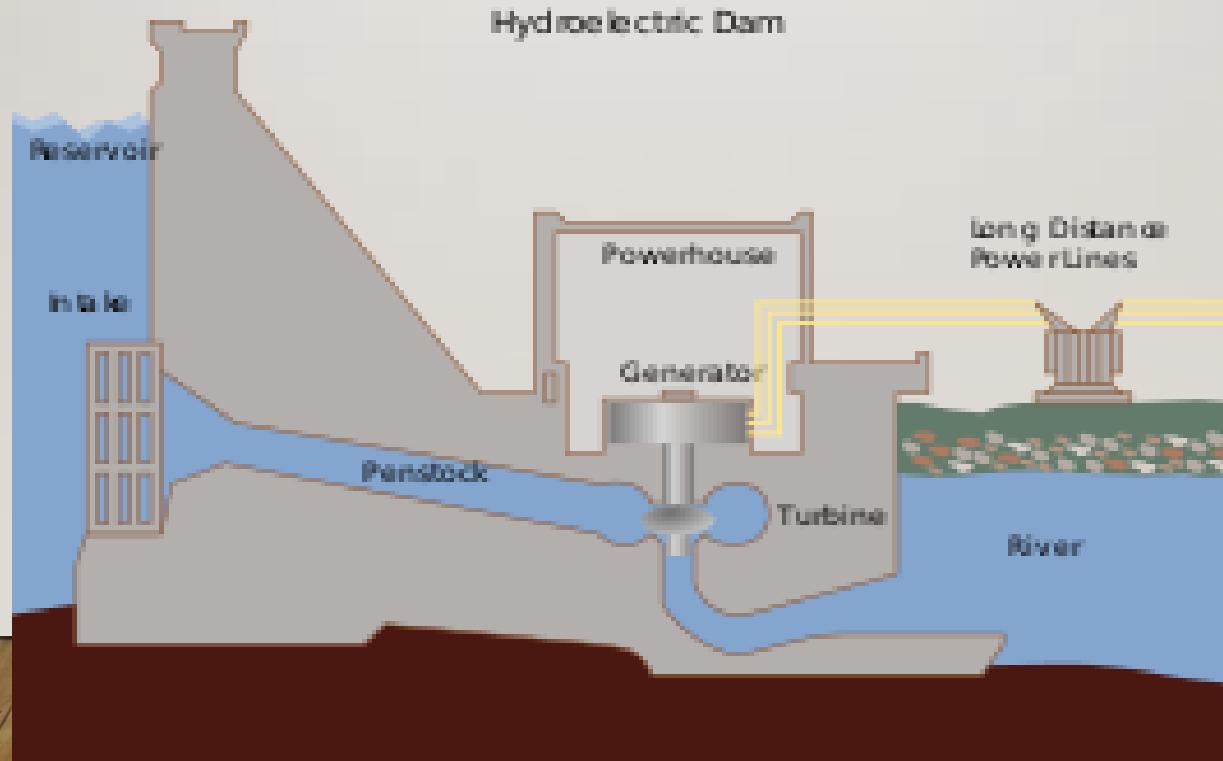


MODULE 3

HYDRO ELECTRIC POWER PLANT



Know the general layout and installation of hydro electric plants

- 3.2.1 Sketch a typical hydro electric installation
- 3.2.2 Describe the function of surge tank, penstock, anchor block and tail race.

INTRODUCTION

Hydroelectric power (hydropower) systems convert the kinetic energy in flowing water into electric energy. • Falling or flowing water turns a propeller like piece called a turbine. • The turbine turns a metal shaft in an electric generator which produces electricity

