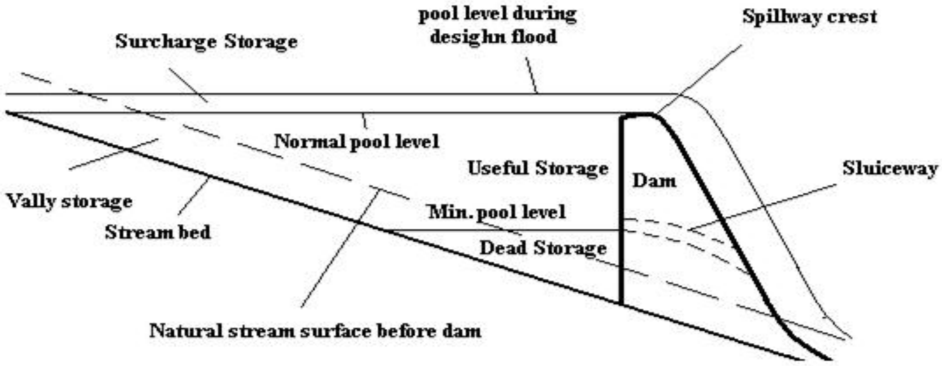
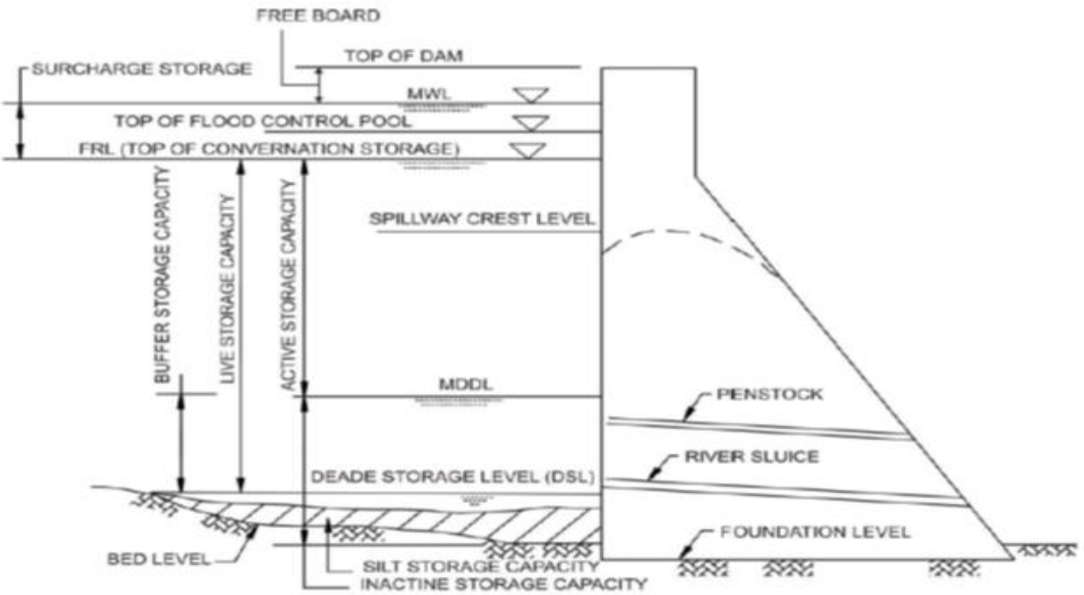
Zones of Storage:





Normal pool level: **is the maximum elevation to which the reservoir surface will rise during ordinary operating conditions. It is determined by the elevation of the spillway crest or the top of the spillway gates.**

Minimum pool level: **is the lowest elevation to which the pool is to be drawn under normal conditions. This level may be fixed by the elevation of lowest outlet in the dam or, in the case of hydroelectric reservoirs, by conditions of operating efficiency for turbines.**

Useful Storage: **is the storage volume between the minimum and normal pool levels.**
For multipurpose reservoirs in accordance with adopted plan of operation, the useful storage may be subdivided into:

- **Conservation storage,**
- **Flood mitigation storage.**

During floods, discharge over the spillway may cause the water level to rise above normal pool level. This *surcharge storage* is normally uncontrolled, i.e., it exists only while a flood is occurring and cannot be retained for later use.

Dead Storage: **is the water held below minimum pool level.**

Reservoir banks are usually permeable, and water enters the soil when the reservoir fills and drains out as the water level is lowered.

This bank storage increases the capacity of the reservoir above that indicated by the *elevation-storage curve*. This storage depends on:

- **Geological conditions,**
- **Reservoir volume.**

The water in a natural stream channel occupies a variable volume of *valley storage*.

The net increase in storage capacity resulting from the construction of a reservoir is the total capacity less the natural valley storage.

This distinction is of no important for conservation reservoirs, but from the viewpoint of flood mitigation the effective storage in the reservoir is the useful storage plus the surcharge storage less the natural valley storage corresponding to the rate of inflow to the reservoir.

Reservoir Yield:

Probably the most important aspect of storage-reservoir design is an analysis of the relation between yield and capacity.

Yield: **is the amount of water that can be supplied from the reservoir during a specified interval of time. The time interval may vary from a day for small distribution reservoir to a year or more for a large storage reservoir.**

Yield is dependent on inflow and will vary from year to year.

***The safe or firm, yield*: is the maximum quantity of water that can be guaranteed during a critical dry period.**

In practice, *the critical period is often taken as the period of lowest natural flow on record for stream*, there is a finite probability that a drier period may occur, with a yield even less than the safe yield.

Firm yield can never be determined with certainty, it is better to treat yield in probabilistic terms. *The maximum possible yield* during a given time interval *equal the mean inflow less evaporation and seepage losses during that interval*. If the flow were *absolutely constant*, no reservoir would be required; but, as variability of the flow increases, the required reservoir capacity increases.

Water available in excess of safe yield during periods of high flow is called *secondary yield*.

Hydroelectric energy developed from secondary water may be sold to large industries on a (when available) basis. Energy commitments to domestic users must be on a firm basis and should not exceed the energy that can be produced with the firm yield unless thermal energy (steam or diesel) is available to support the hydroelectric energy. The decision is an economic one based on costs and benefits for various levels of design.

Selection of Distribution-Reservoir Capacity for a Given Yield:

Often project design requires the determination of the reservoir capacity required to meet a specific demand. Since the yield (outflow) is equal to inflow plus or minus an increment of storage, the determination of the capacity to supply a given yield is based on the storage equation:

$$I\Delta t - \Delta s = O\Delta t$$

Where I and O are the average rates of inflow and outflow for the time interval Δt and Δs is the change in volume water. A simple problem involving the selection of distribution reservoir capacity is given in following examples:

Example (1): The water supply for a city is pumped from well to a distribution reservoir. The estimated hourly water requirements for a maximum day are as in table below. If the pumps are to operate at a uniform rate, what distribution capacity is required? Also determine the yield

Hour ending	Demand(m^3/hr)	Pumping rate (m^3/hr)	Required from reservoir (m^3)
1	273	529.3	0
2	206	529.3	0
3	256	529.3	0
4	237	529.3	0
5	257	529.3	0
6	312	529.3	0
7	438	529.3	0
8	627	529.3	98
9	817	529.3	288
10	875	529.3	346
11	820	529.3	291
12	773	529.3	244
13	759	529.3	230
14	764	529.3	235
15	729	529.3	200
16	671	529.3	142
17	670	529.3	141
18	657	529.3	128
19	612	529.3	83
20	525	529.3	0
21	423	529.3	0
22	365	529.3	0
23	328	529.3	0
24	309	529.3	0
Total	12703	12703	2426