

CAI335 SOLAR AND WIND ENERGY SYSTEM

UNIT IV NOTES



4.1 Windmills

If the mechanical energy is used directly by machinery, such as a pump or grinding stones, the machine is usually called a windmill.

4.1.1 Classification of wind mill

The wind mills machines are classified as follows:

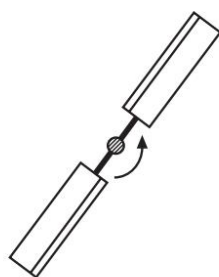
1. Based on the type of rotor: (i) Propeller type (horizontal axis) (ii) Multiblade type (horizontal axis) (iii) Savonius type (vertical axis) (iv) Darrieus type (vertical axis).

2. Based on orientation of the axis of rotor:

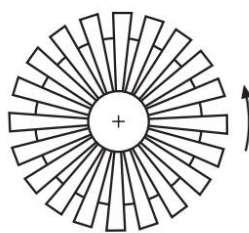
(i) Horizontal axis (ii) Vertical axis

Description of Wind Mills/Machines

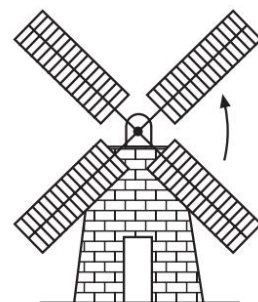
1. Propeller type wind mill: These are most commonly used wind mills. Such a wind mill has two or three blades for economical reasons. Though the two blade design is most efficient, yet it faces the difficulty of vibrations during orientation to wind direction called 'Yaw control'. These machines are rated from 1 to 3 MW



Propeller type (two blade design).



Multiblade type.



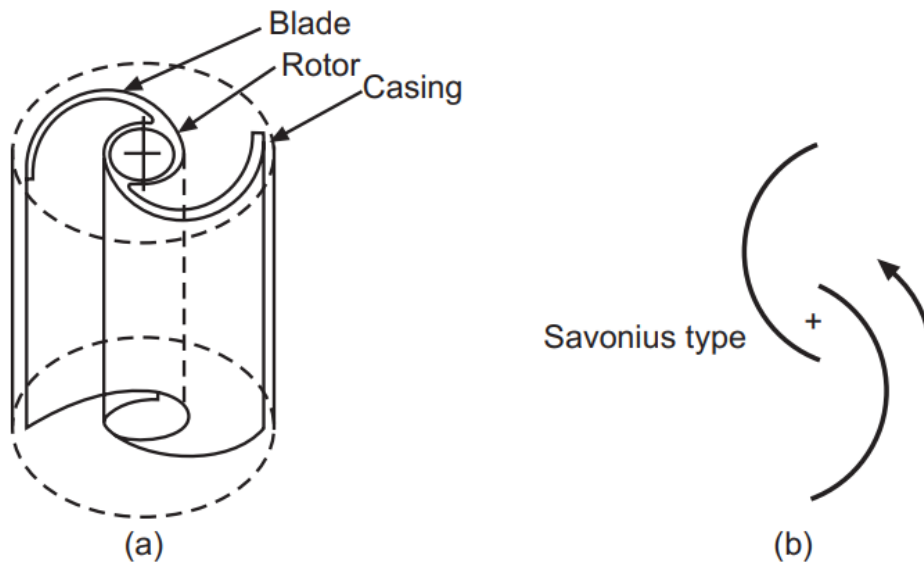
Four-blade dutch wind mill.

2. Multiblade type wind mill:

The multiblade wind turbines are high solidity turbines used for pumping the water because of high starting torque characteristics. The multiblade rotors are less efficient because of interference of blades in each other but they are less noisy.

3. Savonius type wind mill:

This type of wind mill has hallow circular cylinder sliced in half and the halves are mounted on vertical shaft with a gap in between. Torque is produced by pressure difference between the two sides of the half facing the wind.



. Savonius type wind mill.

This is quite efficiency but needs a large surface area.

Advantages:

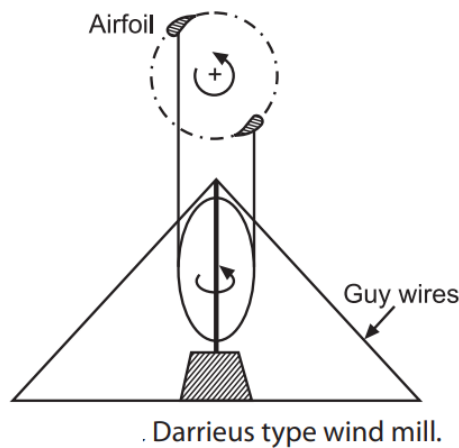
1. Low cost.
2. Operation at low wind velocity
- . 3. No need of yaw and pitch control.
4. Generator can be mounted at the ground level.

Applications. It is useful for grinding grains, pumping water etc.