Advantages

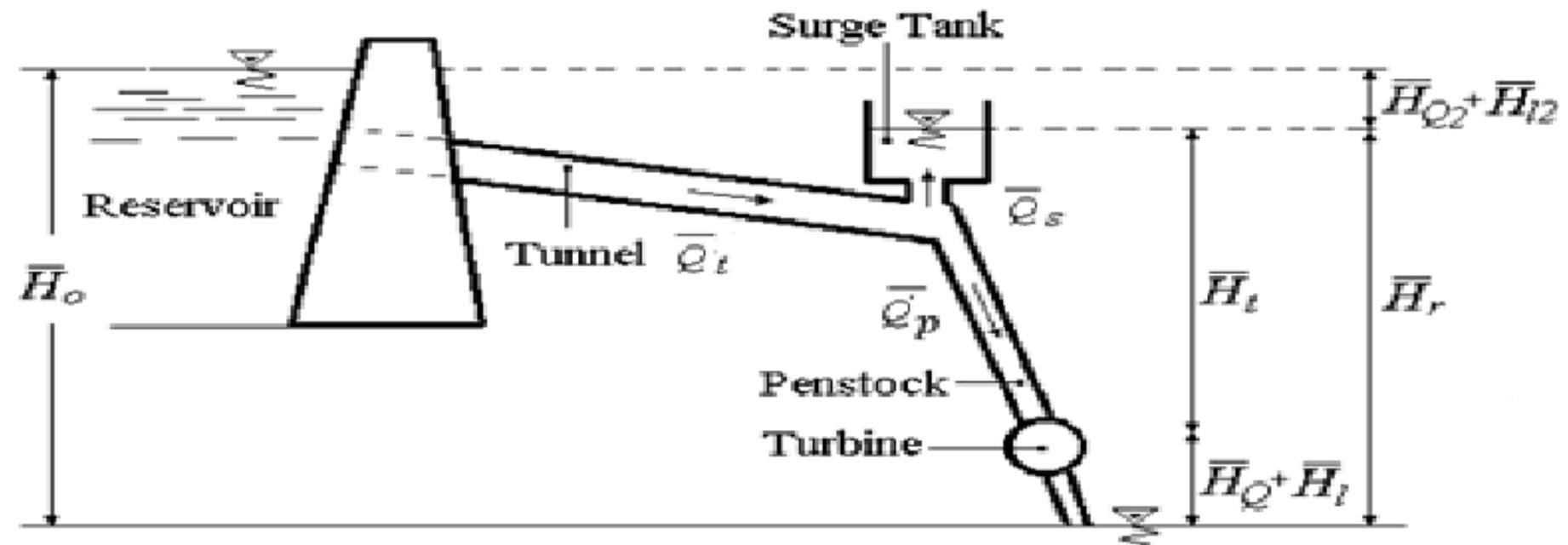
- No fuel required
- No air pollution
- Can easily work during high peak daily loads
- Prevents floods

Disadvantages

- Disruption of surrounding areas
- Requires large areas
- Large scale human displacement

- Low head plants: In this case small dam is built across the river to provide the necessary head. In such plants Francis type of turbines are used.
- Medium head plants: The fore bay provided at the beginning of Penstock serves as water reservoir for such plants. In these plants water is generally carried out in open canals from reservoir to the Fore bay and then to the penstock.
- High head Plant: This plant works above 500mtrs and Pelton wheel turbines are commonly used. In this plant water is carried out from the main reservoir by a tunnel up to surge tank and then from the surge tank to the power house in penstock.

