Midpoint Presentation
Wind Energy - 13
By:

Ahmad Saeed - Technical Analysis and CAD/Main Frame

Abdulrahman Alossaimi - Project Manager / Control Theory / Blade design

Fahad Almutairi - Budget Liaison / Website Developer

Michele Tsosie - Blades design / secretarial support

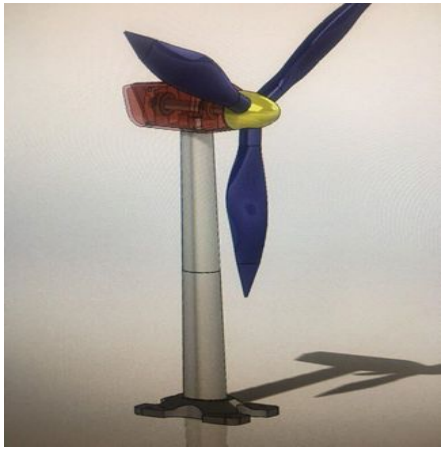
Besongnsi Ntoung - project Manager /Position: Technical Analyst and Researcher

Project description

1. Client: David Willy.
2. To design and build a fully functional and efficient wind turbine.
3. Guidelines based off of the Collegiate Wind Competition.
4. Limited to 45 by 45 by 45cm.

Updates

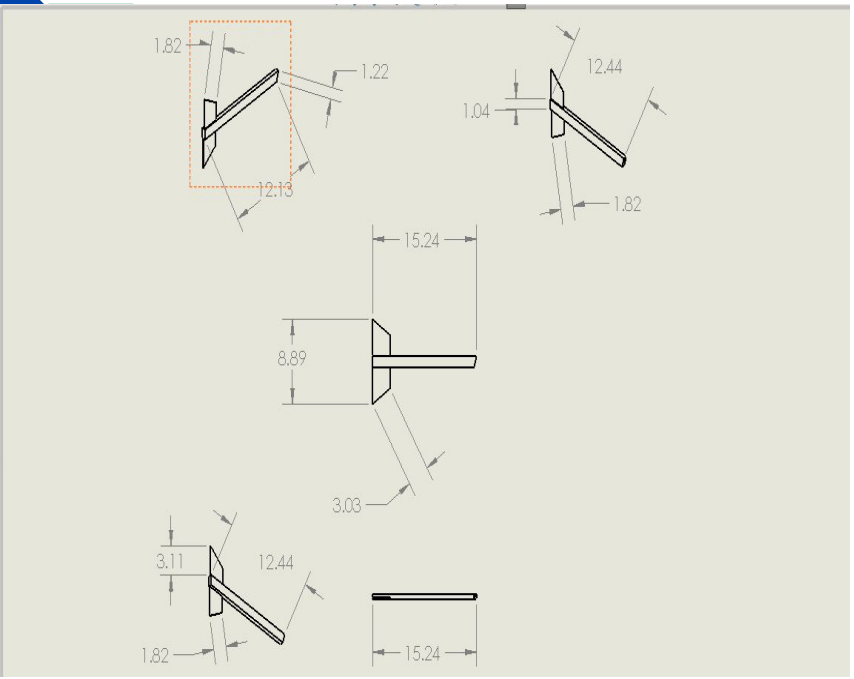
- Got approval from client about brakes, generator and we ordered them.
- We changed our design.
- Changed the nacelle from close to open nacelle.



