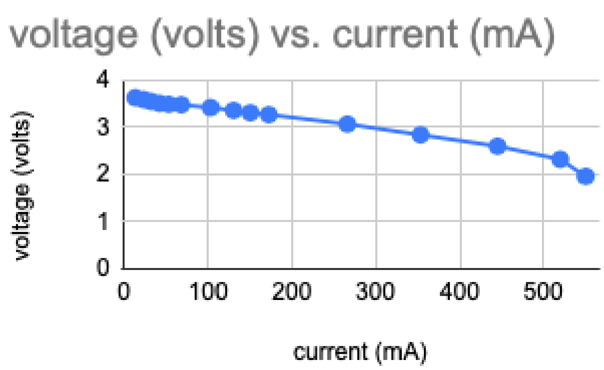


Figure 19) Graph of Voltage vs. Current Measured From Testing

(omitted the first data point because it was an outlier. The high voltage spike without current was likely due to the rampup of the motor.)

Test 2			
tower height : 16 in.			
tower net weigth : 1325.3 g			
data points	load (kg)	load (N)	Deflection (mm)
1	0.1	0.980665	0.03
2	0.2	1.96133	0.06
3	0.3	2.941995	0.1
4	0.4	3.92266	0.14
5	0.5	4.903325	0.17
6	0.6	5.88399	0.21
7	0.7	6.864655	0.25
8	0.8	7.84532	0.29
9	0.9	8.825985	0.34
10	1	9.80665	0.37
11	1.2	11.76798	0.44
12	1.4	13.72931	0.52
13	1.9	18.632635	0.7
14	2.9	28.439285	1.09
15	3.9	38.245935	1.48
16	4.4	43.14926	1.68
17	4.9	48.052585	1.91
18	5.9	57.859235	2.34
19	6.9	67.665885	2.81
20	7.4	72.56921	3.03
21	7.6	74.53054	3.14
22	7.8	76.49187	3.26
23	8	78.4532	3.33
24	8.2	80.41453	3.42
25	8.4	82.37586	3.52
26	8.6	84.33719	3.62
27	8.7	85.317855	3.67
28	8.8	86.29852	3.71
29	8.9	87.279185	3.78
30	9	88.25985	3.81