LAYOUT OF HIGH HEAD PLANT



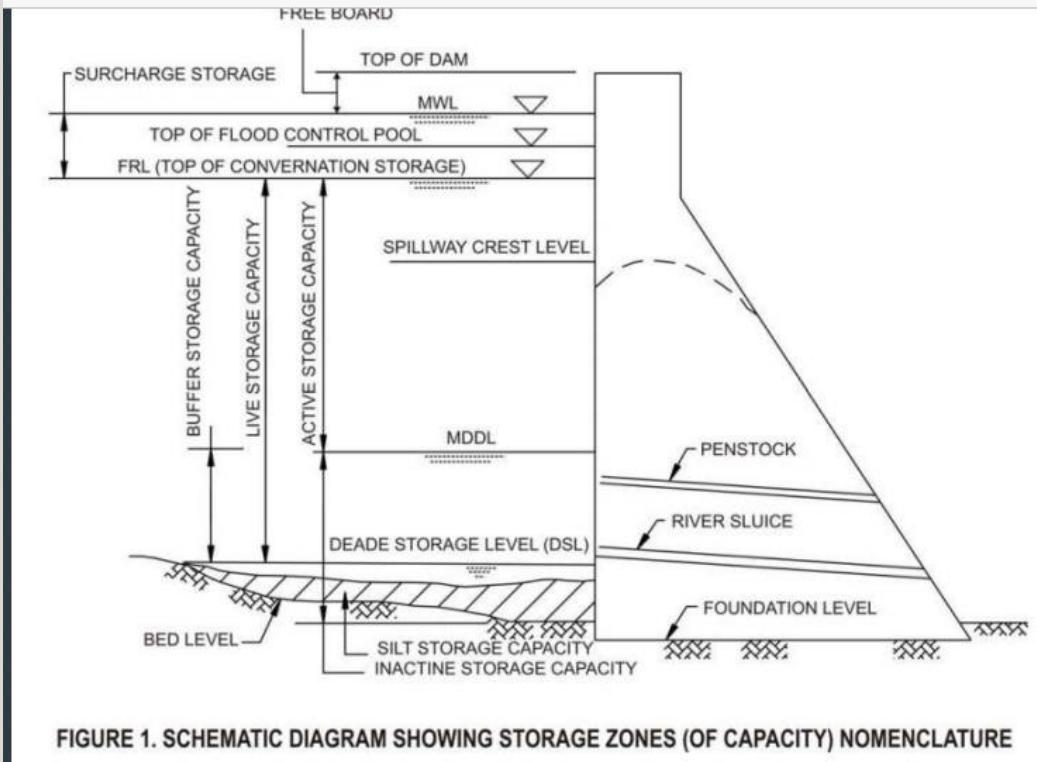
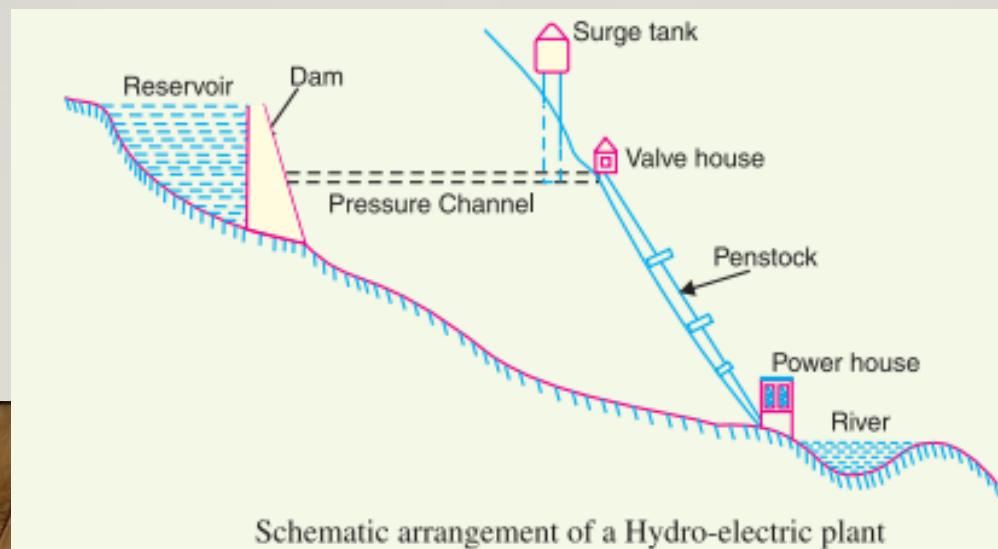


FIGURE 1. SCHEMATIC DIAGRAM SHOWING STORAGE ZONES (OF CAPACITY) NOMENCLATURE

- Mainly in these plants pressure tunnel is provided before the surge tank, which in turn connected to penstock. • A pressure tunnel is taken off from the reservoir and water brought to the valve house at the start of the penstocks. • The penstocks are huge steel pipes which take large quantity of water from the valve house to the power house.
- The valve house contains main sluice gates and in addition automatic isolating valves which come into operation when the penstock bursts, cutting further supply of water. • Surge tank is an open tank and is built just in between the beginning of the penstocks and the valve house. • In absence of surge tank, the water hammer can damage the fixed gates.
- In Majority of dams Sluice gates are provided. • The sluice gates are opened when dam level is below level and there is shortage water for irrigation.



