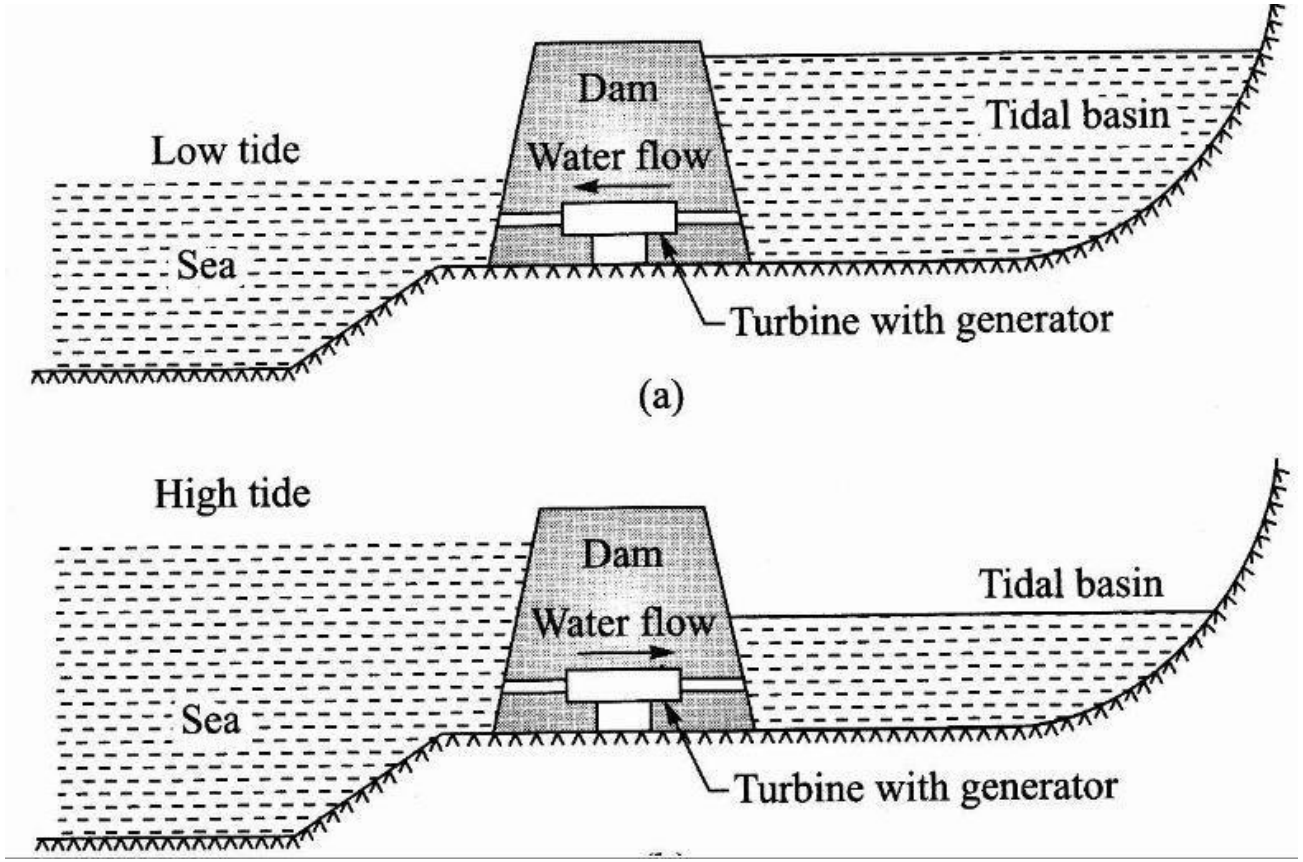
ATME College of Engineering

Module-4
Tidal Power

SUKRUTH SAGAR
Asst. Professor,
Dept. of Mechanical Engineering,
ATMECE, Mysuru

Tidal energy is produced by the surge of ocean waters during the rise and fall of tides.

Tidal energy is a renewable source of energy harnessed by converting energy from tides into useful forms of power, mainly electricity using various methods.



