

Wind Turbine: Solution for Future Energy at Dhaka City (One of the Most Populated Cities around the World)

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Abstract— The term wind energy or wind power describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity. Renewable energy production and demand growth is gaining momentum in many ways across the world. There is a booming demand of wind power today and all wind energy equipment manufacturers are gearing up to meet the demand and take advantage of it. Wind power is a clean energy source; helps protect our planet by reducing pollution and lowering the amount of harmful emission that contribute to global warming. Above all energy by means of wind is completely renewable and is a domestic source which we need not depend on other countries for. This report will present the scope of wind turbine in Bangladesh. In addition of describing all the testing details and results, the report presents an analysis of our tests for a model wind turbine.

Index Terms— Wind Turbine, Horizontal Axis Wind Turbine (HAWT), Vertical Axis Wind Turbine (VAWT), Base, Shaft, Gear, Blades.

1 INTRODUCTION

Global wind turbine installations have been rapidly rising, due to the maturation of wind turbine technology and the proliferation of government policies that support the development of wind energy. Wind is a form of solar energy and is a result of the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and the rotation of the earth. So how do wind turbines make electricity? Simply stated, a wind turbine works the opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. Wind turbines allow us to harness the power of the wind and turn it into energy. When the wind blows, the turbine's blades spin clockwise, capturing energy. This triggers the main shaft, connected to a gearbox within the nacelle, to spin. The gearbox sends that energy to the generator, converting it to electricity. Electricity then travels down the tower to a transformer, where it is converted again to AC or DC voltage depending on the grid. Modern wind turbines fall into 2 basic groups: 1.Vertical Axis Wind Turbine (VAWT) and 2.Horizontal Axis Wind Turbine (HAWT).

2 DESCRIPTION OF MODEL TURBINE TEST

2.1 Designing

We have decided to build a Horizontal Wind Turbine over a lot of arguments and risk factors. Wind speed is the most important factor that needs to be analyzed before building any kind of wind turbine. Unfortunately the wind speed inside of the city Dhaka, as we gathered the required data from the most reliable sources, is very low (almost 2.4 to 3.0 meter per second at the windy season) that it makes our project of building a wind turbine very difficult and

decreases the possibility to complete the project successfully by a large margin. Thus the fact of lack of wind speed in Dhaka was talked in each and every discussion. We can see that by the number of wind turbine constructed in Bangladesh, it is way too low. Where in other countries where wind turbines are more popular, the average wind speed is up to 30 meter per second, which is almost ten times higher than the wind speed we have here in Dhaka.

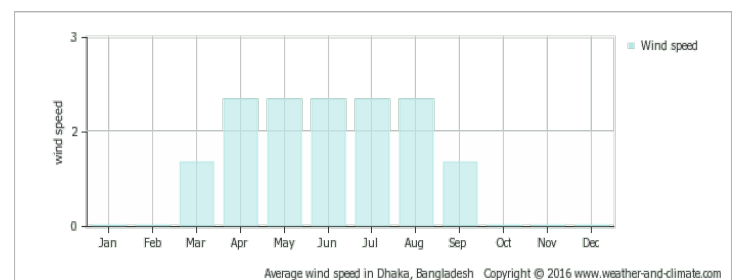


FIGURE 1: AVERAGE WIND SPEED IN DHAKA, BANGLADESH.

The most of the arguments about the design of the wind turbine was related to the design of its base and it has to be efficient and has to hold a lot of weight as the weight of the turbine blades, shaft, gear and generator will directly be carried by the base. The balancing has to be perfect between the turbine blades and the weight of other parts such as generator in order to make this wind turbine fully operational. Then the proposal was about building the base with steel maiden angles, while the base will the shape of a pyramidal structure with three 25 feet long iron maiden angle uniformly keeping definite distance from each other and being connected to each other by Iron maiden uniform triangles welded to them.

The wind turbine is decided to contain a six bladed turbine situated on a pyramidal shaped 25 feet long tower (base). The base will have its 5 feet planted underground or under the surface so the actual height that counts from above the surface will be 20 feet. The angles of the base will keep a distance of 14" between them. A triangular shape having a length of 9.5" each arm will act as the main stage holder for all the weight from the upper parts of the wind turbine at the height of 20th feet of the tower. The gear and the generator will be situated upside of the turbine shaft and will be given protection by a cover/hat of tin sheet. The blade thickness of the turbine will be 1.5 mm, its length will be about 39" and its width will be varied from 8" to 6" as the blade will be curvy. The shaft attached to the gear and the turbine will be cylindrical and hold the measurement of 15"/1".

2.2 Base: We made a hole or base of 4 feet length and 5 feet width using spade and crowbar. For making a strong base we used 4th grade carbon mixed rod, which is attached with steel wire gauge as a square shape. Then we made a cage of rod under the base and we used sand, cement, cobble to make a mixed cob. Then the steel angle cage is put on this base and after that we filled the hole with cob. After 2 or 3 days the base is complete and it became a strong support to the upper things to hold.

