CENG4112-Rilway Engineering

Department of Civil Engineering

Gondar University

RAILWAY TUNNEL

- ✓ ***Tunnel***
- ✓ ***Construction of tunnels***
- ✓ ***Vertical gradient in tunnels***
- ✓ ***Design principles of tunnel section***

Tunnel

*A **tunnel** is an underground passageway, completely enclosed except for openings for entrance and exit, commonly at each end.*

Construction of tunnels

Tunnels are dug in types of materials varying from soft clay to hard rock. The method of tunnel construction depends on such factors as the ground conditions,

- ✓ *the ground water conditions,*
- ✓ *the length and diameter of the tunnel drive,*
- ✓ *the depth of the tunnel,*
- ✓ *the logistics of supporting the tunnel excavation,*
- ✓ *the final use and shape of the tunnel and appropriate risk management.*

There are three basic types of tunnel construction in common use:

- ❖ *Cut and cover tunnels*
- ❖ *Bored tunnels,*
- ❖ *Immersed tube tunnels,*

➢ *Cut and cover tunnels,*

***Cut-and-cover** is a simple method of construction for shallow tunnels where a trench is excavated and roofed over with an overhead support*

system strong enough to carry the load of what is to be built above the tunnel. Two basic forms of cut-and-cover tunneling are available:

- ***Bottom-up method**: A trench is excavated, with ground support as necessary, and the tunnel is constructed in it. The tunnel may be of in situ concrete, precast concrete, precast arches, or corrugated steel arches; in early days brickwork was used. The trench is then carefully back-filled and the surface is reinstated.*

- ***Top-down method**: Side support walls and capping beams are constructed from ground level by such methods as slurry walling, or contiguous bored piling. Then a shallow excavation allows making the tunnel roof of precast beams or in situ concrete. The surface is then reinstated except for access openings. This allows early reinstatement of roadways, services and other surface features. Excavation then takes place under the permanent tunnel roof, and the base slab is constructed.*

➢ ***Boring machines***

Tunnel boring machines (TBMs) and associated back-up systems are used to highly automate the entire tunneling process, reducing tunneling costs.

Tunnel boring in certain predominantly urban applications, is viewed as quick and cost effective alternative to laying surface rails and roads. Expensive compulsory purchase of buildings and land with potentially lengthy planning inquiries is eliminated.

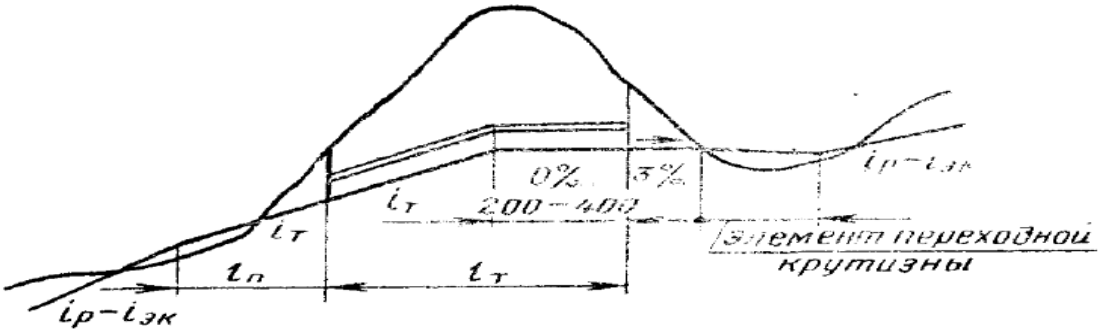
There are a variety of TBMs that can operate in a variety of conditions, from hard rock to soft water-bearing ground. Some types of TBMs, betonies slurry and earth-pressure balance machines, have pressurized compartments at the front end, allowing them to be used in difficult conditions below the water. This pressurizes the ground ahead of the TBM cutter head to balance the water pressure. The operators work in normal air pressure behind the pressurized compartment, but may occasionally have to enter that compartment to renew or repair the cutters. This requires special precautions, such as local ground treatment or halting the TBM at a position free from water. Despite these difficulties, TBMs are now preferred to the older method of tunneling in compressed air, with an air lock/decompression chamber some way back from the TBM, which required

operators to work in high pressure and go through decompression procedures at the end of their shifts, much like divers.

- ***Immersed tube tunnels,***

Sunk into a body of water and sit on, or are buried just under, its bed.

Vertical gradient in tunnels



Tunnel gradient can be calculated as

$$it = mir - icr$$

Where m=factor that depends on the length of tunnel.
(m = 0,9 for 0,3 <lm < 1,0 км; m= 0,85 for 1,0 <lm < 3,0 км;m = 0,75 -- 0,85 for lt>3,0 км).
.ir= ruling gradient
.icr= curve resistance