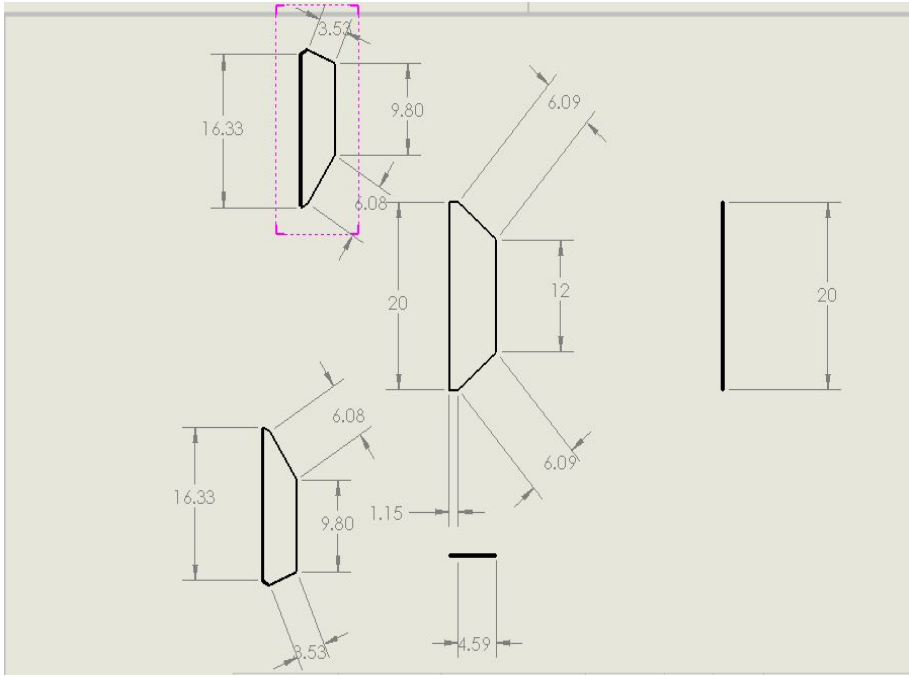
Old design

New design

Fin design



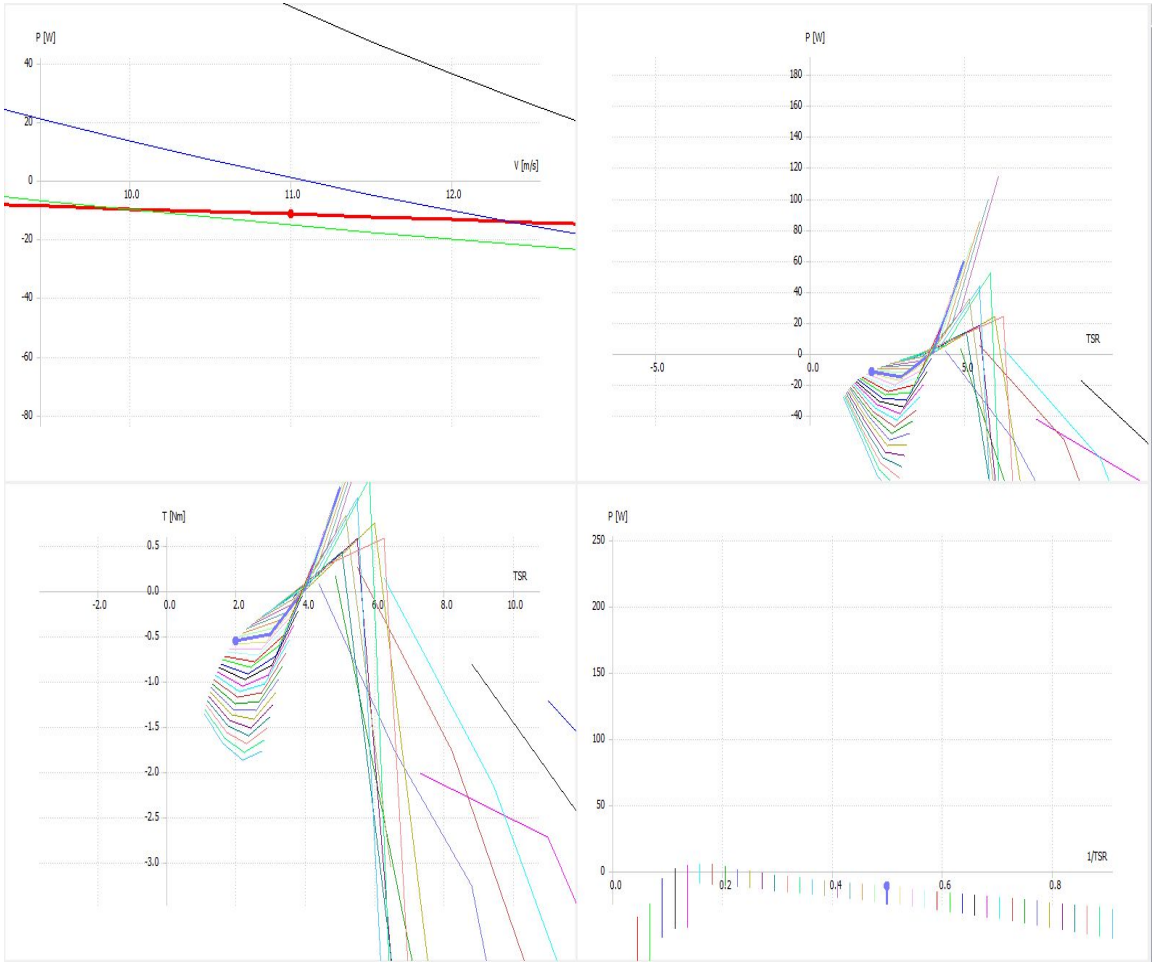
Old design



New design