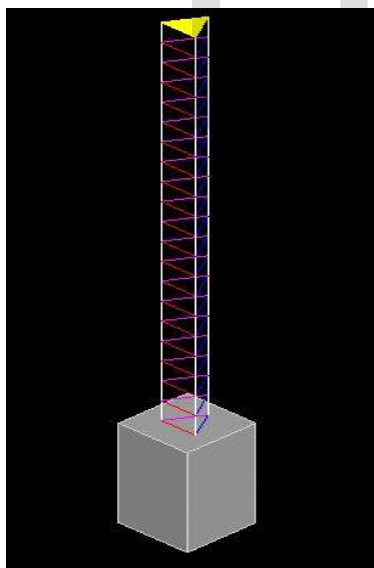


FIGURE 2: 3D OUTPUT OF THE DESIGN OF THE BASE OF THE ONGOING PROJECT

2.3 Shaft: Our turbine selected shaft is vertical axis shaft. Its length is 15 inch and diameter is 1 inch and made with iron and steel combination.

- Transmission shafts.
- 25 mm to 60 mm with 5 mm steps.
- 60 mm to 110 mm with 10 mm steps.
- 110 mm to 140 mm with 15 mm steps.
- 140 mm to 500 mm with 20 mm steps.

The standard lengths of the shafts are 5 m, 6 m and 7 m.

2.4 Gear: A gearbox is used in turbines, windmills, grinders, etc. to change the direction of the rotary motion. The bigger gear that we used having 30.48 cm diameter, 1 inch thickness, 150 teeth and teeth to teeth distance is 6mm. The smaller one is having 2.5 cm diameter, 2cm thickness, 10 teeth and same teeth distance. Here the gear ratio is 1:15.



FIGURE 3: GEAR PARTS

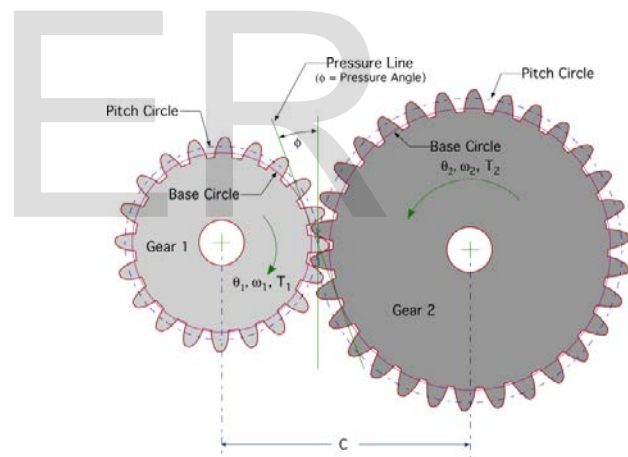


FIGURE 4: GEAR PLACING CONDITION IN OUR WIND TURBINE

2.5 Blades: Wind turbine can be two types. HAWT and VAWT. We made here horizontal axis wind turbine (HAWT). As the number of blades in the wind turbine increases aerodynamic efficiency of turbine increases, but in a diminishing manner. When we move from 2 blades to 3 blades design efficiency gain is about 3%. But as we move from 3 blades to 4 blades design, efficiency gain is marginal.

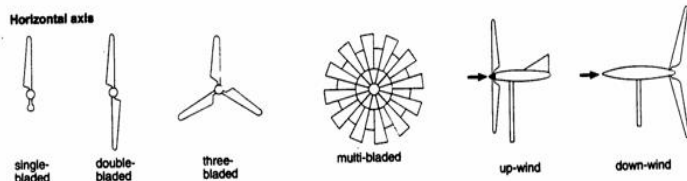


FIGURE 5: VARIOUS BLADES

Here we use total six blades and every blade is 39 inch long from the hub. The thickness of the blades is 1.5 mm. That's why the total diameter covered by the blades is 7 feet. The width from bottom side is 8 inch and from top side is 6 inch. We have used still sheet as the wind turbine blades.



FIGURE 6: PROJECT BLADES

3 LIMITATIONS: Wind turbine is totally depending upon the flow of wind. In Dhaka city wind flow is rare because of its limited space for flowing. Also it is hard to continue this in stormy weather.

4 FUTURE ASPECTS: While wind turbine is not so popular or common source of renewable energy in Bangladesh, still there is a lot of possibility and hope for wind turbine on the south of Bangladesh where the windy coastal area is situated.

5 RECOMMENDATION: It is better to build turbine beside riverside near Dhaka to have maximum efficiency. It also needed to make this 'plug and play' mode so that it could easily remove when weather is stormy. Connections between all different parts should be checked twice. And it is better to store the energy in a battery for further use anywhere.

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6 CONCLUSION: Wind energy is a clean renewable energy source cheaper to maintain saves fuel and can give decentralized energy. We should make maximum use of it (including more efficient boat sails where wind energy is directly used). This needs creation of necessary data and manpower base, setting up some demonstration plants at appropriate locations and carrying out research and studies for indigenization of technology.

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