COMPONENTS OF HYDEL SCHEME

- Water reservoir
- Forebay
- Intake structure
- Penstocks
- Surge tank
- Turbines
- Power house
- Draft tube
- Tail race

Water reservoir

An open-air storage area usually formed by masonry or earthwork where water is collected and kept in quantity so that it may be drawn off for use.

The role of water-storage reservoirs, is to impound water during periods of higher flows, thus preventing flood disasters, and then permit gradual release of water during periods of lower flows.

Dam

- The dam is the most important component of hydroelectric power plant.
- The dam is built on a large river that has abundant quantity of water throughout the year.
- It should be built at a location where the height of the river is sufficient to get the maximum possible potential energy from water.

Spillway

Excess accumulation of water endangers the stability of dam construction. Also in order to avoid the over flow of water out of the dam especially during rainy seasons spillways are provided. This prevents the rise of water level in the dam. Spillways are passages which allows the excess water to flow to a storage area away from the dam

Intake

These are the gates built on the inside of the dam. The water from reservoir is released and controlled through these gates. These are called inlet gates because water enters the power generation unit through these gates. When the control gates are opened the water flows due to gravity through the penstock and towards the turbines.

- Water conveyed from forebay to penstocks through intake structures.
- Main components are trash rack and gate.
- Trash rack prevent entry of debris.

Forebay

A forebay (or head pond) is an enlarged body of water provided at the downstream end of canal just at the upstream of penstocks to act as a small balancing /regulating reservoir. A forebay is required in the case of run-of-river plants at the upstream of the diversion work. In case of a storage plant, it is required only when the power house is located away from the dam and the water is conveyed to the power house through a power canal. If the power house is located at the toe of the dam, a separate forebay is not required since the penstocks directly take water from the reservoir which itself act as a forebay.

Anchor block

The **function** of the **anchor block** is to fix the penstock and do not allow the pipe with any direction of movement. The installation site of the **anchor block** is usually at the connection of forebay pool and **pressure** pipe, connection between **pressure** pipe and **power** house, and when **pressure** pipe changes its direction.

Pressure tunnel

It is a passage that carries water from the reservoir to the surge tank

Penstocks

- Closed conduits which carry water to the turbines.
- Made of reinforced concrete or steel. Concrete penstocks are suitable for low heads less than 30mtrs. • Steel penstocks are designed for any head.
- Thickness of penstocks increases with head or water pressure
- The water in the penstock possesses kinetic energy due to its motion and potential energy due to its height.
- The total amount of power generated in the hydroelectric power plant depends on the height of the water reservoir and the amount of water flowing through the penstock.
- The amount of water flowing through the penstock is controlled by the control gates.
- Either buried in ground or kept exposed.

Surge tank

- Additional storage for near to turbine, usually provided in high head plants.
- Located near the beginning of the penstock.
- As the load on the turbine decreases or during load rejection by the turbine , there will be sudden increase of pressure in the penstock. This phenomenon results in hammering action called water hammer in the penstock. the surge tank provides space for holding water.
- Surge tank acts as a temporary reservoir. It helps in stabilizing the velocity and pressure in penstock and thereby saves penstock from getting damaged.
- To serve as supply tank to the turbine in case of increased load conditions, and storage tank in case of low load conditions.

Turbines

- Turbines are used to convert the energy water of falling water into mechanical energy.

Draft tube

- It is a pipe or passage of gradually increasing cross sectional area, which connect to the exit to tail race.
- it reduces high velocity of water discharged by the turbine.

Power house

Power house contains the electro mechanical equipment i.e. hydro power turbine, Generator, main inlet valves, transformers, governor, transformers etc

Tail race

Tail race is a passage for discharging the water leaving the turbines, into the river.