Site selection :-

1) High annual wind speed
2) Availability of Anemometry Data
3) Availability of Wind V(t) Curve
4) Wind structure at site
5) Altitude of site
6) Terrain & topology
7) Local Ecology.
8) Distance to roads & railways.
9) Nearness to Local users.
10) Nature of Ground
11) Fav. Land cost

Component of WECS :-

1) Wind Turbine → most visible part → include large rotor blades. → Capture K.E of wind
2) Nacelle → housing located at top of tower just behind rotor hub.
3) Tower → Structural support.
4) Generator → convert mech. to electrical
5) Yaw System → ensure rotor rotate horizontally.
6) Controller & Control System →
7) Wind Vane → indicate wind direction → help in adjusting turbine orientation
8) Anemometer → speed of wind
9) Foundation → provide stability to tower.

Torque :- $T = \frac{P}{\omega} = \frac{P}{\pi DN}$

T → Torque (Nm)
ω → Angular velocity of turbine wheel
D → Diameter of turbine wheel.

* Tip Speed Ratio → TSR = $\frac{\text{Speed of blade Tip}}{\text{Wind Speed}}$ →

It is a characteristics of rotor. There exist an optimum TSR at which efficiency is maximum. Higher Rotor speed → Higher TSR → Lesser S.

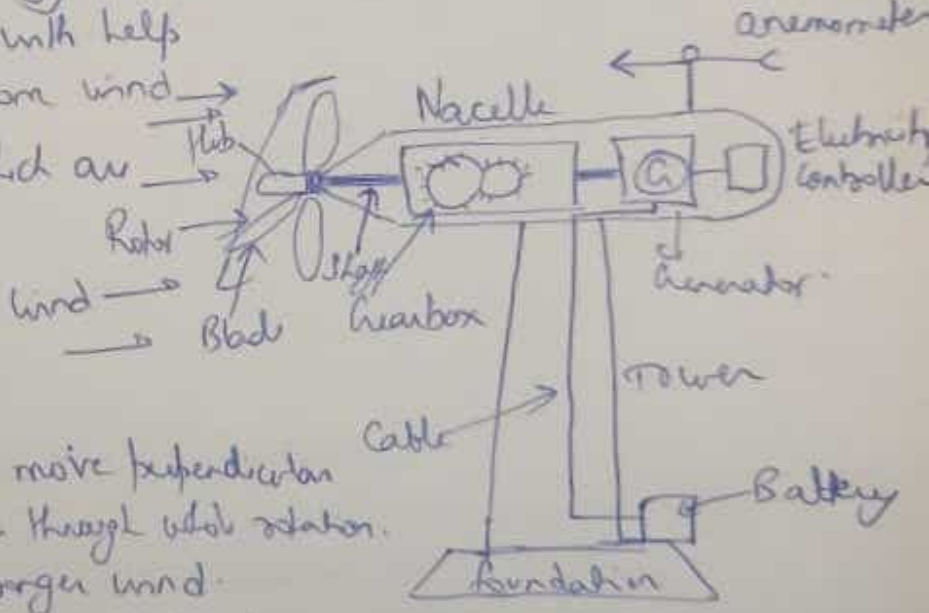
Solidity.
↓
Area of rotor projected on plane perpendicular to axis of rotation / Swept area of rotor

As TSR increases no. of blades decreases.

TSR	No of Blade
1	6-20
2	4-12
3	3-1
4	3-5
5-8	2-4
8-15	1-2

HAWT (Horizontal Axis Wind Turbine):

→ It is a unique technology
→ It produce the electricity with help of some mechanism from wind →
→ It has 3 turbine blade which are set Horizontal.



Adv :-

1) High efficiency since blade move perpendicular to ~~blade~~ wind, receiving power through whole rotation.
2) Tall tower base allow stronger wind.
per 10 m → 20% increase → 34% power output increase.

Disadv.

1) Massive tower construction to support heavy blades, gearbox & generator
2) Components being lifted into position.
3) Highs makes obtrusively visible across large area, disturbing appearance of landscape
4) require additional Yaw control to turn blades towards wind
5) require breaking or yawing device in high wind to avoid destruction of blade

Factor influencing wind :-

1) Location 2) Wind Speed 3) Wind direction
4) Obstacles 5) Altitude 6) Weather Pattern

Wind Speed monitoring.

1) Height → taller → better → b/c they encounter fewer obstacles & experience less turbulent wind
2) Location → Where we place is crucial. Obstacle like tree, buildings, etc reduce speed.
3) Size of Wind Turbine → Bigger → more wind → more energy.
4)

Betz limit :-

Theoretical maximum efficiency for a wind turbine. conjectured by German physicist Albert Betz in 1919. The value is 59.3% meaning atmost 59.3% of K.E of wind can be used to spin the turbine and generate electricity.
In reality turbines cannot reach the Betz limit. Common efficiency are in 35-45% range.

Types of Generator

1) DC Generator → used in small-scale wind energy systems.
→ Simple & cost-effective but less efficient
→ regular check & replacement of brushes & commutators
→ require additional equipment for DC → AC.

2) AC Synchronous Generator → Permanent magnet SG → popularity in recent year → reliable & efficient
→ Electrically excited SG → less common
→ used in specialized applications.
→ require precise synchronization with grid frequency (difficult due to wind speed variation).
→ Complex & expensive compared to other

AC Asynchronous Generator →