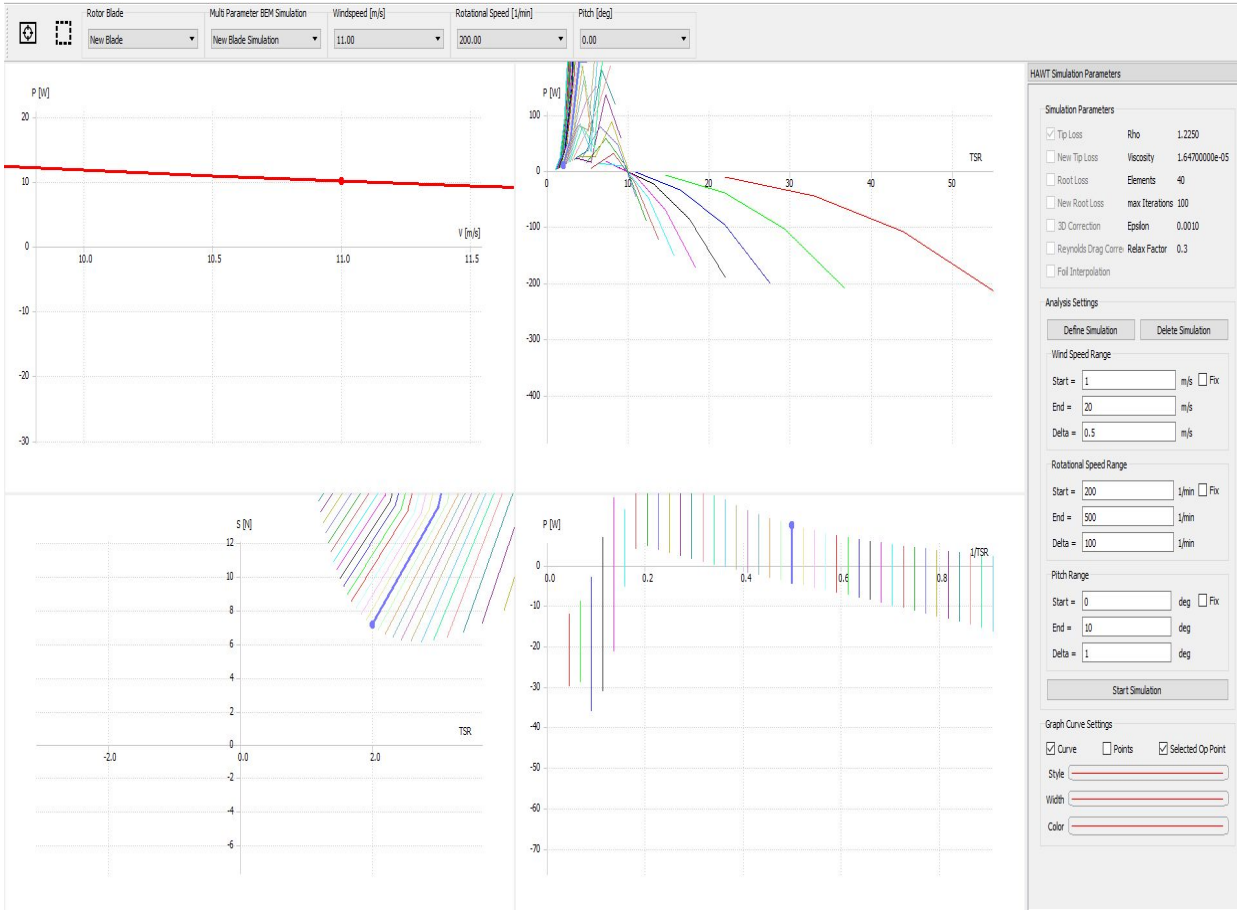
Blade (old design)

- 68 Iterations of airfoils all at 11 m/s.
- Blade Design NACA 2414, 6409, and 4414 (Qblade software) .