Tidal Power

- The periodic rise and fall of the water level of sea which are carried away by the gravitational action of sun and moon is called tide.
- The energy generated by these tides is called tidal energy.
- To harness the tidal energy, the difference in water surface elevations at high tide and low tide is utilized to operate a hydraulic turbine.
- A generator is attached to the turbine to generate electricity.
- The rising water or high tides are called floods and low tides are called ebbs.
- Tides are more predictable than wind energy and solar power.

TIDES AND WAVES AS ENERGY SUPPLIERS AND THEIR MECHANICS

- Tidal forces are periodic variations in gravitational attraction exerted by celestial bodies.
- Tidal forces create corresponding motions or currents in the world's oceans.
- Due to the strong attraction to the oceans, a bulge in the water level is created, causing a temporary increase in sea level.
- As the Earth rotates, this bulge of ocean water meets the shallow water adjacent to the shoreline and creates a tide.
- This occurrence takes place in an unfailing manner, due to the consistent pattern of the moon's orbit around the earth.

- The magnitude motion reflects the changing positions of the Moon and Sun relative to the Earth, the effects of Earth's rotation, and local geography of the seafloor and coastlines.

- The rise of seawater is called high tide and fall in seawater is called low tide.

FUNDAMENTAL CHARACTERISTICS OF TIDAL POWER

• Tidal power or tidal energy is a form of hydropower that converts the energy obtained from tides into useful forms of power, mainly electricity.

• Although not yet widely used, tidal energy has potential for future electricity generation.

• Tidal power is the only technology that draws on energy inherent in the orbital characteristics of the Earth–Moon system, and to a lesser extent in the Earth–Sun system.

• Greater tidal variation and higher tidal current velocities increase the potential of a tidal electricity generation.

• Tidal power is also relatively prosperous at low speeds, in contrast to wind power.

• Water has one thousand times higher density than air and tidal turbines can generate electricity at speeds as low as 1m/s, or 2.2mph.

• Tidal energy is clean, renewable, and sustainable form of energy resource. It has no impact on climate because it does not produce any greenhouse gases.

HARNESSING TIDAL ENERGY

Tidal stream generator: Tidal stream generators make use of the kinetic energy of moving water to power turbines, in a similar way to wind turbines.

- Some tidal generators can be built into the structures of existing bridges or are entirely submersed.

Tidal barrage: Tidal barrages make use of the potential energy in the difference in height (or hydraulic head) between high and low tides.

- When using tidal barrages to generate power, the potential energy from a tide is seized through the strategic placement of specialized dams.
- When the sea level rises and the tide begins to come in, the temporary increase in tidal power is channeled into a large basin behind the dam, holding a large amount of potential energy.
- With the receding tide, this energy is then converted into mechanical energy as the water is released through large turbines that create electrical power through the use of generators

