T. Y. B. Sc. (Physics) Semester: III

Elective-I : Renewable Energy Sources

Subject Code: PH-336

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MODULE V : WIND ENERGY

2. Vertical axis type wind machines :

- In a vertical axis machine , the rotor axis is vertical and fixed , and is perpendicular to both the surface of the earth and the wind stream .
- There two types of the vertical axis wind machines ,

i) **Savonius or S type rotor wind machines**

ii) **Darrieus type rotor wind machines .**

i) Savonius or S type rotor wind machines:

- The Savonius wind turbine is a simple vertical axis device having a shape of half-cylindrical parts attached to the opposite sides of a vertical shaft (for two-bladed arrangement) and operate on the drag force, so it can't rotate faster than the wind speed.
- This means that the tip speed ratio is equal to 1 or smaller .
- As the wind blows into the structure and comes into contact with the opposite faced surfaces (one convex and other concave), two different forces (drag and lift) are exerted on those two surfaces.
- The basic principle is based on the difference of the drag force between the convex and the concave parts of the rotor blades when they rotate around a vertical shaft.
- Thus, drag force is the main driving force of the Savonius rotor .

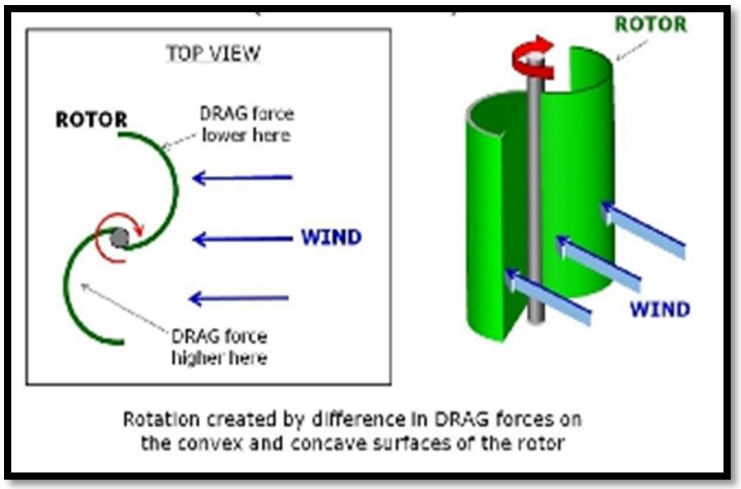

Fig : The Savonius rotor and its stream flow .

Advantages :

- 1. It has high wind collecting capacity ,therefore efficiency is also good .
- 2. Easy to design and requires low maintenance.

Disadvantages :

- 1. The rotation speed is less and weight of the system is also large .
- 2. The large diameter blades are required for proper generation of power .

ii) The Darrieus type wind machines :

- The Darrieus wind turbine is a type of vertical axis wind turbine (VAWT) used to generate electricity from wind energy.
- The turbine consists of a number of curved aerofoil blades mounted on a rotating shaft or framework.
- The curvature of the blades allows the blade to be stressed only in tension at high rotating speeds.
- When air foil blades rotating , they provide a torque about the central shaft in response to a wind stream .
- This shaft torque is being transmitted to a generator to generate electricity .

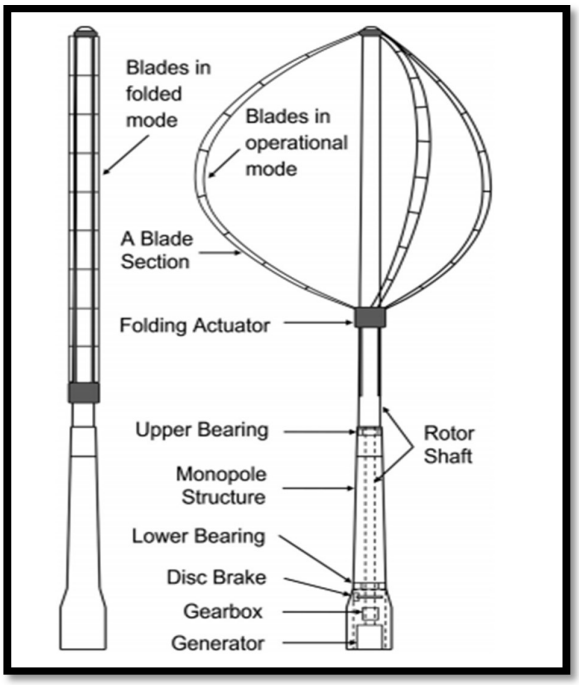

Fig : Schematic diagram of Darrieus type machine .

Advantages :

- 1. The major advantage of this type is that the rotor blades can accept wind from any direction .
- 2. The machine can be mounted on the ground eliminitaing tower structures and lifting of huge weight of the machine assembly .

Disadvantages :

- 1.The efficiency of this machine is less .
- 2. Because a Darrieus rotor is generally situated near the ground , it may also experience lower velocity wind .

Wind data :

- The wind velocity is vector quantity , specified by its magnitude and direction .
- From the point of view of extracting the energy from the , wind , the horizontal component of the magnitude is of interest .
- Measurements of wind speed are made by using anemometer .

- The wind velocity at any location usually varies rapidly and continuously , the variation being irregular both in terms of period and amplitude .
- Typical measurements showing the variation of wind speed with time at a location are shown in following figure .
- It is seen that there are turbulent fluctuations occuring continuously with occasional gusts causing peaks and valleys .
- However for practical purposes , it is the hourly speed which is of interest and this is the quantity generally tabulated .

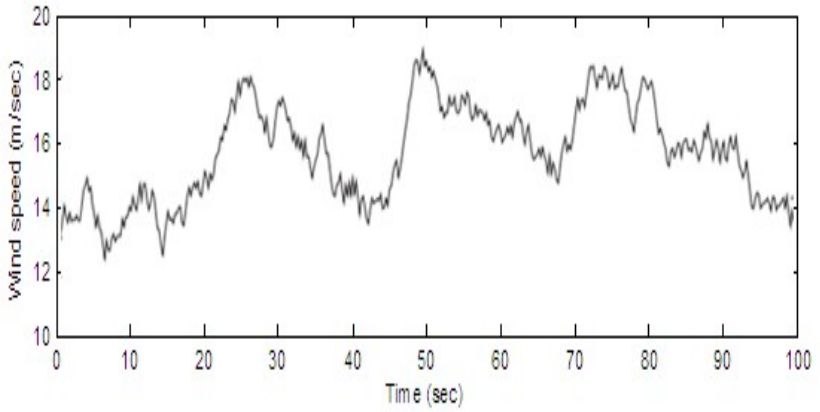

Fig : Typical variation of wind speed with time .

- In India , measurements of wind speed have been made for many years at various stations by the Indian Meteorological Department .
- These have been analysed and tabulations showing the diurnal variation of the mean hourly wind speed (in kmph) for each month and for the year are available for 37 stations across the country .
- It is of greater interest to know the number of hours in month or in a year when the wind speed lies in a certain range .
- This information can also be computed from hourly wind speed data .
- It is usually presented in the form of tables giving the mean percentage frequency distributions of hourly wind speeds .