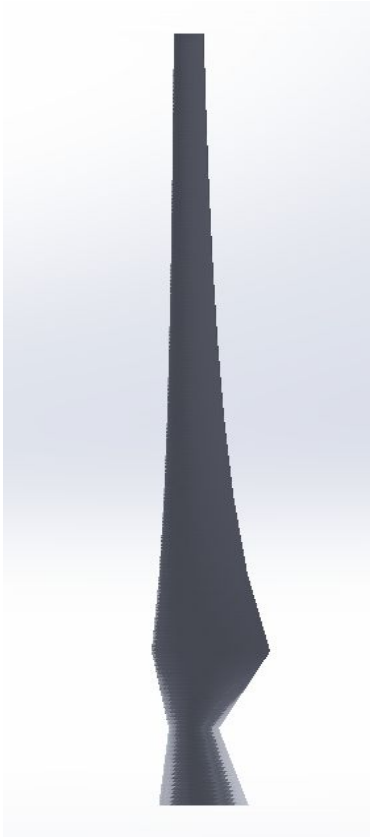
Blade (new design)

- NACA 2414 - chosen airfoil.
- Power and Thrust Evaluated.
- Power - 11 Watts.
- Thrust - 10 Newtons.



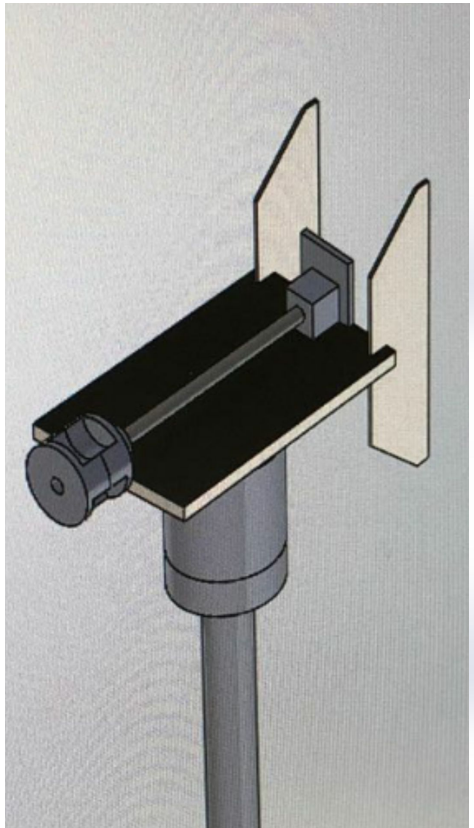
Blade Design (new design)

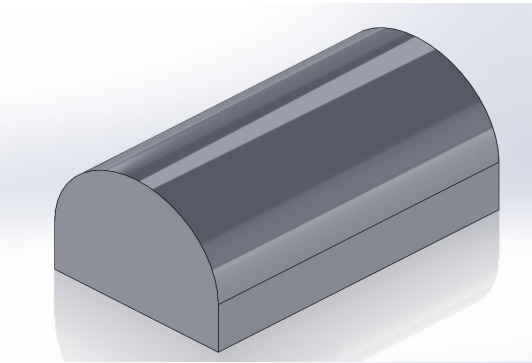
- Qblade design transferred into solidworks.
- Purpose is to 3D print at the Rapid Lab.
- Mate the part to the entire parts assembly.
- 3D printing in Maker Lab.
- Comparison in quality.