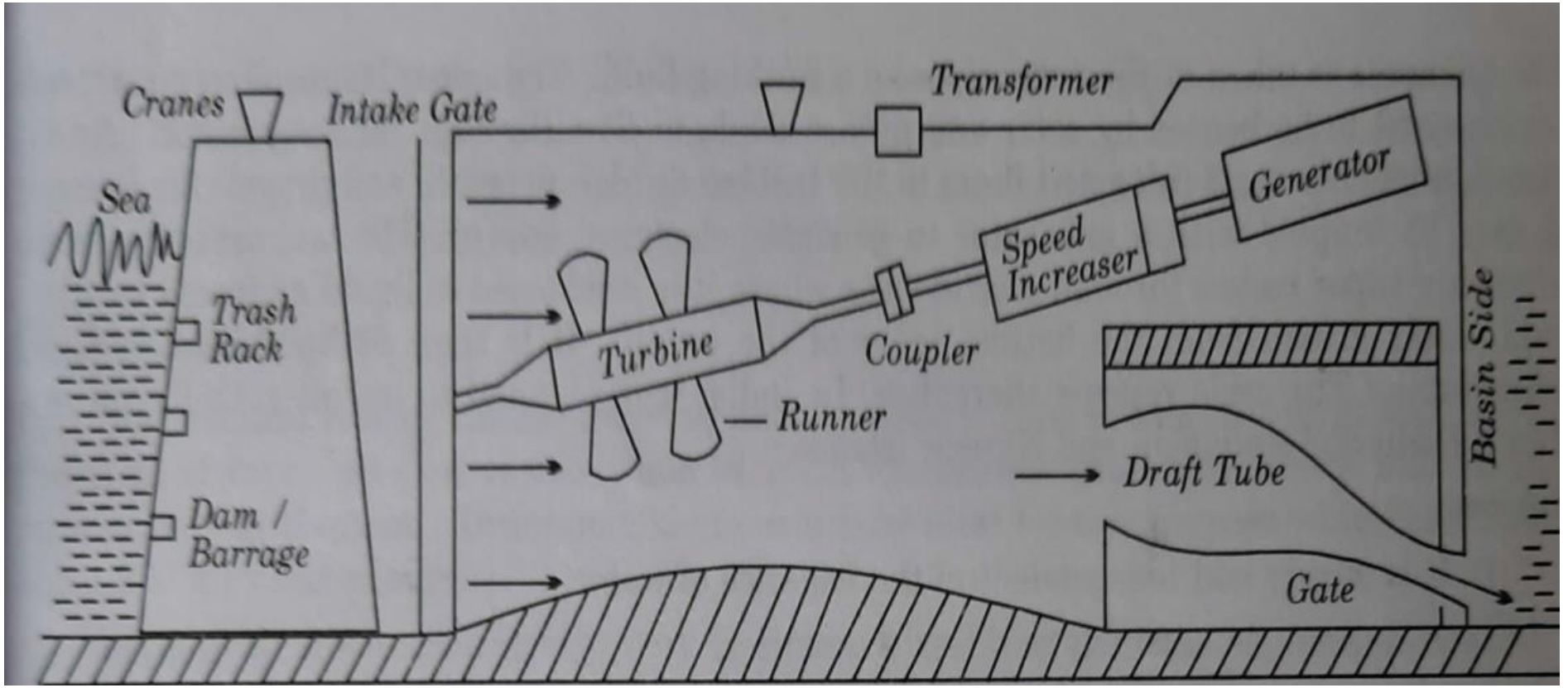
Dynamic tidal power: Dynamic tidal power (or DTP) is a theoretical technology that would exploit an interaction between potential and kinetic energies in tidal flows.

It proposes that very long dams (for example: 30–50 km length) be built from coasts straight out into the sea or ocean, without enclosing an area

Tidal lagoon: A new tidal energy design option is to construct circular retaining walls embedded with turbines that can capture the potential energy of tides.

- The created reservoirs are similar to those of tidal barrages, except that the location is artificial and does not contain a pre-existing ecosystem.

- The lagoons can also be in double (or triple) format without pumping or with pumping that will flatten out the power output.



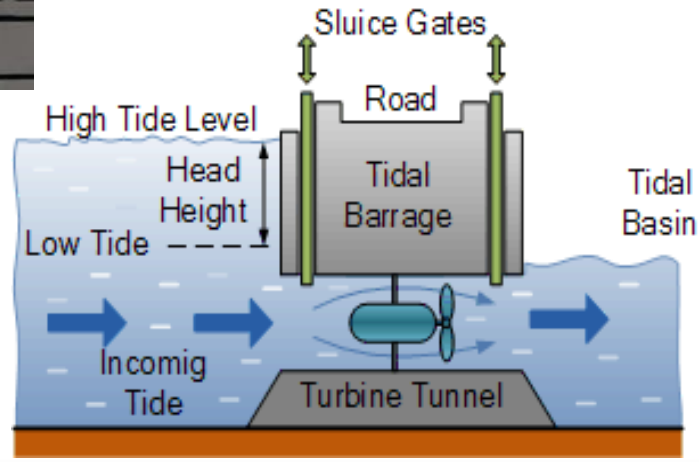


Fig: Schematic layout of tidal power house

The above layout is the tidal power house or tidal power plant that consists of a barrage built across the tidal reach to create pool in which water can be stored.