Figure 20) Data Table for Displacement test

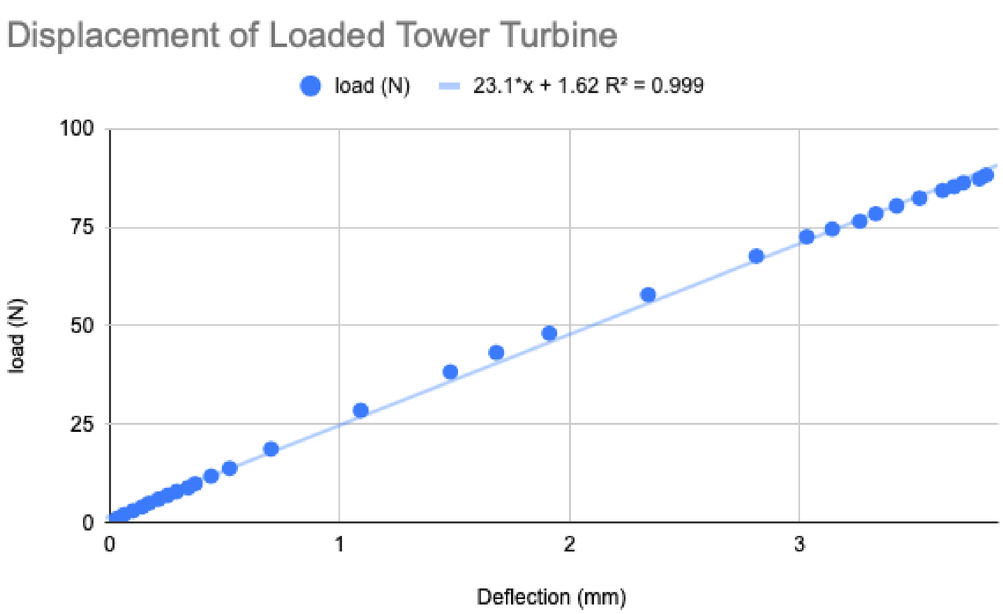


Figure 21) Graph of Displacement from Testing

Stiffness → k = 23.1 kN/m

Correlation factor → $R^2 = 99.9\%$

Max Power Generated: 1.21 watts

Max Theoretical Power: $\frac{1}{2}\rho A v^3$

Density of Air = 1.225 kgm^{-3}

Radius = 3 in = 0.0762 m

Area = πR^2= 0.0182 m

Wind Velocity = 25.5 mph=11.40ms^{-1}

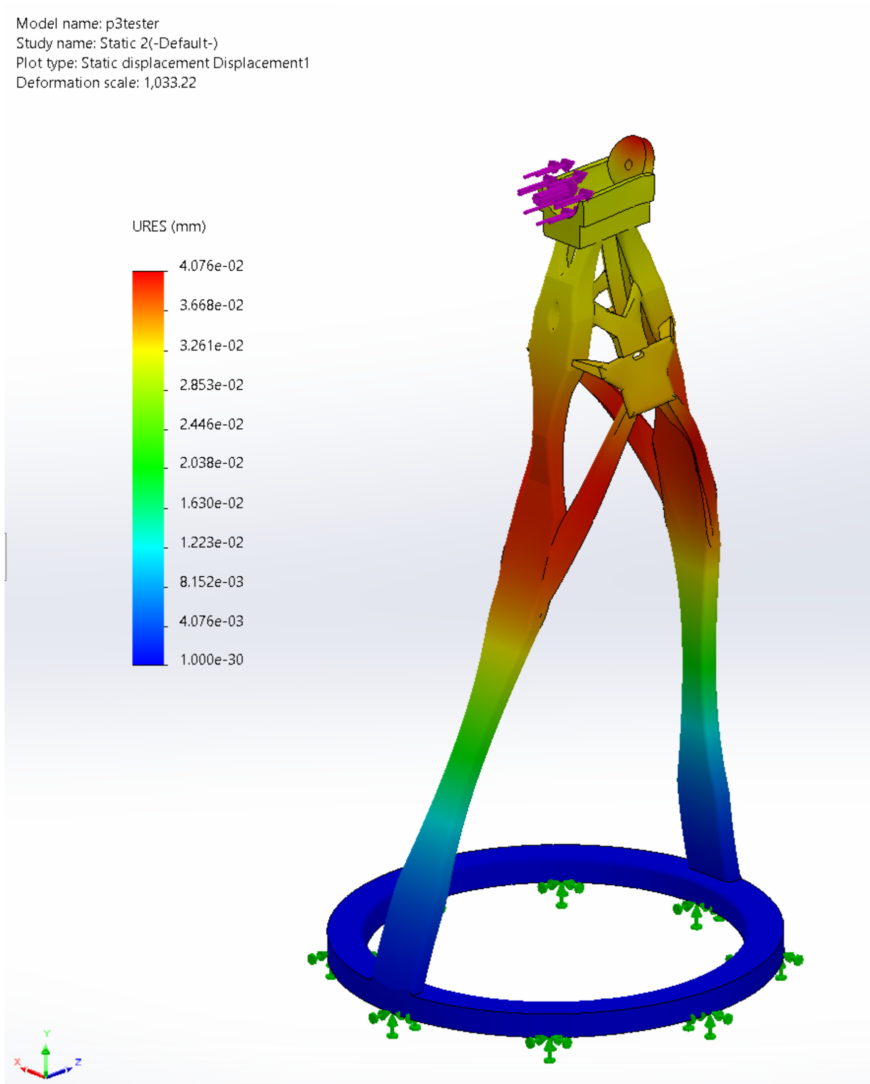
Theoretical Power of Air = 16.55 Watts

Theoretical Maximum Power Due to Betz Limit = 9.81 Watts

Efficiency = $\frac{P_{generated}}{P_{air}}$=0.0731=7.31%

