

UNIT II EXCAVATION TECHNIQUES

2.1 PURPOSES OF TUNNELLING: Tunnels are constructed for several operations:

- In **certain mines**: tunnels are made to extract coal from coal seams
- In **hydroelectric projects**: Diversion tunnels for channel diversion (by diverting the normal flow of river water through the tunnels) and for power generation.
- For **water supply and sewage disposal**: For supply of drinking water or sewage disposal purposes, tunnels are made.
- **Transportation**: to lay roads or railway tracks to regularize the traffic and transportation of goods.
- For **laying cables and service lines**: These are utility tunnels for laying cables and for transport of oil/gas through pipelines.
- To **reduce the distance**: To reduce the distance between places of interest across natural obstacles like hills, to save time and to provide conveyance.

Terminology

Tunnel: An underground passage for vehicles or pedestrians, especially one which is created by digging into earth.

Axis: The lengthwise course of a tunnel, especially along the center line.

Cross section : The shape of a tunnel for eg: horseshoe, round or square.

Excavation: The process of digging or the hole which results.

Muck: Debris removed during excavation.

Grouting: Unstable rock and soil is strengthened by the injection of chemicals, cementitious materials .

Lining: Materials used to finish the inside surface of the tunnel.

Overburden : The soil and rock supported by the roof of a tunnel.

Portal: The open end of a tunnel. Usually includes a wall to retain the soil around the opening.

Audit: Main entrance location of a tunnel **Profile**: A side view of the tunnel.

Shaft: A vertical, underground passage from the top to the bottom where there is initially no access to the bottom.

Tunnel Boring Machine (TBM): A tunneling machine which has cutting teeth at its front. It creates the tunnel opening while passing the waste material through the rear.

Ventilation: Circulation of fresh air is called as ventilation.

CLASSIFICATION OF TUNNELS:

Depending on the nature & competency of the ground, tunnels are classified as:

Hard rock tunnels: The tunnel alignment is essentially through competent rock mass with little or no ground water seepage.

Soft rock tunnels: The tunnel alignment is through unconsolidated or highly weathered material which always encounter the groundwater problems.

EFFECTS OF TUNELLING:

When tunnels are made through weak or unconsolidated formations, they are provided with suitable lining for safety and stability. Lining may be in the form of steel structures or concrete.

- Due to heavy and repeated blasting during excavation of a tunnel, numerous cracks and fractures develop which reduces the compactness in rocks. In addition, rock become loose/more fractured which allow water movement.

- Lining of the tunnel helps in checking the leakage of groundwater into the tunnel.

- Fault zones and shear zones are naturally weak and tunneling through them further deteriorates and cause stability problem.
- Fall of rocks takes place even in hard rocks like granite though devoid of bedding or foliation and this process is known as Popping.
- Roof may collapse due to stress and strain of the region due to overburden.
- Poisonous gases encountered during the excavation of tunnels, sometimes.

Types of Tunnels

- Based on purpose (road, rail, utilities)
- Based on surrounding material (soft clay vs. hard rock)
- Submerged tunnels

Selection of tunnel alignment

- Depend on Topography of area & points of entrance and exit
- Selection of site of tunnel to be made considering two points
- Alignment Restraints
- Environmental Considerations

Classification

1. Based on Alignment

Off- Spur tunnels : Short length tunnels to negotiate minor obstacles

Saddle or base tunnels : tunnels constructed in valleys along natural slope

Slope tunnels : constructed in steep hills for economic and safe operation

Spiral Tunnels : constructed in narrow valleys in form of loops in interior of mountains so as to increase length of tunnel to avoid steep slopes

2. Based on purpose

- Conveyance Tunnels
- Traffic Tunnels

3. Based on type of material met with in construction

- Tunnels in Hard Rock
- Tunnels in Soft materials
- Tunnels in Water Bearing Soils

Setting out of tunnel

Setting Out - Making the centre line or alignment of any construction work on ground Setting out centre line of tunnel by 4 stages:

- Setting out tunnel on ground surface
- Transfer of Centre line from surface to underground
- Underground setting out
- Underground Leveling

Challenges in tunneling

- Preventing soil movements
- Soil pressure
- Water seepage