Comparison betn Vapour Compression & Absorption Systems:-

Sl No.	Principle	Vapour Compression System	Vapour Absorption System.
1.	Working Method	Refrigerant vapour is compressed	Refrigerant vapour is absorbed & heated.
2.	Type of the energy supplied	Works solely on the mechanical energy.	Works solely on the Heat energy
3.	Work or Mechanical energy supplied	Mechanical energy required is more bcoz refrigerant vapour are compressed to higher pressures.	Mechanical energy required to run the pump is less since the pump is required only to circulate the refrigerant.

No.	Principle	Vapour Compression System	Vapour Absorption System
4	COP	Although the coefficient performance is relatively higher but reduces at part loads.	Although the coefficient of performance is relatively low it will be more or less same at part & full loads.
5.	Capacity	The design capacity is limited since a single compressor unit can produce upto 1000 tons of refrigeration	The absorption system can be designed to capacities well above 1000 tons.
6.	Noise	Noise is more due to the presence of the compressor	Almost quiet in operation as there is no compressor.
7.	Refrigerant	Freon-12	Ammonia
8	Leakage of Refrigerant	Due to high pressures the chances of leakage of the refrigerant is more & is a major problem.	Almost there is no leakage of the refrigerant
9.	Maintenance	The maintenance is high bcoz of the compressor	The maintenance is less.
10	Operating Cost	The operating cost is high since the electrical energy is expensive	The operating cost is less bcoz the thermal energy can be supplied from sources other than the electrical energy & also the electrical energy required to run the pump is relatively less.

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SITE SELECTION CRITERIA FOR A POWER PLANT

1. Supply of Fuel

2. Geology and Soil Type

3. Availability of Water

4. Availability of Land

5. Transportation Facilities

6. Nearness to Load Centers

7. Distance from Populated Areas

4.1.5 Thermal Power stations in India

There are about 26 thermal power stations in India. Their capacities varies from 50 to 600 MW. In Tamilnadu, we have 6 thermal power stations.

In order to face the persisting power crisis, super thermal power plants with installed capacity of 2000 – 3000 MW have been put to use. The major super thermal power plants are at Singrauli, Korba, Ramagundam, Neyveli, Talcher and Farakka.

... rainfall is deficit, the plant cannot work to full capacity.

4.2.6 Hydro – Electric Power Plants in India

There are about 28 Hydro – electric power plants in India. Their capacities are ranging from 25 MW – 1500 MW. In Tamilnadu, we have the following hydro – electric power projects.

1. Kodayar Hydro – Electric Project - Kodayar.
2. Kundah Basin Development Project - Kundah Basin
3. Mettur Basin Development Project - Mettur.
4. Periyar Basin Development Project - Periyar.

4.3.12 Nuclear Power Plants in India

1. Tarapur Nuclear Power station (Near Bombay)
2. Rana Prathap Sagar Nuclear Power station (Rajasthan)
3. Kalpakkam nuclear Power station (Tamil nadu)
4. Narora Nuclear Power station (Uttar Pradesh)
5. Kakrapar Nuclear power station (Gujarat)
6. Kaiga nuclear power station (Karnataka)

We also have heavy water plants at Kotah, Baroda, Tuticorin and Talcher.

ENGINE COMPONENTS

Internal combustion engine consists of a number of parts which are given below :

i) **Cylinder:** It is a part of the engine which confines the expanding gases and forms the combustion space. It is the basic part of the engine. It provides space in which piston operates to suck the air or air-fuel mixture. The piston compresses the charge and the gas is allowed to expand in the cylinder, transmitting power for useful work. Cylinders are usually made of high grade cast iron.