Inside the barrage reversible water turbines and flood gates are installed. During the occurrence of high tide and low tides, the flood gates open and close respectively.

One tide cycle is identified as the shift from low tide to high tide and back to low tide. The time duration to complete one tidal cycle is approximately 12.5 hours.

During this period the pool is filled and empties. Theses may be classified as single basin system and double basin system

Advantages

- It is independent of rain, and inexhaustible.
- Large area of valuable land is not required
- When a tidal power plant works in combination with thermal or hydro-electric power plant, peak power demand can be met effectively.
- Free from pollution
- Less maintenance cost

Disadvantages

- Power generation is not uniform.
- Life of turbines reduces due to corrosive sea water.
- Construction of dams in sea is difficult.
- The power transmission cost is high as it is located away from load centers.
- Sedimentation and siltation of basins

ATME College of Engineering

Energy from ocean waves

SUKRUTH SAGAR
Asst. Professor,
Dept. of Mechanical Engineering,
ATMECE, Mysuru

HOW CAN WE GET ENERGY FROM THE OCEAN?

There are three basic ways to tap the ocean for its energy. We can use

1. The ocean's waves.

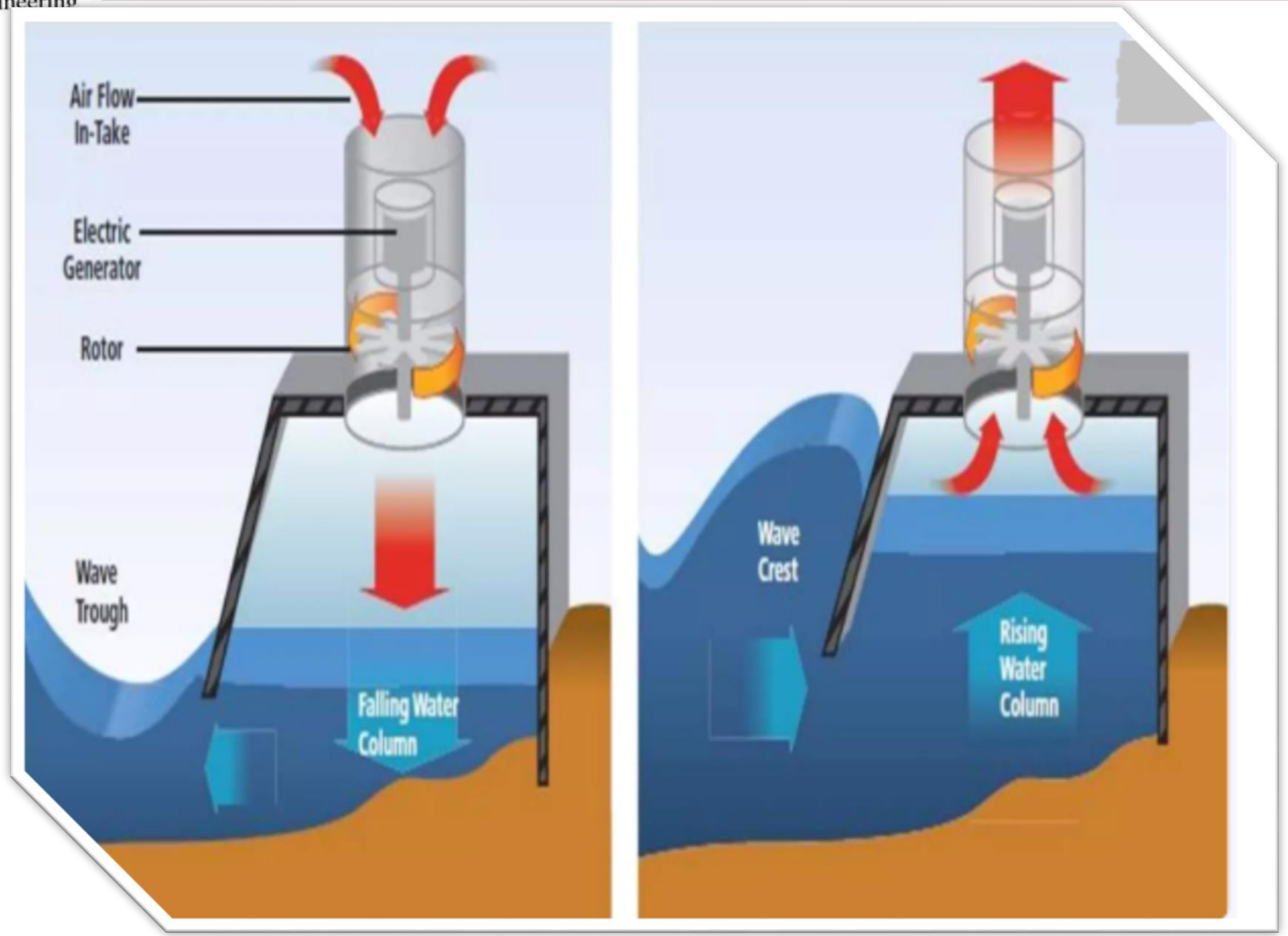
2. The ocean's high and low tides .

