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Study On Tunnling Works in Mumbai MML-3

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ABSTRACT

The growing demand for public transport in cities has serious effects on the urban ecosystem especially due to increased atmospheric pollution and changes in land-use patterns. This project report presents the work related to the implementation of such an ongoing transport system of MUMBAI CITY that focuses on the construction of the underground Metro Tunnelling project, also referred to as Colaba-Bandra-SEEPZ Line. The present research contributes to the engineering sector and, thus, engineering education by providing the methodology of a feasibility study for railway projects, which balances social, environmental, and economic aspects. The elements that comprise the factors that further improve the quality of a rail project, as well as probable parameters which increase the rail use are examined. The second key part of this article refers to the application of this methodology based on a case study of the MUMBAI Metro Tunneling railway. From the study, we have compared the Standard Norms provided for NATM, TBM, and the method for the field construction as per IS code.

1. INTRODUCTION

Metro Tunnelling's one of the main public transports carrying most of the commuters in major cities because of its advantages like efficiency, safety, convenience and so on. Major cities are continuously expanding their Metro Tunnelling system to satisfy the increasing demands of commuters, therefore more and more metros are being constructed. It is important to select the suitable method of construction for each project. The selection should be made based on the trait of each project, and to satisfy both the function of the Metro Tunnelling engineering itself and the demand for exploiting and utilizing the useful space both above and under the ground. At the same time, the negative effects on the surroundings brought by the Metro Tunnelling construction should be minimized.

Selection of construction method has a huge effect on the line embedment, the structural form of Metro Tunnelling station, and the construction period will directly influence the cost of the project and the benefits to society, economy, and environmental protection further.

There are three main construction methods that are widely used in the Metro Tunnelling construction both at home and abroad, namely the Cut and Cover Method, New Austrian Tunnelling Method, and Shield Method. The combination and innovation methods of Metro Tunnelling construction are mainly based on the above methods. In practice, it is important to identify the character and application condition of each method to select the most suitable construction method for the project. In this paper, a review of the three methods is presented to help engineers gain a further understanding to these methods.
Tunnels are unlike any other civil engineering structures. In buildings or bridges, the building materials have design properties, and they can be tested to ensure they meet these, whereas this is not the case in tunneling. Although a tunnel structure often needs support systems made up of concrete and steel, it is the ground that is a major part of the structure, and this can have both a supporting and a loading role.
This paper organizes as follows: Section II covers the objectives of the paper. Section III covers the Literature review. Section IV covers the critical issue in underground metro rail construction. V section covers the application and advantages of the desired study.

This paper is organized in such a way to review and study the tunneling construction method to make the metro line for Mumbai city and to study the different applicability of the metro in Mumbai situation regarding the land use as well as traffic and soil conditions. Specific objectives and outcomes of this study are listed below:

1) To propose the most appropriate route for Mumbai city underground metro alignment.
2) To study the various materials used for the production of concrete and prefabricated tunnel segments and their properties.
3) To analyze the test results of construction materials and compare the same with Indian standard codes.
4) To discover the challenges that tunnels in Dhaka will face during construction
5) To develop the knowledge of how underground metro rail construction is carried out by both TBM and NATM construction.

2. Literature Review

A Review of Metro Tunnel Construction Method, Haogang Guo1 1 College of Environment and Civil Engineering, Chengdu University of Technology, Chengdu, 610051, China. The construction of a metro tunnel is limited by geological conditions. Therefore, it is important to choose an appropriate construction method that suits the local conditions. This paper summarizes three major methods of metro tunnel construction, including their principles, processes, applicable conditions, strengths, weaknesses, and latest developments. This paper aims to provide reference to subway station constructions and related scientific research.
Case Study on Underwater Metro Tunnel, Kolkata Hrushikesh Bang, the technology used for the tunnel below the Hooghly River is the reinforced concrete segmental tunnel linings that have a thickness of more than a quarter of a matrix and are called with a composite gasket of neoprene and hydrophilic rubber to seal the tunnel from ingress of water.
Urban tunneling in mixed soil conditions: A study of tunneling works in Bangalore metro rail project, India Subrahmanya Gudge Bangalore Metro Rail Corporation Ltd Bengaluru, India. Bangalore Metro Rail Project faced several difficulties in implementing the First Phase of this project. One of such challenges was the construction of Tunnels and Underground Stations. Tunneling in mixed strata, below major roads and old buildings, influenced the progress. Tunneling in the ground filled with huge boulders and excavating very hard rock by controlled blasting for station excavation were some of such difficult works.

3. Critical Issues in Underground Metro Rail Construction

A. Over-estimation of Traffic Demand Forecasts

The financial viability of any transportation projects (road-based, rail-based, or a combination of these two) greatly depends upon the accuracy of traffic demand forecasts/ridership estimation. These forecasts not only provide a technical justification for these projects but also a guide and tool for their socio-economic and environmental appraisal vis-à-vis their projected/estimated costs and benefits. However, most of these forecasting/modeling exercises for transportation projects rarely provide a true picture, often leading to inaccurate or sometimes even a misleading picture about the project, forcing the decision/policy makers to take a wrong or flawed decision. In the context of metro rail projects, an overestimation of the ridership figure leads to over-sizing and underutilization of the infrastructure/resources leading to over-investing in idle capacity resulting in financial mismanagement or crisis for the project. On the other side, an underestimation of traffic demand/ridership estimation leads to chaos and inefficiency and ultimately a significant further investment as adding capacity to an existing facility is much costlier than building the whole capacity/infrastructure in one go.