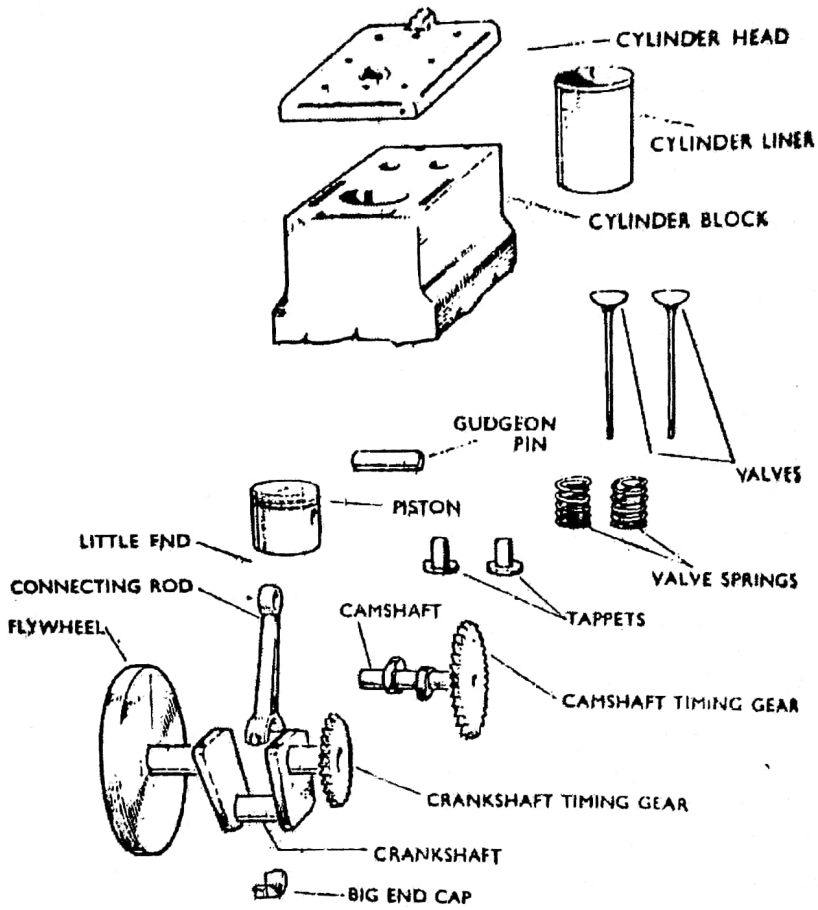
ii) **Cylinder block:** It is the solid casting body which includes the cylinder and water jackets (cooling fins in the air cooled engines).

iii) **Cylinder head:** It is a detachable portion of an engine which covers the cylinder and includes the combustion chamber, spark plugs or injector and valves.

iv) **Cylinder liner or sleeve:** It is a cylindrical lining either wet or dry type which is inserted in the cylinder block in which the piston slides. Liners are classified as : (1) Dry liner and (2) Wet liner.

Dry liner makes metal to metal contact with the cylinder block casing. wet liners come in contact with the cooling water, whereas dry liners do not come in contact with the cooling water.

v) Piston: It is a cylindrical part closed at one end which maintains a close sliding fit in the engine cylinder. It is connected to the connecting rod by a piston pin. The force of the expanding gases against the closed end of the piston, forces the piston down in the cylinder. This causes the connecting rod to rotate the crankshaft (Fig 3). Cast iron is chosen due to its high compressive strength. Aluminum and its alloys preferred mainly due to it lightness.



Engine components

Head (Crown) of piston: It is the top of the piston.

Skirt: It is that portion of the piston below the piston pin which is designed to adsorb the side movements of the piston.

vi) Piston ring: It is a split expansion ring, placed in the groove of the piston. They are usually made of cast iron or pressed steel alloy (Fig.3). The function of the ring are as follows :

a) It forms a gas tight combustion chamber for all positions of piston.
b) It reduces contact area between cylinder wall and piston wall preventing friction losses and excessive wear.
c) It controls the cylinder lubrication.
d) It transmits the heat away from the piston to the cylinder walls.

Piston rings are of two types: (1) Compression ring and (2) Oil ring

vii) Compression ring

Compression rings are usually plain, single piece and are always placed in the grooves of the piston nearest to the piston head. They prevent leakage of gases from the cylinder and helps increasing compression pressure inside the cylinder.