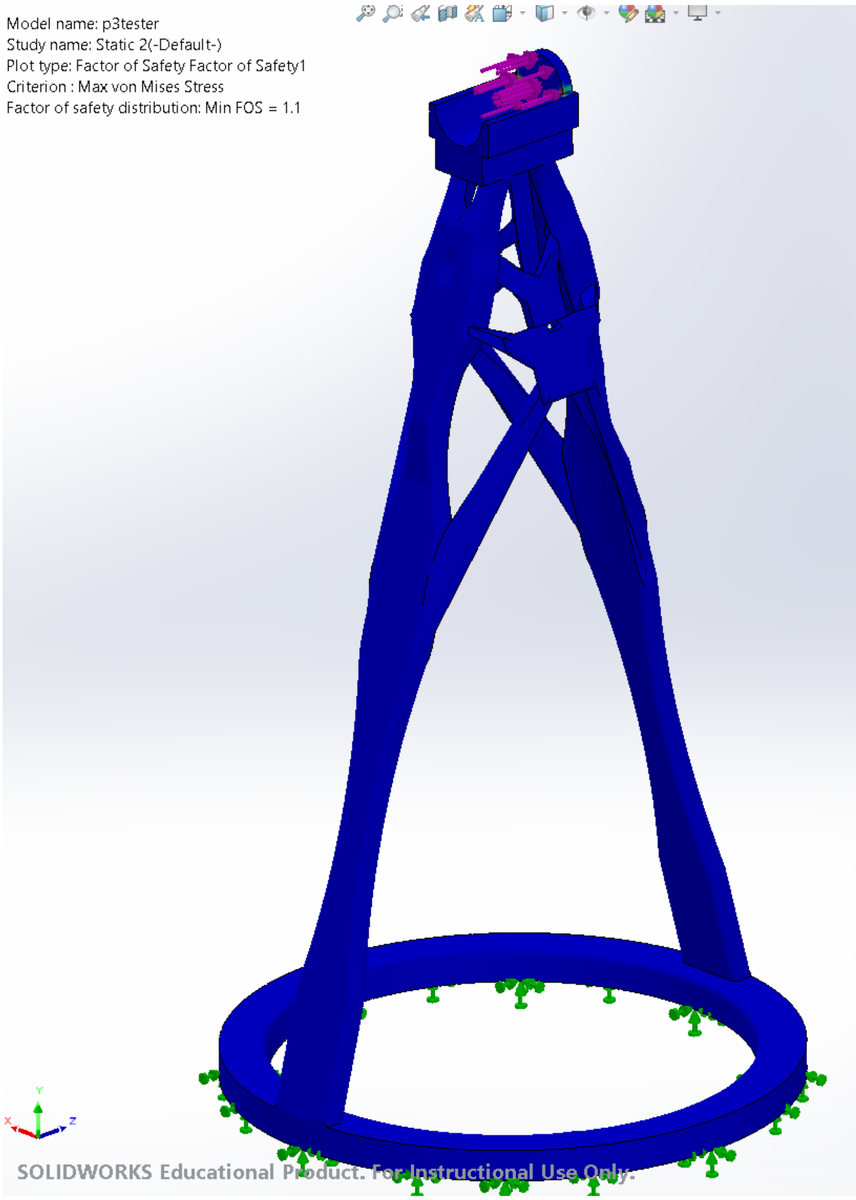
Finite Element Analysis Results Comparison

Displacement Simulation (5N)



For our finite element analysis of 5N, we found that the maximum displacement would theoretically be 0.04076 mm while our testing gave us a displacement of .17 mm. This indicates that our FEA testing was very inaccurate which points to the material properties of our ABS being different from what we inputted for our simulation. It may also be that the anisotropy introduced in the manufacturing process by the 3d printer skewed our results.

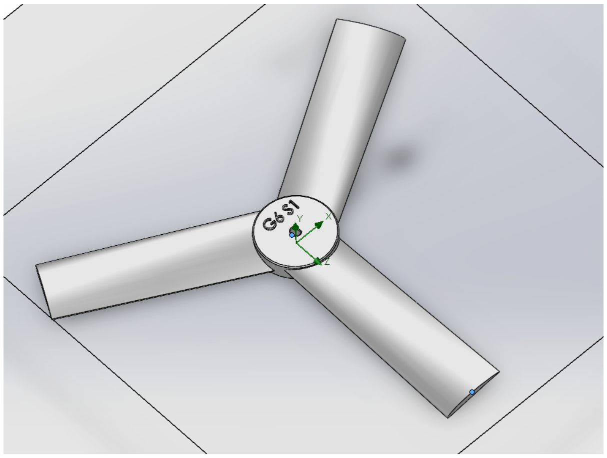
Factor of Safety (500N)