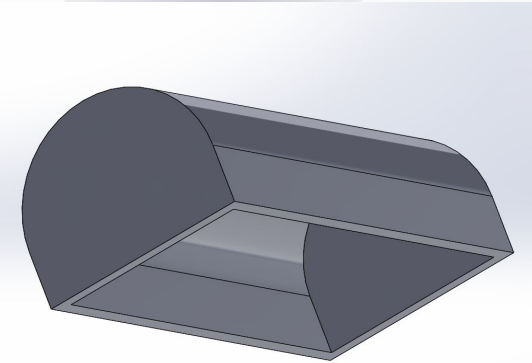


Nacelle Design

- The first design was a covered nacelle to protect the components, such as: generator, brake, and shaft.
- Steel flat bar.
- New CAD of the nacelle drawing.







Shaft update

- By calculation, the first design was 18 mm diameter with 30 CM length.
- Shaft Has to touch generator, brakes system and blades.
- New shaft is 10 mm diameter with 20 cm length.
- Shaft will handle many forces like radial force, thrust force and moment.

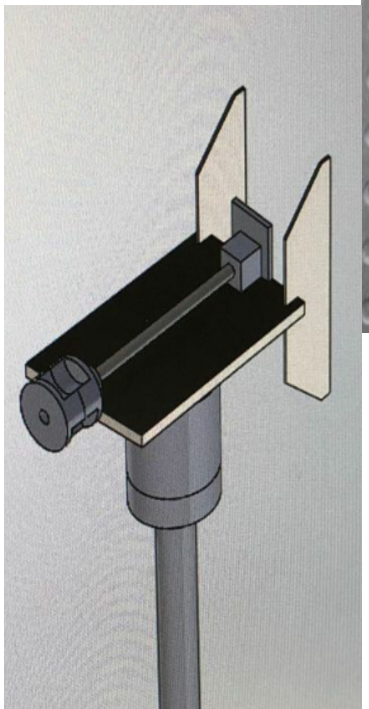
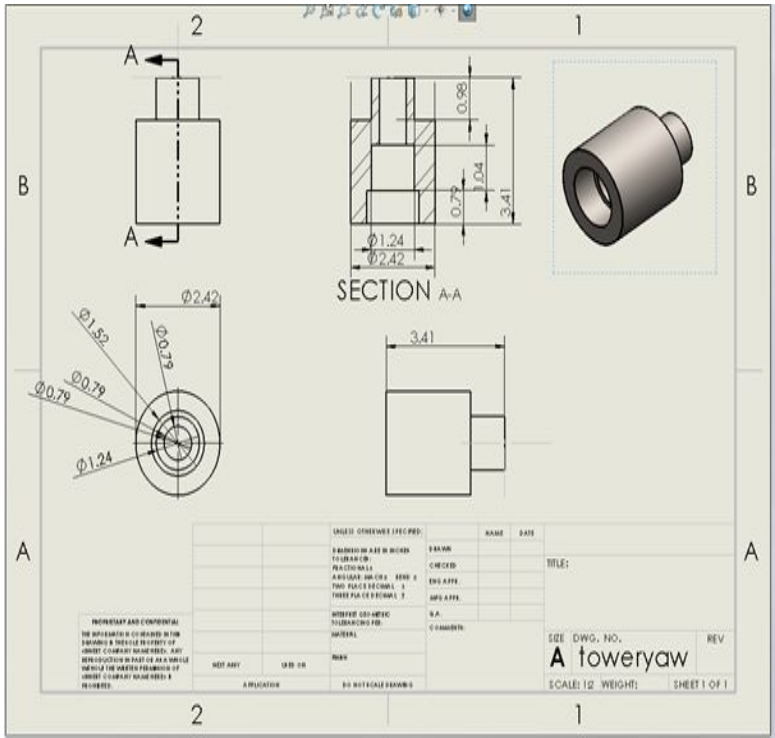


Figure 1: Shaft Adapter [1]

Updates

What is left in the manufacturing of the design?



- Brake disk - $2.36
- Linear actuator - $12.20
- Towerya

Moving forward

Manufacturing:

- NAU machine shop - Order for base flange, tower beam, nacelle yaw and nacelle.
- Braking system - Wind team 13 (Electrical devising and assembly).
- Rotor - Wind team 13 (Blades and hub) will be 3D printed.
- What's left - shaft, generator and wiring will be assembled by wind team 13.