Oil ring: Oil rings are grooved or slotted and are located either in lowest groove above the piston pin or in a groove above the piston skirt. They control the distribution of lubrication oil in the cylinder and the piston.

Piston Pin: It is also called wrist pin or gudgeon pin. Piston pin is used to join the connecting rod to the piston.

viii) Connecting rod: It is special type of rod, one end of which is attached to the piston and the other end to the crankshaft (Fig.3). It transmits the power of combustion to the crankshaft and makes it rotate continuously. It is usually made of drop forged steel.

ix) Crankshaft: It is the main shaft of an engine which converts the reciprocating motion of the piston into rotary motion of the flywheel (Fig.3). Usually the crankshaft is made of drop forged steel or cast steel. The space that supports the crankshaft in the cylinder block is called *main journal*, whereas the part to which connecting rod is attached is known as *crank journal*. Crankshaft is provided with counter weights throughout its length to have counter balance of the unit.

x) Flywheel: Flywheel is made of cast iron. Its main functions are as follows :

a) It stores energy during power stroke and returns back the energy during the idle strokes, providing a uniform rotary motion of flywheel.
b) The rear surface of the flywheel serves as one of the pressure surfaces for the clutch plate.
c) Engine timing marks are usually stamped on the flywheel, which helps in adjusting the timing of the engine.
d) Sometime the flywheel serves the purpose of a pulley for transmitting power.

xi) Crankcase: The crankcase is that part of the engine which supports and encloses the crankshaft and camshaft. It provides a reservoir for the lubricating oil. It also

serves as a mounting unit for such accessories as the oil pump, oil filter,, starting motor and ignition components. The upper portion of the crankcase is usually integral with cylinder block. The lower part of the crankcase is commonly called oil pan and is usually made of cast iron or cast aluminum

xii) **Camshaft:** It is a shaft which raises and lowers the inlet and exhaust valves at proper times. Camshaft is driven by crankshaft by means of gears, chains or sprockets (Fig3). The speed of the camshaft is exactly half the speed of the crankshaft in four stroke engine. Camshaft operates the ignition timing mechanism, lubricating oil pump and fuel pump. It is mounted in the crankcase, parallel to the crankshaft.

xiii) **Timing gear:** Timing gear is a combination of gears, one gear of which is mounted at one end of the camshaft and the other gear at the crankshaft. Camshaft gear (fig.) is bigger in size than that of the crankshaft gear and it has twice as many teeth as that of the crankshaft gear. For this reason, this gear is commonly called half time gear. Timing gear controls the timing of ignition, timing of opening and closing of valve as well as fuel injection timing.

xiv) **Inlet manifold:** It is that part of the engine through which air or air-fuel mixture enters into the engine cylinder. It is fitted by the side of the cylinder head.

xv) **Exhaust manifold:** It is that part of the engine through which exhaust gases go out of the engine cylinder. It is capable of withstanding high temperature of burnt gases. It is fitted by the side of the cylinder head.

xiv) **Top dead centre** - When the piston is at the top of its stroke, it is said to be at the *top dead centre* (TDC),

xv) **Bottom dead centre** - when the piston is at the bottom of its stroke, it is said to be at its bottom dead centre (BDC).

In two stroke cycle engine both the sides of the piston are effective which is not the case in four stroke cycle engine.

xvi) Scavenging

The process of removal of burnt or exhaust gases from the engine cylinder is known as scavenging. Entire burnt gases do not go out in normal stroke, hence some type of blower or compressor is used to remove the exhaust gases in two stroke cycle engine.

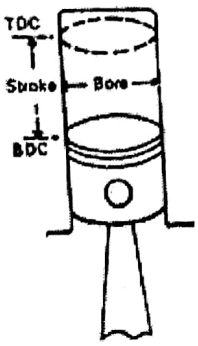
TERMINOLOGY CONNECTED WITH ENGINE POWER

Bore- Bore is the diameter of the engine cylinder.