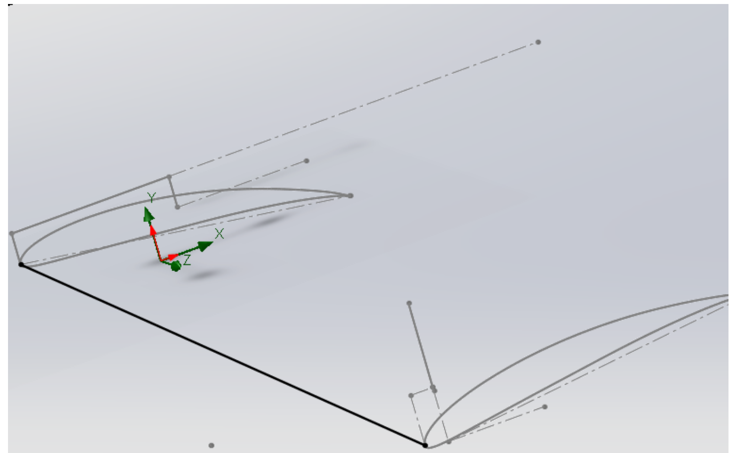
Our FEA also indicated that under a 500 N load, our minimum factor of safety would be 1.1. We were unable to test our design to failure so it is unknown what the accuracy of this simulation was. If we assume the error between our FEA and our reality was multiplicative by a factor of 4.17 then our simulation would indicate that our design's maximum load would be 120 N.

