Types of tunnels | Function | Shape and Size | Advantage and Disadvantage

Introduction

An underground passage made without removing overburden. Tunnels are the structure constructed for the conveyance of flow or for transportation purposes or to store food or radioactive. Usually in hydro-technical practice, tunnels are used for the conveyance of flow. There are different types of tunnels.

Hydro-technical tunnels are could be classified as non pressure tunnel and pressure tunnel. The tunnel in which flow takes place for the free surface exposed to the atmosphere or flow in the tunnel is open channel flow is called non pressure tunnel. For example spillway tunnel, diversion tunnel, tailrace tunnel etc.
Types of Tunnel

Usually, the pressure tunnel is designed for the circular section and non-pressure tunnels are another shape too. Pressure tunnels are subjected to internal water pressure which is frequently much time in excess of the internal rock and groundwater pressure. The resultant tensile stress can be resisted most economically by a circular section.

Advantages and disadvantages of different types of tunnels

Tunnels are constructed underground surface following the shortest route so it has the main advantage of the following the shortest route and optimum space utilization. Following are the advantages and disadvantages of tunnels:

Advantages of the tunnel

• Less environmental effect: as tunneling work reduces the
land acquisition, resettlement issues, forest clearance etc, the environmental effect will be minimum.

- Natural landscape of the hilly area is not distributed
- Possible shortest and direct way so minimum losses and considerable economy in the project cost.
- Less cost at urban area with good rock quality: at urban area, their cost of land is expansive so construction of tunnel in underground will be less costly.
- Optimum space consumption
- Low maintenance cost
- Advantage to get more head
- Less seismic effect
- Easy for inter-basin transfer
- Time saving: shortest route to connect two points

Disadvantage of the tunnel

- Normally high construction cost
- The construction period is normally long
- High construction risk
- Expansive investigations
- Additional cost for lightening and ventilation

Read Also,

Types of Stairs

Types of Culvert

Types of foundation
Function of tunnel

Based on the function, the tunnel may be service tunnel or water carrying tunnel. The service tunnels are dry tunnels for accessibility to powerhouse or other tunnels where water carrying tunnels convey water from one place to another location.

The tunnel may be headrace tunnel or power tunnel, tailrace tunnel or diversion tunnel. These tunnels carry water for hydropower generation purpose or diversion purpose.

Size of the tunnel

The minimum diameter of the tunnel is fixed with consideration of the transportation, excavation and hauling during tunneling and should be greater than 2 m in case of circular section and in other case of other shapes should be greater than 1.9 meter in width and 2.1 meter in height. Other sizes are fixed based on the functional requirements, for example, to carry large discharge, the size of tunnel is fixed based on requirements. For transportation purpose, the size of tunnel is fixed based on the types of road constructed, one lane or multilane road.

Geometric shapes of tunnel—Types of tunnels

The following geometric designs are generally used for tunnel cross-sections.
1. Circular section

The circular section is most suitable from the structural consideration. However, it is difficult for excavation, particularly where cross-sectional area is small.

For tunnels which are likely to have resisted heavy inward or outward radial pressure, it is desirable to adopt a circular section.

Cross-sectional area \( A = 0.785D^2 \)

And, Perimeter \( P = 3.14D \)

2. D-section

D shaped sections are suitable for tunnels located in good quality rocks. The main advantages of this section over horse shoe section are the added width of the invert which gives more working floor space in the tunnel during driving and flatter invert which helps to eliminate the tendency of wet concrete to slump and draw away from the tunnel sides.

Cross-sectional area \( A = 0.8293 \, D^2 \)

And perimeter \( P = 3.57 \, D \)

3. Horse-shoe or modified horse-shoe section
These sections are a compromise between circular and D shaped sections. These sections are structurally strong to withstand external rock & water pressure.

The sections are found to be mostly suitable, where a moderately good rock is available, advantage of a flatter rock invert are required for construction purposes and the tunnel has to resist internal pressure.

Cross-sectional area (A) = 0.8293 D²

Perimeter = 3.267 D

And Hydraulic radius = 0.2538 D

4. Egg-shaped section

When the rock is stratified, soft and very closely laminated (sand, stones, slates, micaceous schists) and where rock falls are cause due to high external pressure and tensile stresses in rock, egg shaped section may be considered.

Area of section (A) = 0.854 D²

Perimeter of section (P) = 3.313 D

I hope this article on “Types of tunnels” remains helpful for you.