3. Temperature differences in the water.

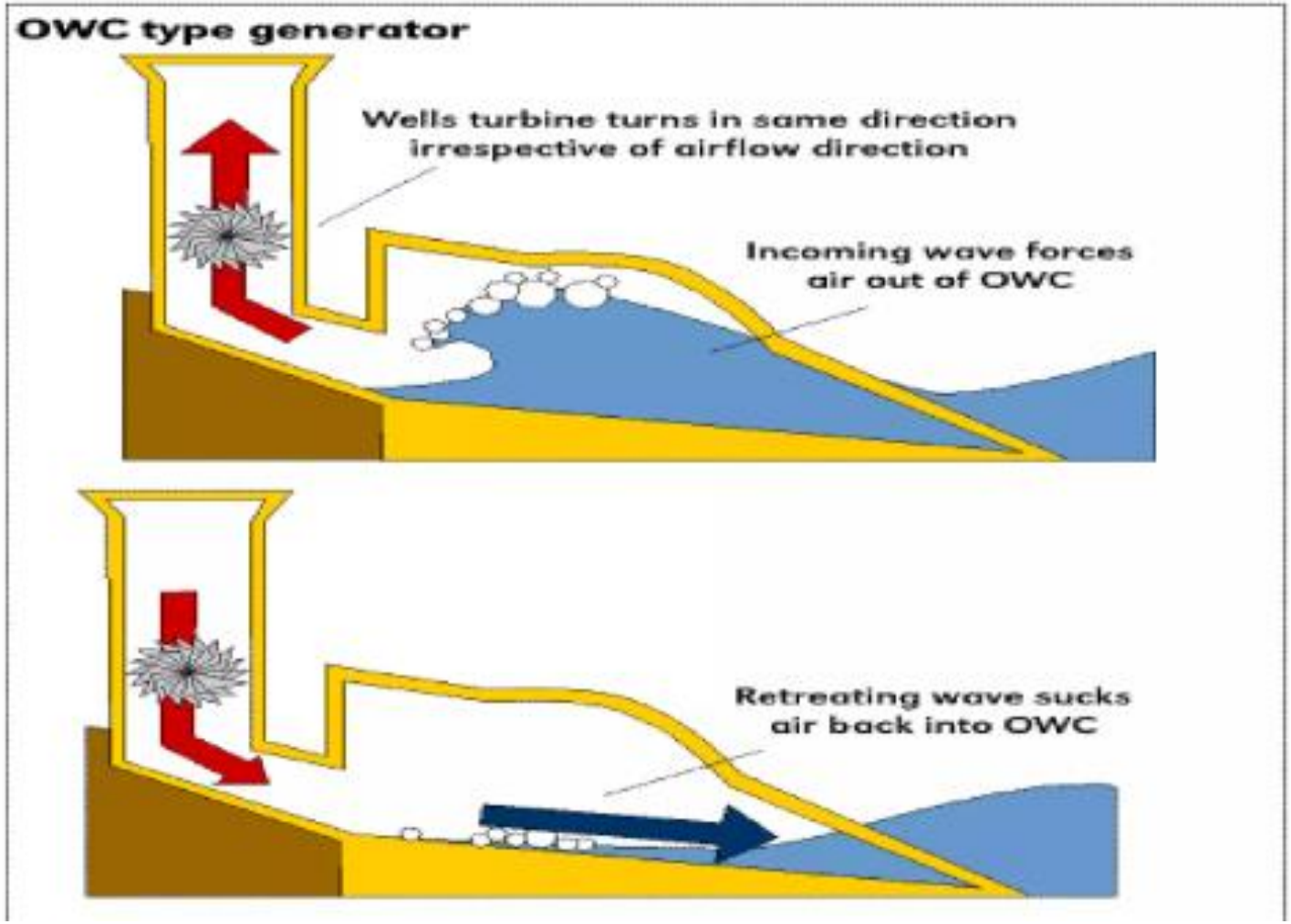
Wave energy

Kinetic energy (movement) exists in the moving waves of the ocean. That energy can be used to power a turbine. The wave rises into a chamber. The rising water forces the air out of the chamber. The moving air spins a turbine which can turn a generator.

When the wave goes down, air flows through the turbine and back into the chamber through doors that are normally closed.


Air Flow
In-Take
Electric
Generator
Rotor
Wave
Trough
Falling Water
Column
Wave
Crest
Rising
Water