CAD Drawings

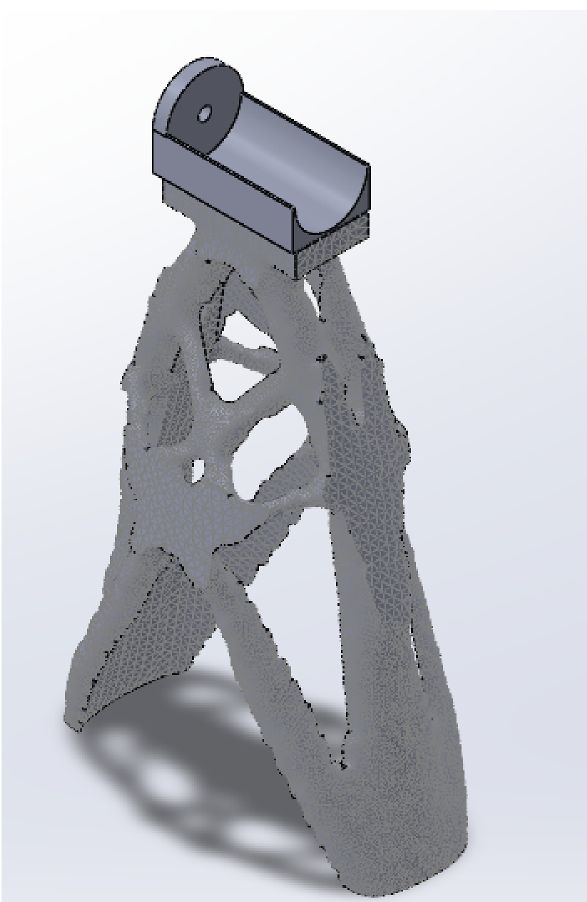
Blade



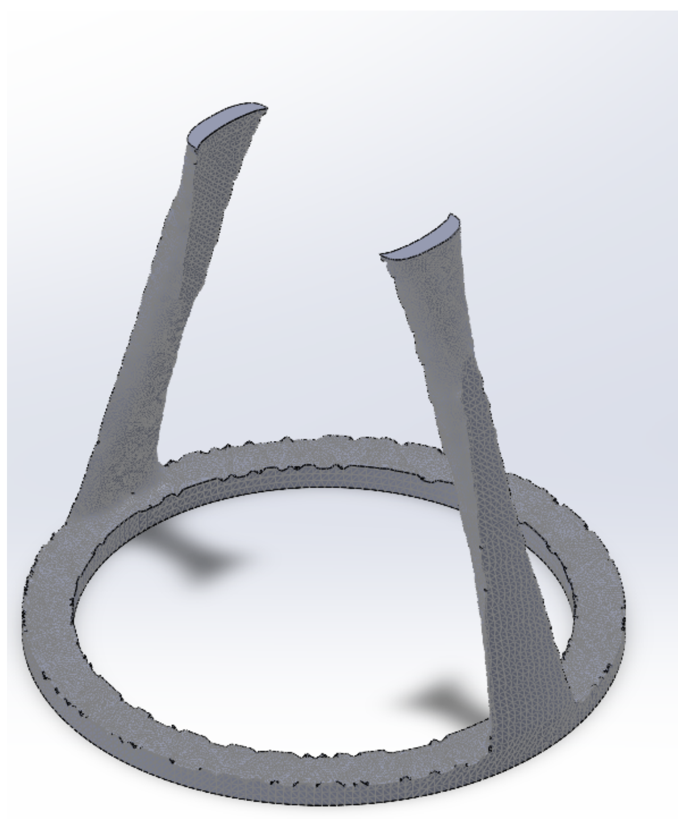
Blade Loft Profiles



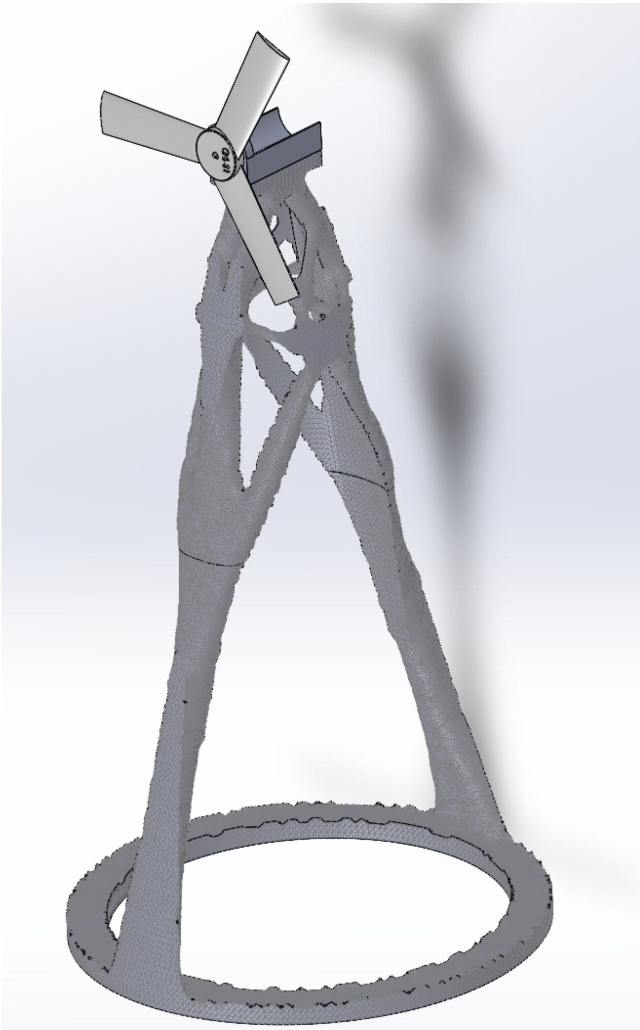
Tower Top Half



Tower Bottom Half

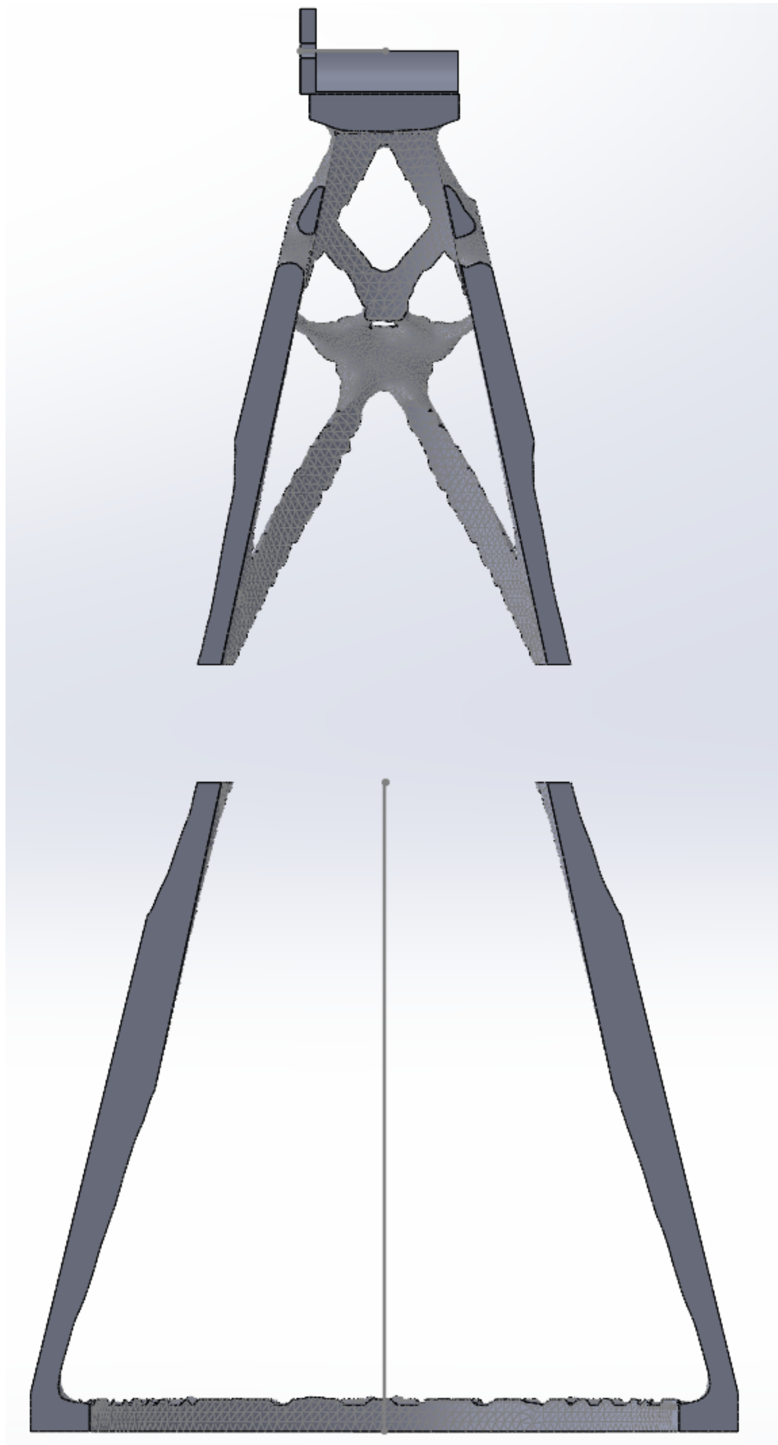


Assembly

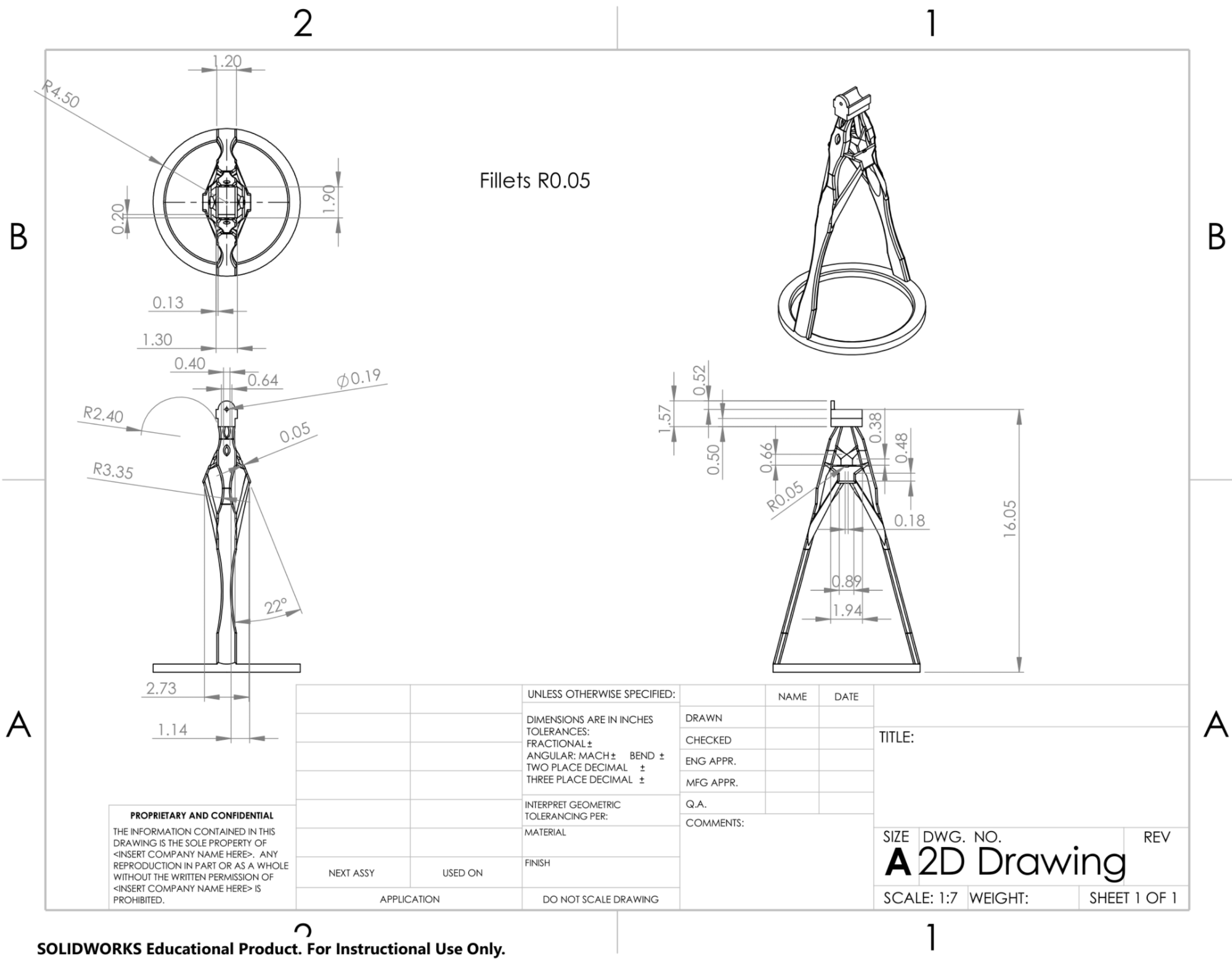


Exploded

Section View



Tower Drawing



Conclusions

After much discussion, testing, and research, we decided to make a turbine with 3 blades with a profile based on the SG6043 airfoil, a twist of 15 degrees, and an angle of attack of 8 degrees. The blades were made as wide as possible and as tall as possible to help generate as much power as possible. The blade had a diameter of 3 inches and was 0.25 inches tall.

The tower was made organically using the topology study feature in Solidworks to make it as stiff as possible while being within the volume requirement. The uniquely shaped supports were able to hold 9kg without breaking and at 1kg, the deflection of the tower was 0.37mm. The overall weight of the entire tower and base plate was 1.3253kg and the height was 16 inches.