Stroke - It is the linear distance traveled by the piston from Top dead centre (TDC) to Bottom dead centre (BDC).

Stroke-bore ratio -The ratio of length of stroke (L) and diameter of bore (D) of the cylinder is called stroke-bore ratio (L/D). In general, this ratio varies between 1 to 1.45 and for tractor engines, this ratio is about 1.25.

Swept volume - It is the volume (A x L) displaced by one stroke of the piston where A is the cross sectional area of piston and L is the length of stroke (Fig.4).



Bore and stroke of IC engine

Compression ratio - It is the ratio of the volume of the cylinder at the beginning of the compression stroke to that at the end of compression stroke, i.e. ratio of total cylinder volume to clearance volume.

The Compression ratio of diesel engine varies from 14:1 to 22:1 and that of carburetor type engine (spark ignition engine) varies from 4:1 to 8:1.

Power - It is the rate of doing work. S.I. unit of power is watt.

Watt = Joule/sec. (4.2 Joules = 1 Calorie).

In metric unit the power can be expressed in kg.m/sec.

Horse power (HP) - It is the rate of doing work. Expressed in horse power

Conversion factors from work to power

4500 kg m of work /minute = 1.0 hp

75 kg. m of work /second = 1.0 hp.

Indicated horse power (IHP) - It is the power generated in the engine cylinder and received by the piston. It is the power developed in a cylinder without accounting frictional losses.

$$IHP = \frac{PLAN}{4500} \times \frac{n}{2} \text{ (for four stroke engine)}$$

★ Steam power plant / Thermal.

⊙ Advantages.

① less land area required as compared to hydro power plant.

② Has easy maintenance cost.

③ Can be installed anywhere where water sources & transportation facility are easily available.

④ Coal is used as fuel & coal is cheaper than petrol & diesel.

⑤ labour availability.

⑥ ~~The life of thermal P.P~~

★ Disadvantages.

① Running cost is high because of fuel, maintenance, etc.

② Due to release of burnt gases of coal ful it produces global warming.

③ Heated water thrown in rivers, ponds, etc have adverse effect on living organism of water & disturbs ecology.

④ more pollution.

⑤ The life of thermal P.P is less than hydro-electric P.P.

