# 5.1 GEOLOGICAL CONSIDERATIONS FOR DESIGN AND CONSTRUCTION OF DAM AND RESERVOIR

**Dam:**

A dam is a hydraulic structure constructed across a river to store water in the upstream side for various purposes like domestic water supply schemes, irrigation, hydro-power generation, etc.

**Geological considerations for site selection:**

1. Topography
2. Water tight reservoir basin with adequate capacity, in which the rate accumulation of silt is not likely to exceed the admissible limits.
3. A narrow river channel.
4. Safe foundation.
5. Provision for disposal of surplus water through a suitable spillway and
6. Availability of the required materials for construction in the neighbour good area.

**1. Topography:**

Topography refers the naturally available land features, such as mountains, valleys, rivers, plains, plateau, etc.

The topography of an area suggests the first choice of the type of the dam.

Eg

i. A narrow V shaped river valley suggests the selection of an arch dam.

ii. A narrow U shaped river valley suggests the selection of a concrete gravity over flow dam.

**2. Water tight reservoir basin:**

The reservoir may fail due to:

i. Excessive leakage of water

ii. Rapid accumulation of silt in it.

The rate of leakage of water from any reservoir is dependent on the initial position of the water table underneath the basin and nature of the rocks forming the country.

In many river valleys regional water table lies near the earth's surface and as a result the river or stream is partially fed from the groundwater. Those streams are called effluent streams.

Streams which feed groundwater are known as influent streams. Therefore, reservoirs lying along the course of effluent rivers are not likely to lose much water through seepage.

**3. Narrow river channel:**

This is a natural characteristic, purely contributing towards the size of the dam and hence the economy of the dam project. If the river channel is narrow, relatively smaller dam can be built with low cost and vice versa.

**4. Safe foundation & abutments of dams:**

The failure of a dam, due to the prevalence of adverse geological conditions along its foundation and abutment may lead to devastating flood in the downstream area.

So, in selecting a dam site, immense responsibility is involved, which includes geological and geophysical studies to find out the depth to the bed rocks on which the dam has to stand. The thickness of the overburden, i.e., unconsolidated deposits of clay, silt, sand, gravel, etc., can be found out by geophysical investigations.

Granite, syenite, diorite, gabbros, gneiss, schist, quartzites and other varieties of massive igneous and metamorphic rocks are capable of supporting enormous load and are impervious to desired extent, provided they do not contain much of joints and other planes of weakness.

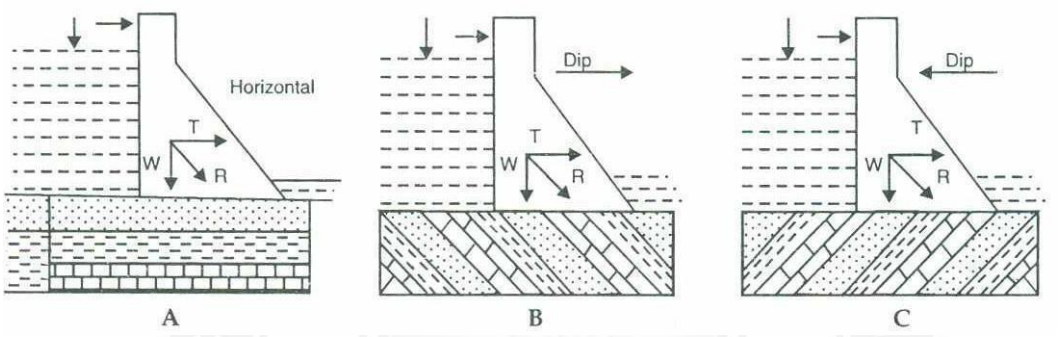
Volcanic rocks like basalts are generally vesicular and jointed and these opening allow excessive percolation. So, they are unsuitable for the supporting the load of the dam. Carbonate rocks like limestones, dolomites, marbles and other soluble rocks often contain enough joints and solution cavities which allow percolation of enough water through them. So, the extent of leakage has to be studied carefully.

**Dams on various Geological Strata:**

The strength of sound, unfractured stratified rock is always greater when the stresses are acting normal to the bedding planes than if applied in other directions.

This being so, horizontal beds should offer best support for the weight of the dam.

But as is shown in a latter section, the resultant force is always inclined downstream.




The most unfavourable strike direction is the one in which the beds strike parallel to the axis of the dam and the dip is downstream

It must be avoided as far as possible.

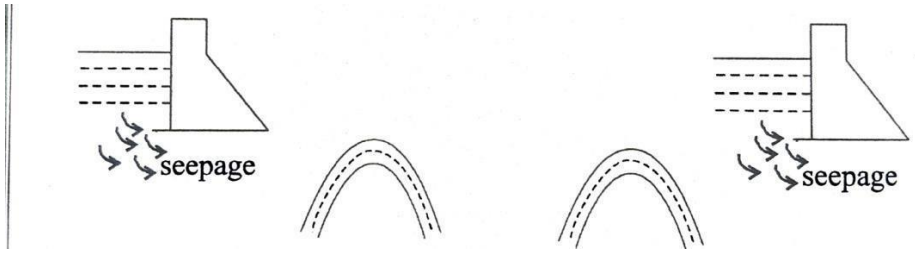
Therefore, other conditions being same, beds with upstream dips are quite favorable sites for dam foundations.

**Dam in Anticlinal upstream and downstream sides**

**Fold – Favourable situations for civil engineering projects:**

1. **Dam along upstream side of anticline:**

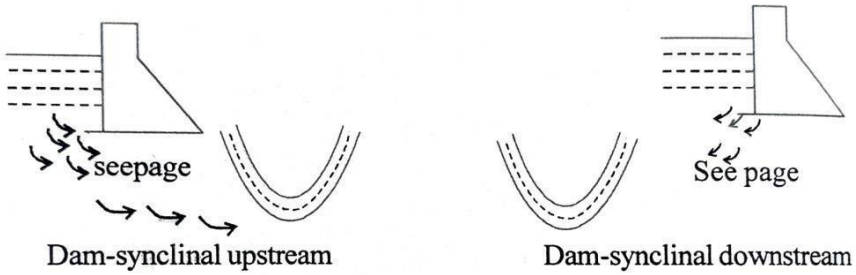
The upstream side of the anticline will be a favourable site for dam, because, seepage from reservoir, if any, will be along the upstream side of the anticline, i.e., within the reservoir side itself.



**2. Dam along downstream side of syncline:**

The downstream side of the syncline will be a favourable site for dam, because, seepage from reservoir, if any, will be along the downstream side of the syncline, i.e., within the reservoir side itself.

Folded strata are found favourable for accumulation of oil and natural gas.




Dam-synclinal upstream  Dam-synclinal downstream

**Fold – Unfavourable situations for civil engineering projects:**

**1. The downstream side of anticline:**

Unfavourable for dam project, because, there will be loss of water to reservoir, due to seepage towards the downstream side of the dam.

**2. The upstream side of syncline:**

Unfavourable for dam project, because, there will be loss of water to reservoir, due to seepage towards the downstream side of the syncline as well as dam.