The efficiency of our turbine was significantly lower than the efficiency of the average commercial turbine. The efficiency of an average turbine is 20-40% while ours was 7.13% ("Renewable Energy Fact Sheet: Wind Turbines", 2013). This could be due to the differing scales between our design and real turbines.

Overall, we all learned a lot about wind turbines and their construction. The project also allowed us to learn more about Solidworks, basic fluid dynamics, and the math behind what makes an effective wind turbine. Even though it wasn't as efficient as we'd like, the tower performed a lot better than we expected to in the deflection test and we are satisfied with our results.

Recommendations for Future Work

Over the course of our design process we made a couple of errors and missed a few opportunities to improve our design which are discussed below.

While we chose an airfoil befitting the low Reynolds number of the scenario, we still did not properly account for the amount of laminar flow that occurred in our design which may have caused increased drag. Optimally, we would decrease our angle of attack to account for the increased drag and prevent problems with stalling. Furthermore, we could also have included small ridges in our blade design to break up the flow of laminar air into turbulent air and therefore reduce the presence of the Laminar Bubble. The error in our angle of attack propagated to an issue in blade profile twist which created further drag. In our design, we also failed to correctly label the direction from which the blades should be oriented which led to poor initial testing results before the blades were reversed.

Our tower design did boast a good mass to stiffness ratio but this could have been improved by including the motor hub into the topology simulation. FEA revealed that the weakest element of our tower design was by far the hub of the tower. By including the hub in the topology optimization we may have been able to further increase the stiffness of our tower. Furthermore, given the nature of topology optimizations, more research into the expected loads that our tower might face would have allowed us to further decrease the mass while staying within a reasonable factor of safety.

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Appendices

Appendix A: Raw Data

Wind Turbine Performance Data

Group#: 6 **Team members (Names):** Jackson Zilles, Stephanie Akakabota, Anisa Torres, Justin Wang, Andrew Moncada?