B. Loss of Trees/Green Cover

During the construction phase of metro rail projects, many times trees have to be cut, resulting in the loss of green cover along the metro rail corridors. Most of these trees are part of roadside/linear plantations on the median and/or on the sides of the existing road(s). The loss of tree/green cover may cause micro-climatic changes and affects the aesthetics of the area. It is desirable and should be ensured that the afforestation is carried out near the project site itself whenever possible in consultation with local authorities/departments. Sometimes even underground corridors are also proposed to prevent the loss of trees cover

C. Noise Pollution and Vibration Issues

Noise and vibration-related issues along the corridor(s) are one of the major issues which may be significant during both the construction as well as the operational phase of the project. During the construction phase, the use of heavy machinery and construction equipment may cause vibrations and also increase the ambient noise levels. Vibrations generated during the construction phase may have several adverse impacts, including cracks developed on the surrounding buildings which can have serious implications on the structural safety.

During the operation of the metro rail, rail–wheel contacts with tracks generate noise and vibration. Engine, cooling fans, and generators further increase ambient noise and vibration levels inside the coaches and also outside the metro rail corridor. Worldwide, several efforts are being made to reduce the impact of noise and vibration generated by the metro rails, both at the source as well as receptor levels. New and advanced technology in rails and brake systems, namely, by providing damping wheels and tracks, reducing the roughness of the rails; and noise levels can be further reduced by providing mass-spring system technology and noise barriers along the corridor at critical locations along the corridor.

D. Traffic Issues during Construction Phase

Most of the metro rail corridors (especially elevated corridors) are being built along the existing roads or within the existing ROW of the roads. As a result, traffic needs to be diverted temporarily (or only a narrow width of the existing road is allowed to be used for traffic flow) for carrying out construction activities smoothly and to avoid any accident involving construction machinery/equipment. This diversion of road traffic further from the existing road corridors increases the traffic loads on the adjoining roads leading to congestion and traffic jams during peak hours during the construction phase of the project. The situation may be further aggravated during the monsoon season due to water logging problems at the project site. Traffic diversion plans, including barricading of the project site (that is, the portion of the existing road which needs to be taken over temporarily), need to be implemented in consultation with traffic police and local authorities before the start of the construction activities. The public should also be made aware of these diversions/closures well in advance to avoid inconvenience.

4. CASE STUDY

This study is based on the premise that metro rail projects in cities are considered inevitable for efficient urban transport by many planners and policymakers, however, these projects have major implications for achieving inclusive sustainable low-carbon development goals. The focus of the study is not on whether to undertake the metro project, but rather on explicitly discuss the material used by the contractor is in the Indian Standard code or not. The broad purpose of this study is to examine the material used in metro tunnel projects for achieving better strength of tunnel lining and quality of the material.

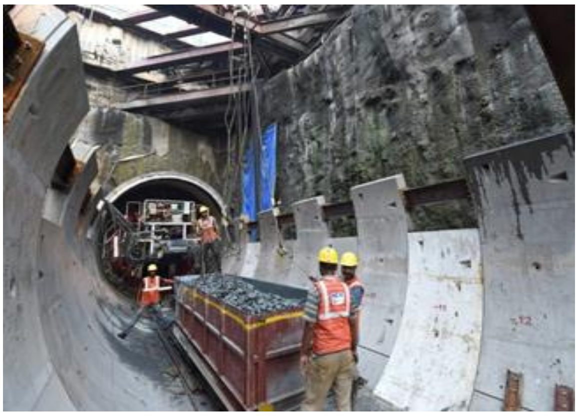

Figure1: Tunnel lining

Figure 2: Metro Tunnel Construction

5. Applications & Advantages

A tunnel is an elongated, narrow, essentially linear excavated underground opening with a length greatly exceeding its width or height. Rock-mechanics investigations have provided a vast reservoir of knowledge concerning the behavior of rocks under stress, and this knowledge can be applied to the planning and design of tunnels to the extent that underground geological conditions can be predicted. Tunnels have been constructed for a great variety of purposes. A classification of tunnels by use follows:

1. Tunnels were driven to gain access to economic mineral deposits and to provide haul-ways for extracted materials. Commonly, such tunnels provide drainage of underground water. In some mining operations tunnels are driven to provide adequate circulation of air in underground workings.

2. Transportation tunnels, including pedestrian, highway, navigational, and railroad tunnels. These are among the largest, and, at times, the most difficult of all tunnels to excavate.

3. Water (and sewage) tunnels: These tunnels may or may not be constructed so to transport liquids under pressure, and a distinction is made between gravity-flow tunnels and pressure tunnels. The latter are designed to contain without leakage water under a hydrostatic or force-pressure head.

4. Military tunnels: These tunnels are driven in connection with underground military operations.

5. Access tunnels to underground chambers or vaults.

6. Tunnels to provide protection from atomic explosions.

7. Utility tunnels: Built to contain power and communication transmission lines, gas lines, air pressure lines, etc.

Conflict Of Interest

The authors declare that they have no conflict of interest.

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