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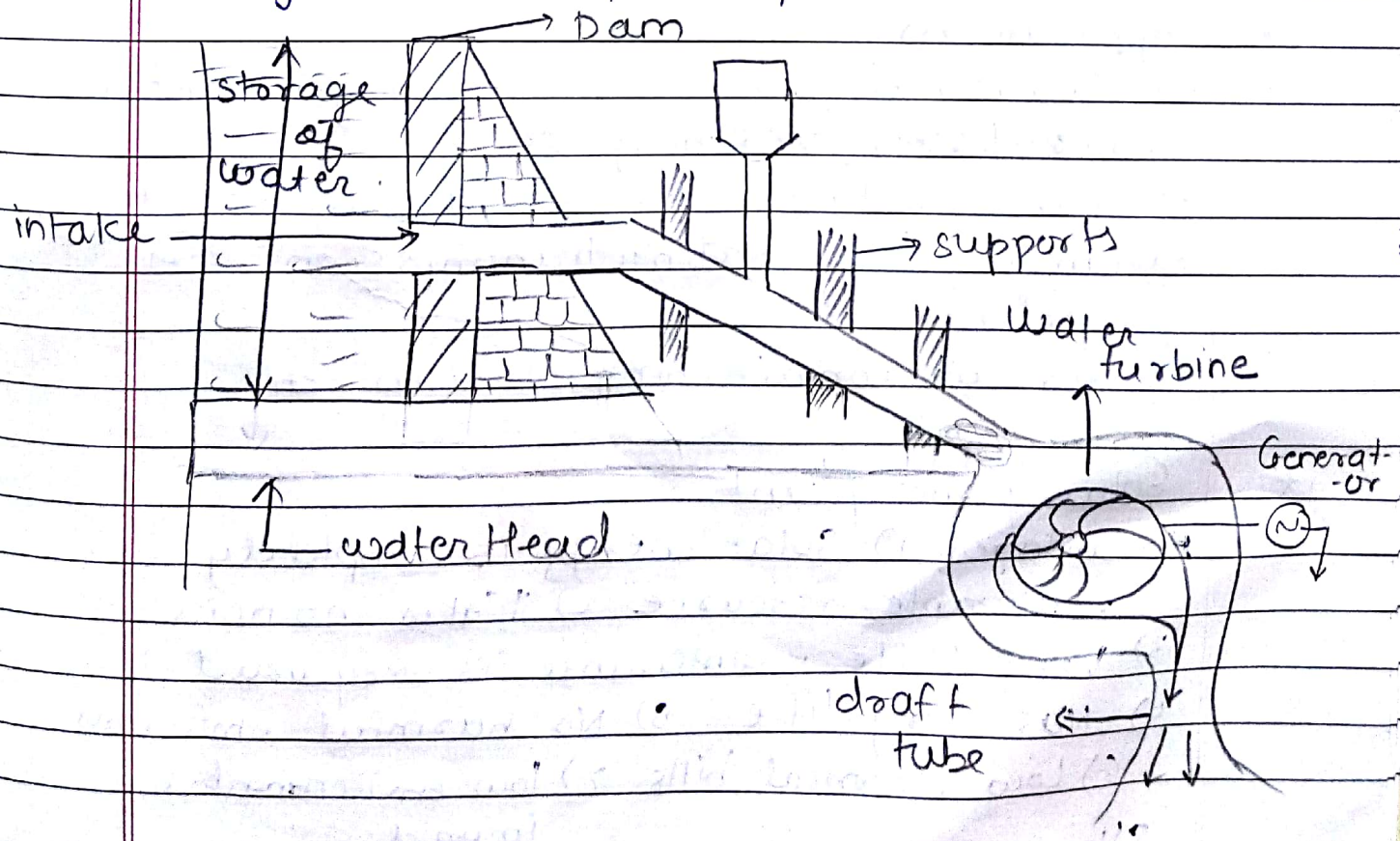
Site selection

1. Availability of coal
2. Ash Disposal facilities
3. Water availability
4. Transport facility.

Applications

1. Producing power only for a private client.
2. As a quick start back up to solar energy and or wind energy.
3. Can burn many different sources & types of fuel.
4. producing electrical power from geothermal energy which is then used to turn a turbine generator set.

Hydro electric power plant.



* Site selection
① Availability of water / H_2O storage ② land useful ③ Cost ④ transport of electricity ⑤ Construction.