4. Darrieus type wind mill :

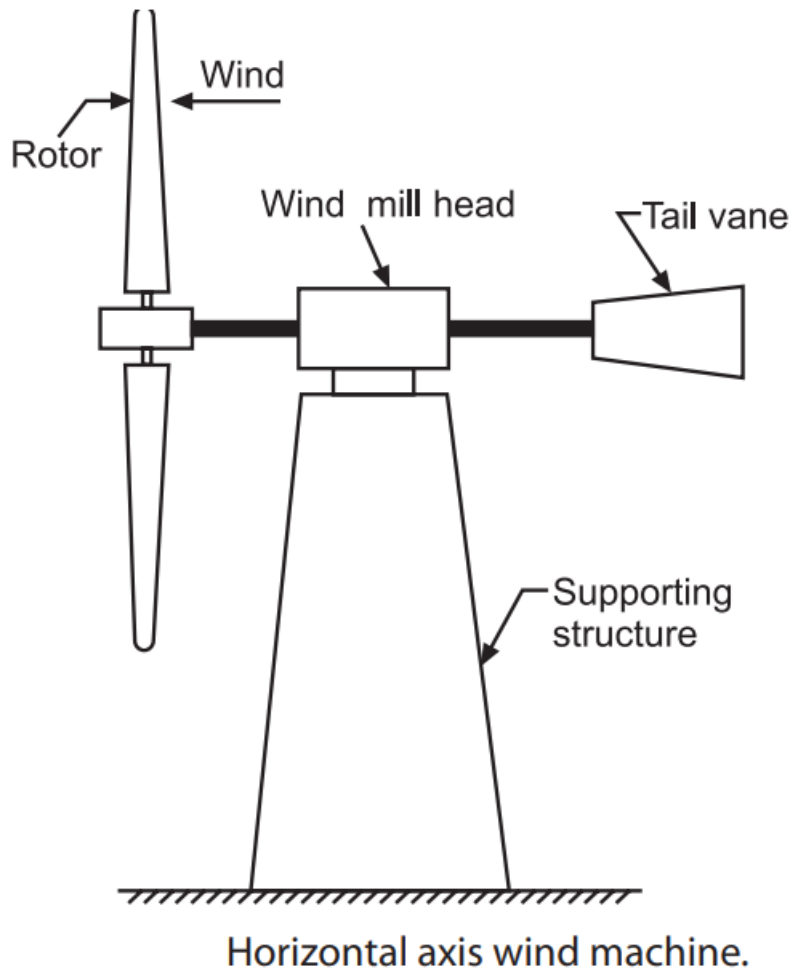
This wind mill needs much less surface area. It is shaped like an egg beater and has two or three blades shaped like airfoils. This wind mill needs much less surface area. It is shaped like an egg beater and has two or three blades shaped like airfoils.

Characteristics of Darrieus rotor: (i) Not self starting, needs auxiliary starter. (ii) High speed. (iii) High efficiency (iv) Potentially low capital cost. **Advantages:** (i) The generator, gear box etc. are placed on the ground. (ii) No need of yaw mechanism to turn the motor against the wind.



5. Horizontal axis wind machines

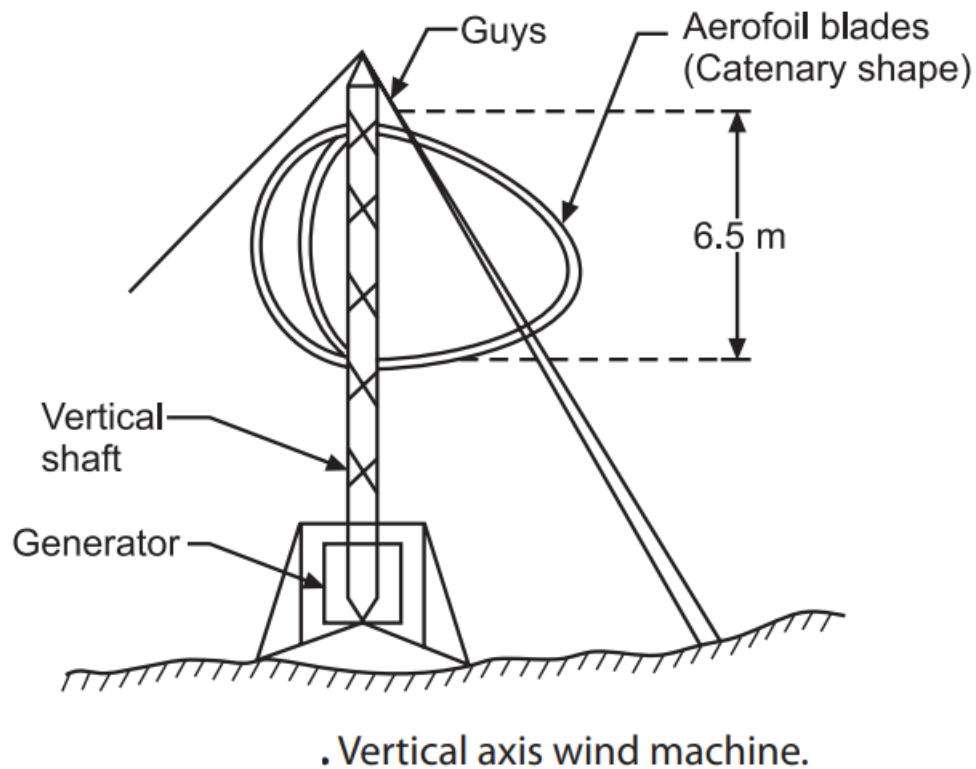
Although the common wind turbine with a horizontal axis is simple in principle, yet the design of a complete system, especially a large one that would produce electric power economically, is complex. It is of paramount importance that the components like rotor, transmission, generator and tower should not only be as efficient as possible but they must also function effectively in combination.



6. Vertical axis wind machines :

One of the main advantages of vertical axis rotors is that they do not have to be turned into the windstream as the wind direction changes, because their operation is independent of wind direction.

These vertical axis machines are called panemones.



Advantages of vertical axis wind machines:

1. The rotor is not subjected to continuous cyclic gravity loads since the blades do not turn end over end (Fatigue induced by such action is a major consideration in the design of large horizontal axis machines).
2. Since these machines would react to wind from any direction, therefore, they do not need yawing equipment to turn the rotor into the wind.
3. As heavy components (e.g. gear box, generator) can be located at ground level these machines may need less structural support.
4. The installation and maintenance are easy in this type of configuration.