Abstract

Metros are now a days emerging option for the communication in cities. This paper discuss the features of large underground metro constructions. The environmental aspect is also necessary while constructing metros. The paper mainly focuses on the general arrangement and presents a short review on the various planning ideas and construction technology.

1. Introduction

Metros which are coming up in many cities across India are instruments of urban development and renewal. They have to be carefully planned and constructed so that minimum disturbance is caused to the surroundings during construction. Underground constructions are always preferable from the point of view of environmental impact. This paper describes the construction technology used for Metro Underground stations. The work on the various metro construction in other countries is explained in [1-4].

2. Why underground?

Public transportation and utilities in the urban environment are best kept underground. Constructing them above ground may cost less than half but the visual damage to the environment may become a blot for the next 100 years.

Below grade options leave the ground free for other facilities like roads and buildings.

Also underground constructions cause less Environmental Impact and less demand and less strain on the environment.

It cuts noise pollution in the surrounding built up areas by atleast 10 dB as reported.

A typical underground station measures about 250mx 25m in plan and has a depth of 20m or more, Fig. 1.

3. Peripheral Wall

The first activity is to fix the footprint of the station on the alignment. Then we construct the outer periphery so that the remaining constructions can be carried out without difficulty. The more common ways of constructing the periphery is by:

a) Diaphragm wall, Fig. 2
b) Secant pile wall, Fig. 3
c) Contiguous pile wall, Fig. 3
d) Soldier pile wooden lagging wall Fig. 4
While (a) forms a part of the permanent structure in the Indian scenario, (b), (c) and (d) are of temporary nature to facilitate earthwork excavation within the periphery. After the construction of the station buildings (b), (c), (d) have no utility.

The type of wall selected for the construction of the periphery depends on factors like type of sub strata, ground water table, etc. and is perhaps the most important decision to be taken at the start of the project.

The selection of sequence of construction is an important decision from the point of view of economy and safety. Whatever the type of peripheral wall, it is feasible to construct only by providing supports to aid in withstanding the high earth pressures that would develop in the deep excavation. The supports often take the form of anchors outside the excavation, Fig. 5 or struts within the excavation, Fig. 6, which neutralize the earth pressures exerted on opposite walls.
Whatever the method of providing supports to the peripheral wall, the excavation and the supports must be done sequentially.

Also, the floor slabs within the station must be made full use of in the matter of providing supports. Usually there is at least one concourse slab, Fig. 7, but occasionally more slabs are provided depending on the requirement, Fig. 8.

4. Tunnel Construction

At the two ends of the station arrangements have to be made to integrate the twin tunnels to the end walls Fig. 1. The lined tunnels are bored along the alignment at the required level by employing tunnel boring machines (TBMs). In most cases the end part of the station are used for launching the TBMs or retrieving them. The TBMs require to be lowered, Fig 9 into position from the ground level using cranes or portal gantries supported by temporary steel constructions supported from inside the base of the excavations.

5. Entries

The station box which accommodates the platforms must be accessed from ground level at selected points by Entry Structures, Fig. 1. Lifts and escalators need to be positioned in such a manner that it is possible to evacuate the whole station in 4 minutes in case of an emergency.

Multidisciplinary Project

The metro station is a highly complex enclosure which has to cater to the following facilities:

- Environmental Control System
- Tunnel Ventilation System
- Lifts and Escalators
- Platform Screen Door
- Track Work
- Rolling Stock
- Traction Power / Power Supply
- Signaling and Communication
- Automatic Fare Collection
- Adjacent Contracts

It is indeed a multi-disciplinary project where the main players are from Structure, Geotechnical, Architecture and MEP (Mechanical, Electrical, Plumbing). During the construction of this large excavation it is normal to encounter large number of underground utilities. Shutting off such utilities would cause tremendous problem for the buildings nearby or even part of the city. They have to be either to be diverted to enable construction to take place or have to be temporarily supported in their existing location, Fig 10.
7. Conclusion

With a proliferation of metro constructions coming up in the country it is important to understand that the Underground option is best from the point of view of reducing the impact on the environment. Metros are constructed in crowded urban areas and this expensive piece of infrastructure must be carefully planned and executed.