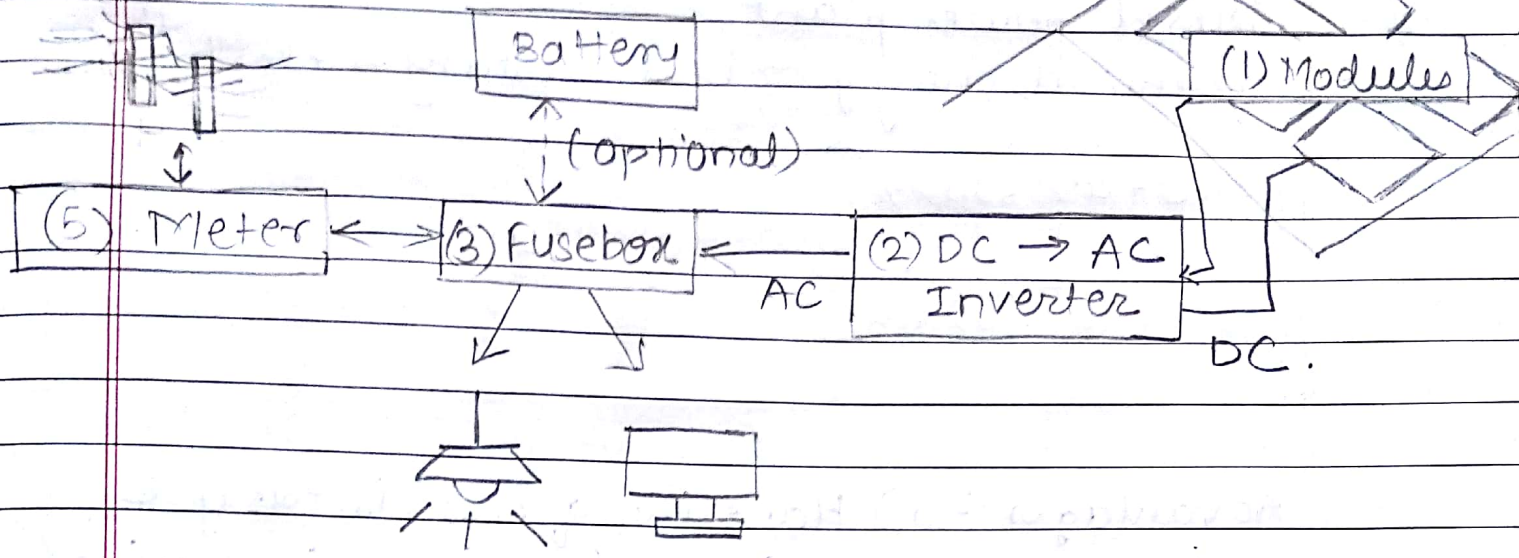
- Advantages.
① Once a dam is constructed, electricity can be produced at a constant rate.
② Hydroelectric power is not that expensive
③ Hydro power is a fueled by water, so it is a clean fuel source.

- Disadvantages.
① Dams are very expensive to build & must be built to a very high standard.
② People living in villages & towns are in valley to be flooded, must move out.
③ Fish population can be impacted if fish live in the dam

- Applications.
① Industrial process for power generation, fabrication, refining, etc.
② Infrastructure such as water treatment, electrical power transmission, gas pipelines, etc.
③ For air conditioning system, etc.

* Solar power plant
Advantages- 1) Solar energy is completely renewable resource. 2) Makes no noise 3) Very little maintenance is required. 4) Has long life 5) No harmful emissions 6) Low electrical bills 7) low environmental impact. 8) Low maintenance cost.

(6) Grid.



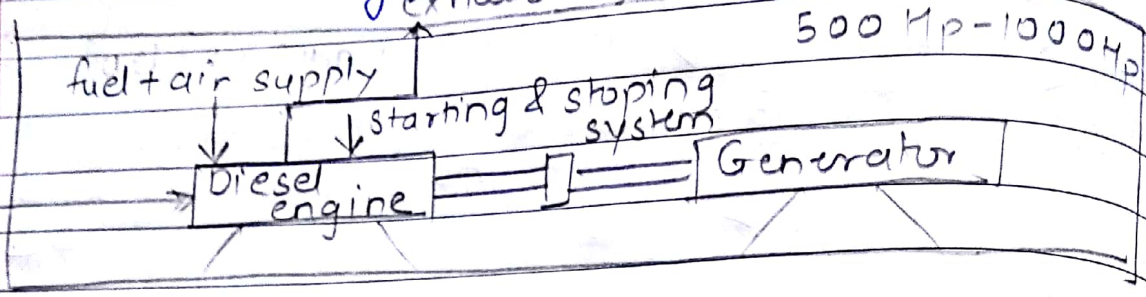
Disadvantages :- 1) Weather dependent.
2) High initial cost for solar pannels.
3) Requires good solar exposure.
4) Doesn't work at night.
5) Very expensive to build solar power stations.
6) Can be unreliable units you are in sunny climate.

Applications :- 1) Solar distillation 2) Solar pumping 3) Solar electric power generation
4) Solar thermal power productions
5) Solar drying of agricultural & animal products
6) Solar water heating

Site Selection :- 1) Availability of solar radiation 2) Distance from transmission line
3) Local weathering concision.
4) Land prices & future rise.
5) Availability of large land.