Column

OWC Generator



Ocean wave energy, or just simply **Wave Energy**, is another type of ocean based renewable energy source that uses the power of the waves to generate electricity.

Unlike tidal energy which uses the ebb and flow of the tides, *wave energy* uses the vertical movement of the surface water that produce tidal waves.

Advantages

Zero emissions

Renewable

Energy potential

Reliable

Disadvantages

Environmental effects

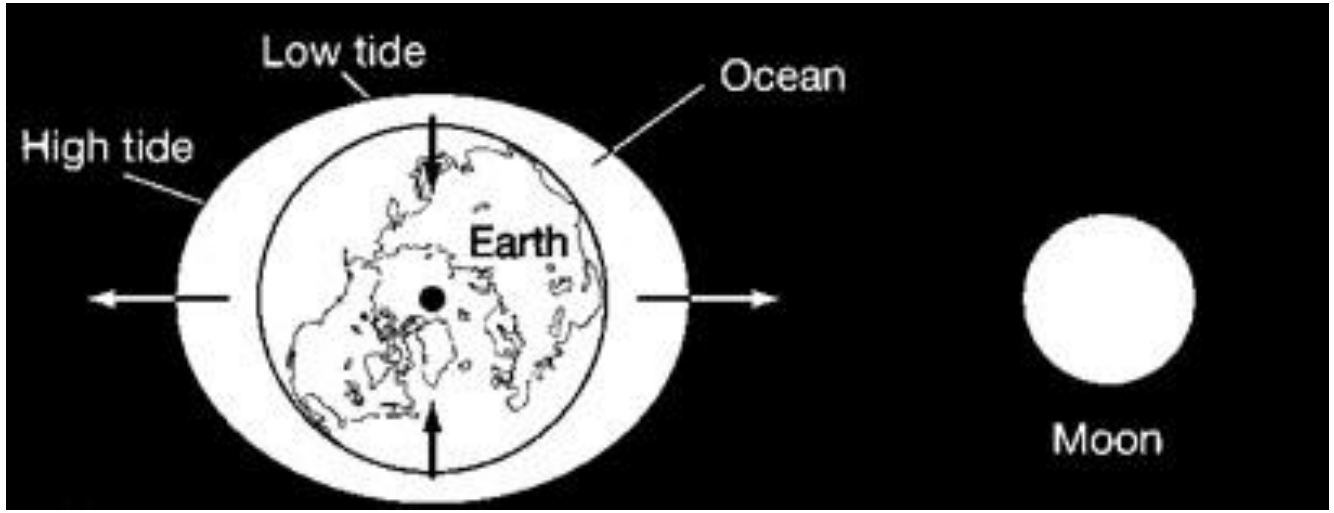
High costs

Scalability- challenging to implement wave energy generators at a usable scale.