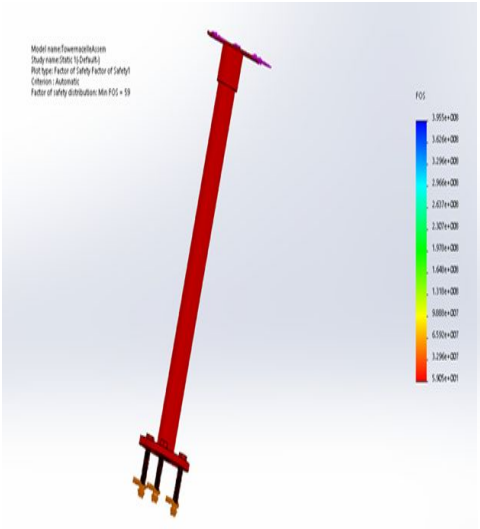
Design Testing:

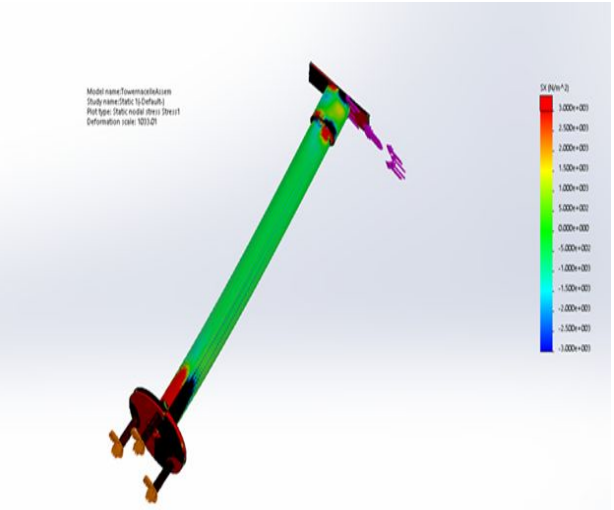
- Two Methods - Theoretical and experimental methods.

Experimental

- 253L lab - Deflection, stress and strain test (tower, base flange & shaft).
- Digital multimeter tester (Voltage).

Theoretical - FEA, CAD and Analytical Calculations





F.S. = 59
Deformation = 1.033 mm

Wind turbine Analytical Analyses:

Solidworks:

- Calculated mass of 9280.87 , Volume of 1181072.60 cubic millimeters and Surface area of 279442.71 square millimeter.
- The center of mass in the X,Y and Z direction are 264.05 mm, 374.56 mm and 574.40 mm respectively.

Mathematical Calculations:

- Thrust - 20 N - 44 N.
- Brakes - Clamping force 40 N - 88 N (F.S.=2).
- Bearings - Load capacity greater than (C_10 >= 6 KN for shaft) and (C_10 >=10 kN for toweryaw).

Bill of Materials

BILL OF MATERIALS (BOM)

ITEM N(	Material	Purchase	QTY.	COST PRICE	Manufacturer	Description	Part Number	Website
1	Brakes	X	1	$35.00	king motor	stainless steel / carbon pads		https://m.ebay.com/itm/NEW-KING-MOTOR-Brake-Hardware-HPI-BAJA-5B-SS-5T-5SC-Compatible-GB9-/312092464877
2	Shaft	X	1	$38.76	master carr	stainless steel rod		https://www.mcmaster.com/#precision-shafts/=1djipt2
3	Generator	X	1	$45.24	Turnigy power system	HD 3508 Brushless Gimbal	9244000018	https://hobbyking.com/en_us/turnigy-hd-3508-brushless-gimbal-motor-bldc.html
4	Welding	X	1/2	$90.00/hr.	Artisan Metal Works	Welding and Metal Fabrication	xxxxx	http://www.artisanmetalworks.net/
5	Turning	X	1/2	$90.00/hr.	Artisan Metal Works	Turning of metal pipe	xxxxx	http://www.artisanmetalworks.net/
6	Milling	X	1/2	$90.00/hr.	Artisan Metal Works	Milling of raw metal	xxxxx	http://www.artisanmetalworks.net/
7	Aluminum 6061-T6	X	1	$32.00/sheet	Metals Depot	0.04 " thick metal sheet 4x3 ft	S3040-6061	https://www.metalsdepot.com/aluminum-products/6061-aluminum-sheet-plate
8	CD Steel	X	1	$6.60/2ft.	Metals Depot	3/8' by 3/4' HR A36 Steel Rolled fla	F23834	https://www.metalsdepot.com
9	Blades	X	3	$3.38	Maker Lab - Cline	PLA 3D printing		https://nau.edu/library/
10	Blades	x	3		Rapid Lab - Fab Lab	3D printing		https://nau.edu/cefns/engineering/mechanical/research-and-labs/labs-facilities/engineering-fabrication-lab-(machine-shop)/
11	Hollow Steel Pipe	X	1	$0	Metals Depot	HR A36 Hollow Steel	xxxxx	https://www.metalsdepot.com
		TOTAL PRICE		$295.98				