* Diesel power plant.

Chemical energy → heat → rotary → electricity



Advantages :- 1) Handling of fuel is easy & only small space for fuel storage is required.
2) Can be located near load centre.
3) Can start quickly.
4) This plant is smaller in size than a steam power plant of same capacity.
5) Easy operation.
6) Thermal efficiency is higher than steam P.P.
7) Requires less amount of water for cooling.

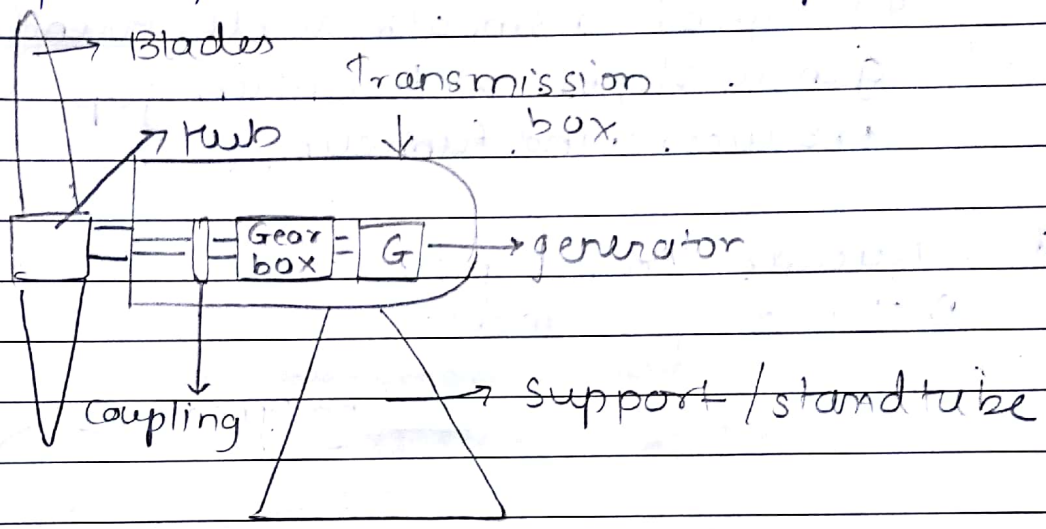
Disadvantages :- 1) Diesel oil is costly.
2) The overload response of plant is not satisfactory for longer periods.
3) Lubricating cost is high.
4) They are of limited capacity.

Applications - 1) A central station for medium or small power supplies.
2) And for emergency services as a stand by plant to hydroelectric P.P & steam P.P.
3) For mobile generation, transportation systems like automobiles, railways, airplanes & ships.
4) Also used for electrical power generation.

in capacities 100 to 500 H.P.

* Site selection -1) availability of fuel
2) availability of transportation facilities.
3) availability of water supply
4) distance from populated area.
5) availability of land at reasonable rate.

* Wind power plant.



Advantages - 1) Wind is a clean energy source
2) It is very cheap to supply, so do not have to pay lots of money.
3) ~~Doe~~ Wind doesn't need a factory to be produced, so it is protecting the enviroment.
4) It can be recycled.