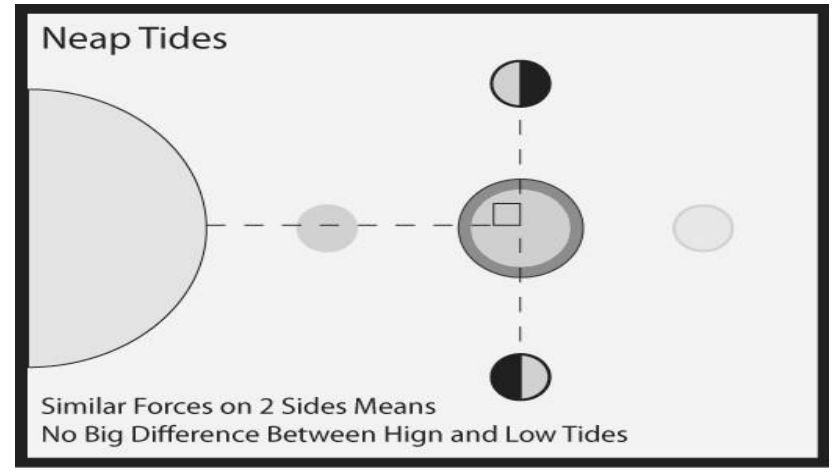
END OF SLIDE SHOW

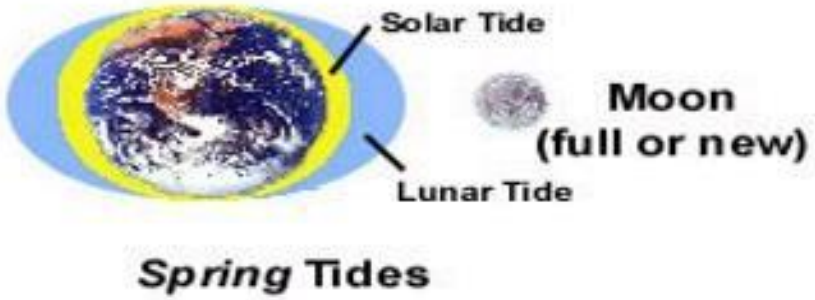
Basic principle of Tidal Power

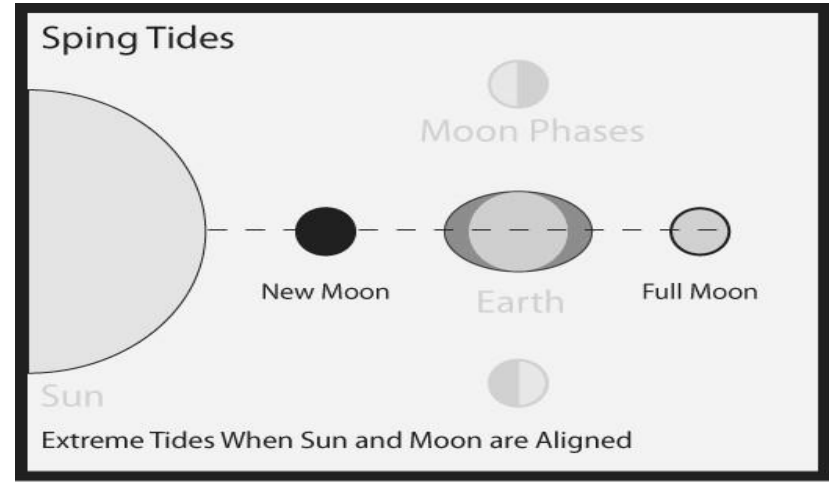
- The gravitational force of attraction between two bodies is directly proportional to the product of their masses.
- The gravitational force of attraction between two bodies is inversely proportional to the square of the distance between their centers.