1. *Power Measurements*

a. **Blade to Fan Distance: (at 25 mph wind speed)**: 11 in.

b. **Wind Speed:** 25.5 mph (In front of the motor and prior to blade installation)

c. **Power Measurements:**
(Note: Wait ~5 sec. between readings for reading stability)

Data points	Voltage V(Volts)	Current mA I (Amps)	Power P (Watts)	Blade Speed (rpm)	Notes
0	33.8	0	0	~~5350~~ 5330	
1	3.62	13	0.04	5270	
2	3.58	23	0.08	5250	
3	3.54	32	00.11	5230	
4	3.50	42	0.14	5203	
5	3.48	53	0.18	5165	
6	3.47	68	0.23	5145	
7	3.41	103	0.35	5070	
8	3.35	130	0.43	5028	
9	3.30	150	0.49	4978	
10	3.26	172	0.55	4952	
11	3.06	266	0.8	4740	
12	2.83	353	1.0	4400	error ?
13	2.59	445	1.15	4230	
14	2.31	520	1.21	3941	
15	1.95	550	1	~~3192~~ 3336	redid this trial to check

Comment

Figure 22) Raw Data from Power Test

2. Deflection Measurements

a. **Tower Height:** 16 in.

b. **Tower Net Weight:** 1325.3 gram. (Total Assembly – Bottom board)

c. **Deflection Measurements :**

Data Points:	Load (Kg)	Load (N)	Deflection (mm)	Observations
1	0.1		0.03	
2	0.2		0.06	
3	0.3		0.1	
4	0.4		0.14	
5	0.5		0.17	
6	0.6		0.21	
7	0.7		0.25	
8	0.8		0.29	
9	0.9		0.34	
10	1.0		0.37	
11	1.2		0.44	
12	1.4		0.52	
13	1.9		0.7	
14	2.9		1.09	
15	3.9		1.48	
16	4.4		1.68	

Comment

17	4.9	1.91
18	5.9	2.34
19	6.9	2.81
20	7.4	3.03
21	7.6	3.14
22	7.8	3.26
23	8.0	3.33
24	8.2	3.42
25	8.4	3.52
26	8.6	3.62
27	8.7	3.67
28	8.8	3.71
29	8.9	3.78
30	9.0	3.81

ky

Figure 23) Raw Data from Deflection Test

Appendix B: Group Course Evaluations

Fillout Task List
Task Owner: Justin Wang
Project Title: [ENGINEERING] Fall 2021 Evaluations
Category: COE-2021
Subcategory: Fall

Subject	Due date	Status
ENGIN 26 LEC 001 3 DIMEN MOD DES	Sunday, December 12, 2021	Completed
ENGIN 26 LEC 001 3 DIMEN MOD DES (EVAL FOR GSI)	Sunday, December 12, 2021	Completed

Fillout Task List
Task Owner: Anisa Torres
Project Title: [ENGINEERING] Fall 2021 Evaluations
Category: COE-2021
Subcategory: Fall

Subject	Due date	Status
ENGIN 26 LEC 001 3 DIMEN MOD DES	Sunday, December 12, 2021	Completed
ENGIN 26 LEC 001 3 DIMEN MOD DES (EVAL FOR GSI)	Sunday, December 12, 2021	Completed

Fillout Task List
Task Owner: Jackson Zilles
Project Title: [ENGINEERING] Fall 2021 Evaluations
Category: COE-2021
Subcategory: Fall

Subject	Due date	Status
ENGIN 26 LEC 001 3 DIMEN MOD DES	Sunday, December 12, 2021	Completed
ENGIN 26 LEC 001 3 DIMEN MOD DES (EVAL FOR GSI)	Sunday, December 12, 2021	Completed

Fillout Task List
Task Owner: Andrew Moncada
Project Title: [ENGINEERING] Fall 2021 Evaluations
Category: COE-2021
Subcategory: Fall

Subject	Due date	Status
ENGIN 26 LEC 001 3 DIMEN MOD DES	Sunday, December 12, 2021	Completed
ENGIN 26 LEC 001 3 DIMEN MOD DES (EVAL FOR GSI)	Sunday, December 12, 2021	Completed

Fillout Task List
Task Owner: Stephanie Akakabota
Project Title: [ENGINEERING] Fall 2021 Evaluations
Category: COE-2021
Subcategory: Fall

Subject	Due date	Status
ENGIN 26 LEC 001 3 DIMEN MOD DES	Sunday, December 12, 2021	Completed
ENGIN 26 LEC 001 3 DIMEN MOD DES (EVAL FOR GSI)	Sunday, December 12, 2021	Completed

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