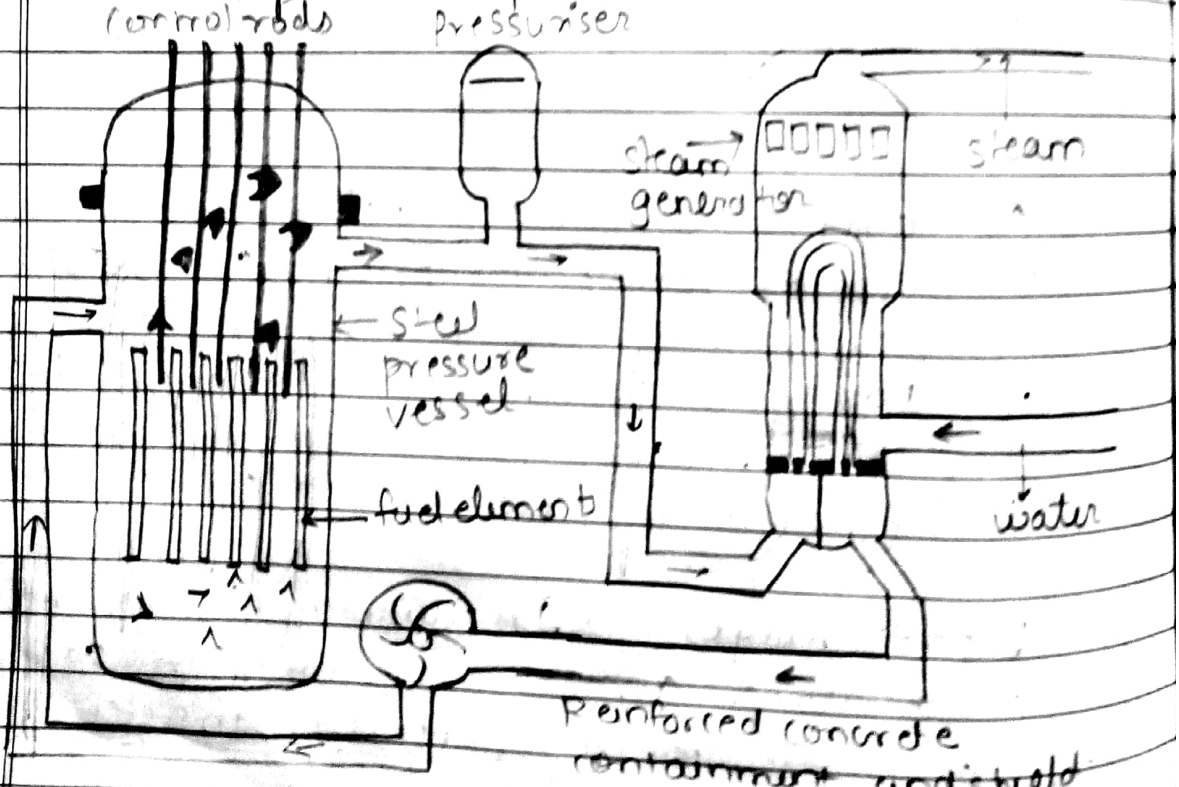
Disadvantages:- 1) In summer, there is not much wind as the rest of the year, ~~so supply~~ so amount of supply is inconsistent.
2) It makes a lots of noise.
3) It needs big open spaces of land to be on.
4) Windmill farms are only available in certain states.

Applications :- 1) Electricity production 2) water pumping 3) Industrial application like telecommunications & weather stations, 4) Windmill is used for battery charging, etc.

Site selection :- 1) High annual wind speed
2) No tall obstructions for a radius of 3km
3) Open plain or open shore.
4) Top of a smooth, well rounded hill with gentle slopes. 5) Mountain gap which produces wind funneling.

* Nuclear Power plant :

1) It ~~occupies less sp~~



Advantages :- 1) A nuclear power plant occupies less space when compared with other conventional power plants of same size.

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2) Fuel transportation cost are less
3) Fuel storage facilities needed are less
4) They are not affected by adverse weather conditions.

Disadvantages :-
1) Cost of establishing is more.
2) Sufficient care must be taken to dispose off the radio active wastes which may cause serious health problem as well as problem to environment.
3) Maintanence cost is high.
4) Requires skilled person for operation.

Application :
1) Nuclear process 2) Heat for industries.
3) Nuclear reactors for space. 4) Nuclear power ships. 5) Peaceful nuclear explosion.
6) Radioisotopes in industries.
7) Radiisotopeds in medicine
8) Research reactors.

Site selection
1) Availability of water 2) Distance from load center 3) Distance from populated area
4) Accessibility to site 5) Waste disposal.