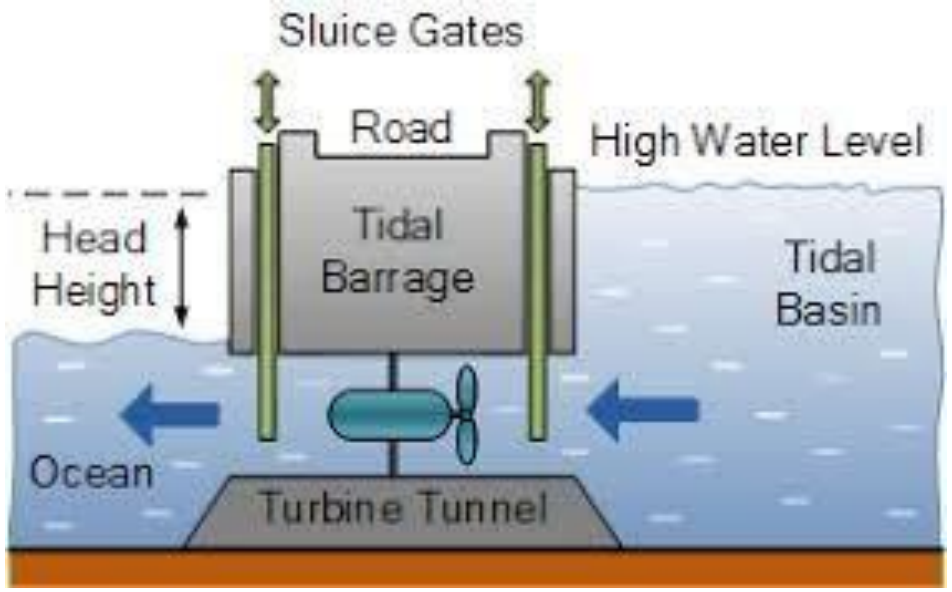
Neap and Spring Tides

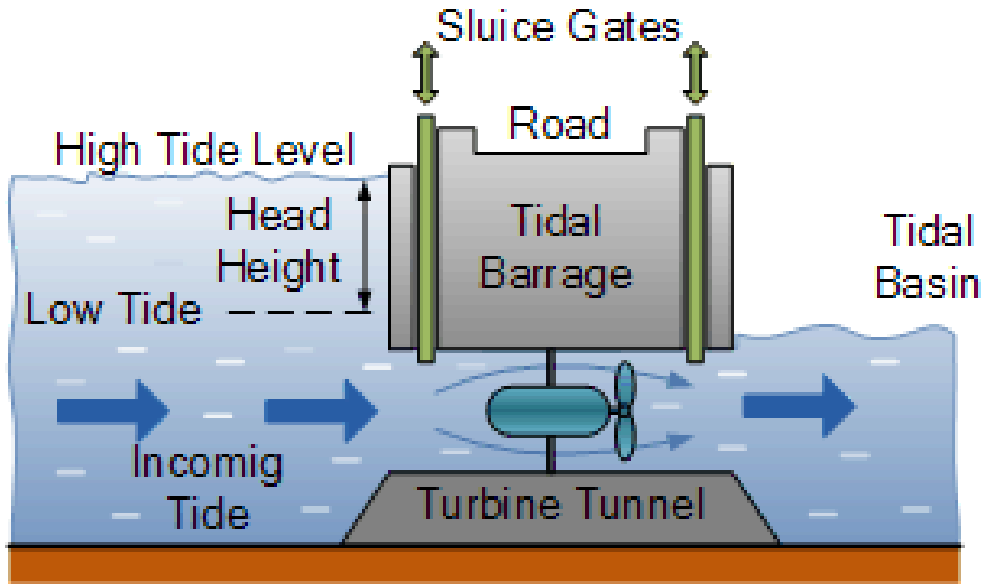






Working of Tidal Power plant





TIDAL POWER PLANT in WORLD

Current sites of tidal power plants

Station	Capacity (MW)	Country
Sihwa Lake Tidal Power Station	254	South Korea
Rance Tidal Power Station	240	France
Annapolis Royal Generating Station	20	Canada
Jiangxia Tidal Power Station	3.2	China
Kislaya Guba Tidal Power Station	1.7	Russia
Uldolmok Tidal Power Station	1.5	South Korea
Strangford Lough SeaGen Sundaraban area	1.2 40	United Kingdom india

22