RAW MATERIAL	
SUB-ASSEMBLED	
MANUFACTURE	

Gantt Chart

ACTIVITY	Begin Date	End Date	Assigned To	PERCENT COMPLETE
Final Proposal	6/2/2018	6/6/2018	Team	100%
Website Check 1	6/7/2018	6/13/2018	Fahad	100%
HR1 Summary and Peer Eval 1	6/14/2018	6/20/2018	Team	100%
Individual Analysis II	6/21/2018	6/27/2018	Individually	100%
Midpoint Report	6/28/2018	7/4/2018	Team	100%
HR2 Summary and Peer Eval 2	7/5/2018	7/11/2018	Team	100%
Drafts of poster and operation manual	7/12/2018	7/18/2018	Team	70%
Website Check 2	7/19/2018	7/25/2018	Fahad	40%
Final Postor and Operation manual	7/26/2018	8/1/2018	Team	20%
Final Report, Website, Peer Eval 3 and CAD Package	8/2/2018	8/7/2018	Team	35%

Hardware Review 2

Figure 2: Generator [1]

- Calculations verified by client
- Blade selection evaluated
- Numerical values acceptable in reference to previous Wind Teams from client
- Material suggested from previous Wind Teams

Hardware Review 2

1. Wind energy - created by blade rotation
2. Mechanical energy - wind energy converted to mechanical by the rotation of shaft component
3. Generator - shaft turns the generator and converts the mechanical to electrical
4. Fin - regulates the direction of the blades to stay perpendicular to the wind.

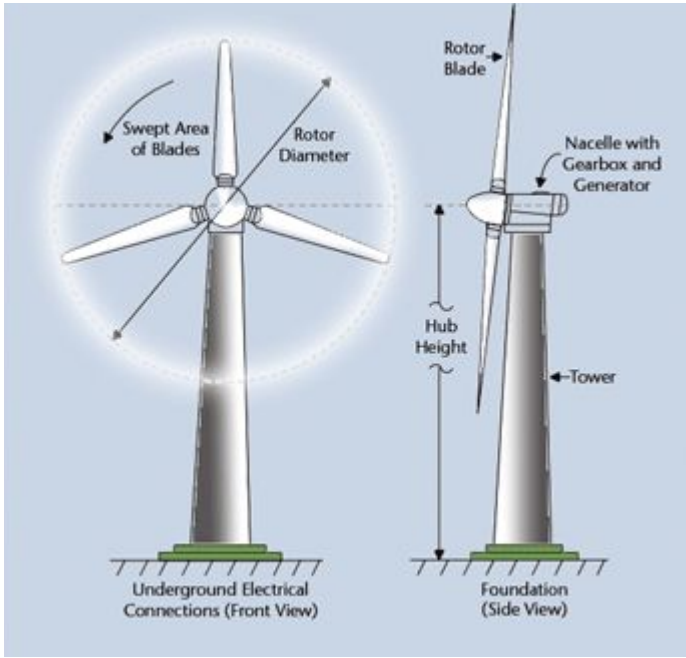


Figure 3: Wind Turbine [2]

References

[1] HobbyKing. [Online]. Available.

https://hobbyking.com/en_us/turnigy-hd-3508-brushless-gimbal-motor-bldc.html

[2] Offshore Wind energy Production. 2017. [Online]. Available. http://data.naturalcapitalproject.org/nightly-build/invest-users-guide/html/wind_energy.html

Thank you,
Any Questions?