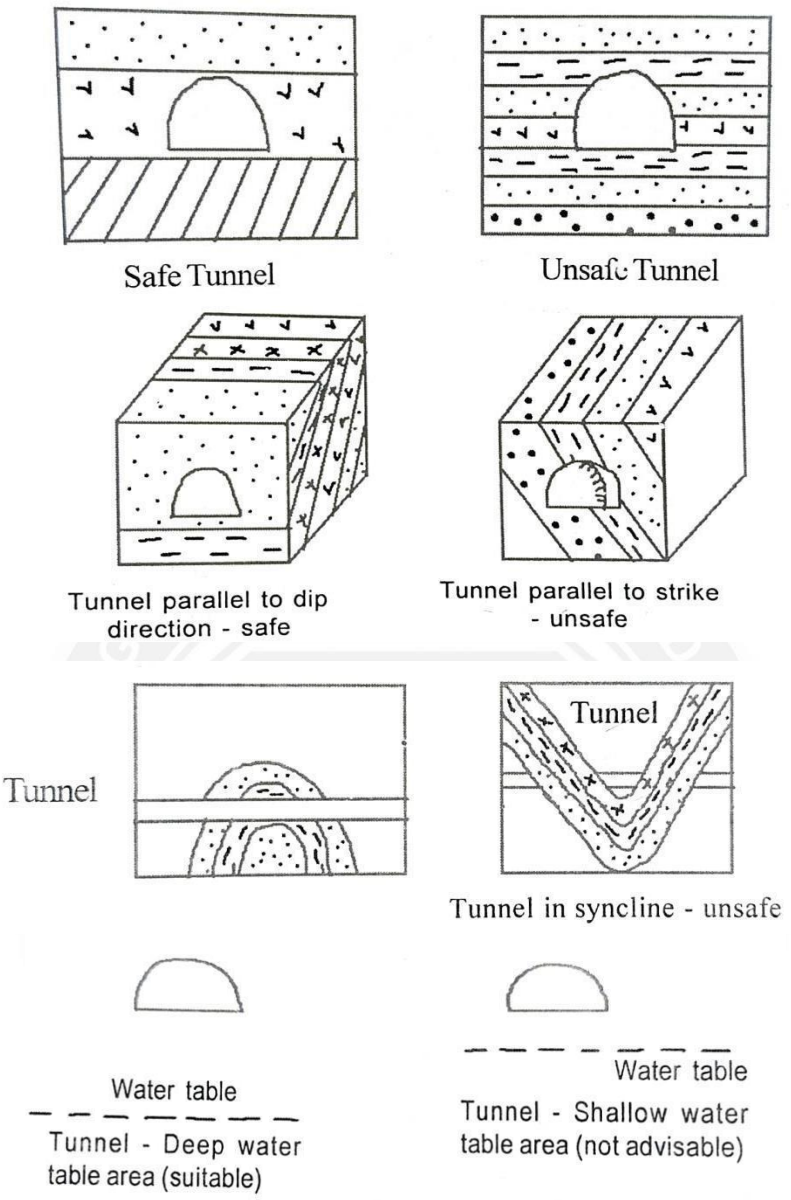
5.2 GEOLOGICAL CONSIDERATIONS FOR DESIGN AND CONSTRUCTION OF TUNNELS

Tunnels: Tunnels are the underground passages or routes through hills, mountains or earth crust used for different purposes. These passages are made by excavating rocks below the surface or through the hills, mountains.

Types of tunnels: Tunnels are basically made to serve some specific purposes.

For instance:

1. Transportation tunnels: tunnels made across hills or high lands to lay roads or railway tracks for regular traffic and transportation purpose.
2. Traffic tunnels: Tunnels lay to reduce the distance between places of interest across natural obstacles like hills, to save time and provide convenience is called traffic tunnels. These have the advantage of leaving the ground surface undisturbed so that it can be used as desired.
3. Diversion tunnels: The tunnels laid for diverting normal flow of river water to keep the dam site dry are called diversion tunnels.
4. Pressure tunnels: these are also called as hydropower tunnels. These are used to allow water to pass through them under force, used for power generation.
5. Discharge tunnels: These are meant for conveying water from one point to another under gravity force, like across hill.
6. Public utility tunnels: These are the tunnels laid for public supplies like drinking water supply, cables laying, sewage discharge or oil supply etc.

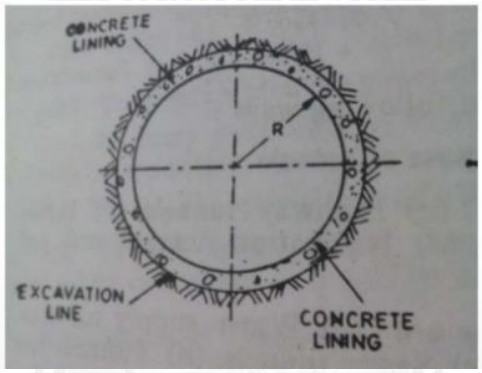


Effect of tunneling on the ground:

- Deterioration of the physical conditions of the ground is the common effect of tunneling.
- This happens because due to heavy and repeated blasting during excavating, the rocks get shattered to a great extent and develop numerous cracks and fractures.
- This reduces the cohesiveness and compactness of rocks.
- At normal conditions the earth crust or underground rocks are under great pressure (overburden) or they will be in association with some geological structures like folding will be at equilibrium stress holding the prevailing strain intact.

- When the tunnel is created, such rocks which are at equilibrium gets disturbed resulting in the collapse of the roof. Frequent bursts may also occur.
- This phenomenon of fall of rocks in brittle and hard rock is called Popping. Due to tunneling, the overlying Rocks deprive of support from the bottom and may become unstable.
- Such unstable conditions become still more precarious if the tunneled beds are incompetent or loose or unconsolidated or saturated with ground water

Lining of tunnels:



- When tunnels are made through weak or loose or unconsolidated formations, they are provided with suitable lining for safety and stability. Lining refers to the support provided to tunnel.
- Lining may be in the form of steel structures or concrete. The main purposes of lining are to resist the pressures fromthe surroundings and to protect the shape of tunnel. It takes care of the weaknesses of the ground.
- It also helps in checking leakage of ground water into tunnel. The thickness of concrete lining depends on the extent of protection required, and the degree of weakness of the ground. It also depends on the over break phenomenon. Lining is provided to support weak parts of the tunnel. Lining is also provided in such places where the seepage of water into the tunnel occurs and creating problems.
- In the case of very weak rocks with unfavourable geological structures, lining may be necessary throughout the length of the tunnel.
- The zones of faulting or shearing also need suitable lining to impart strength to them.

Over break: During tunneling the excavations normally involve the removal of extra rocks or matter around the tunnel. The quantity of rock broken and removed, in excess of what is required by the perimeter of the proposed tunnel, is known as over break.

Factors governing the amount of over break: The nature of the rocks. Orientation and spacing of joints or weak zones in them.

In the case of sedimentary rocks, the orientation of the bedding planes

- Thickness of the beds with respect to the alignment of the tunnel.
- Geological factors influencing the over break: Massive and soft rocks of a homogenous nature cause less over break than harder rocks with well-developed joints or weak zones. In sedimentary rocks, thin formations and those with alternating hard and soft strata produce more over break. This is because, during excavation, softer rocks yield more than the hard rocks.