WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

PROJECT EXECUTION METHODS OF MUMBAI METRO LINE 3: PACKAGE 5 & 6

Poras S Kawale[1], Mr. G. C. Dhanjode[2]

[1]UG Student, Department of Civil Engineering, Nagpur Institute of Technology, Nagpur.
[2]Assistant Professor, Department of Civil Engineering, Nagpur Institute of Technology, Nagpur.

ABSTRACT

Mumbai, the money capital of Asian nation, has witnessed fantastic growth in population and employment. Meanwhile, to cut back the holdup, it becomes obligatory to the govt. to expand the traffic property. Currently, Bombay railroad line a pair of and rail road line three square measure underneath construction. This analysis article details concerning the development ways and construction technique dead at the underground construction of Bombay railroad line 3: Package five and Package vi. These Packages square measure important, since it involves Chatrapati Shivaji International flying field, Bombay and underground tunnel construction during this space is additionally terribly sensitive. This paper additionally includes the key issues faced throughout construction introduce Package five and vi.

Keywords: *Mumbai Metro line 3, Package 5, Package 6, Construction methods, Problems*

1. INTRODUCTION

The population of Mumbai island city and suburbs has increase from 99,25,891 (61183 per sq-km) during 1991 to 1,29,31,000 (64814 per sq-km) as per 2011 survey . The government of Mumbai has planned metro lines which has simple motive to connect the unconnected Mumbai areas. One of the metro lines is Mumbai Metro line which is the underground metro line connecting the extreme south Cuffe Parade and Central Special Economic Zone SPEEZ. Overall this metro line: 3 run through length of 33.5km having 26 underground stations and one at grade station (Fig.1). The tunnels are being constructed underneath busy commercial area and large number of tall

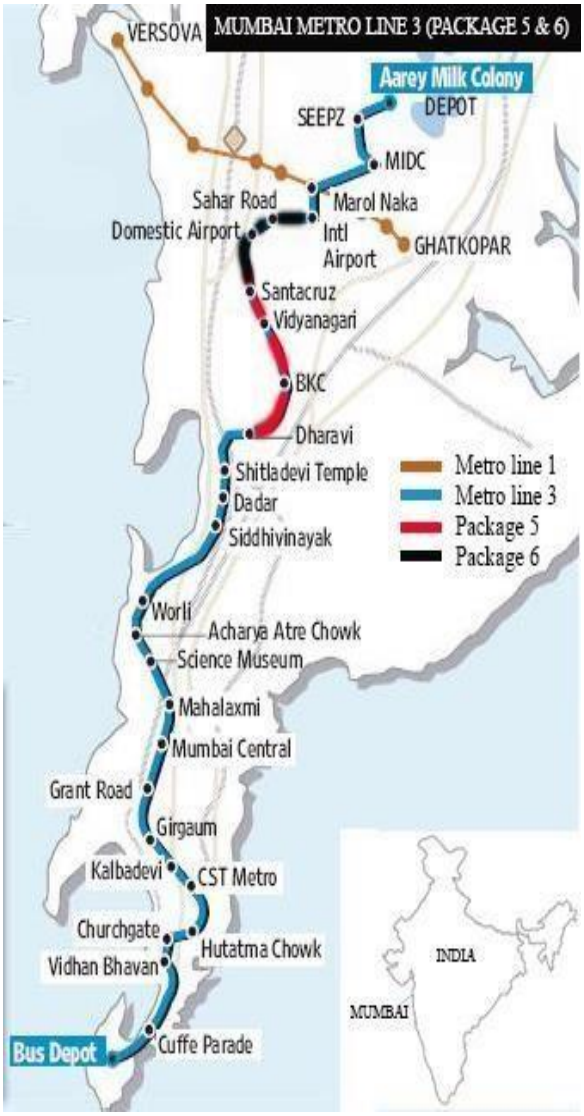

Fig.1: Mumbai Metro Line 3 (Package 5-6)

buildings and heritage sites. The cost of this corridor is estimated at 23,136 crores as per DPR, Nov 2011. The tender for civil construction work of metro line: 3 has been split into seven packages, each consisting of a 4–5 km long twin tunnel. Package 5 and 6 for civil work has been appointed to J. Kumar Infra projects. The construction planning and methods of this package has been detailed in this paper.

2. CONSTRUCTION METHODS

Cut and Cover Method:

In Cut-and-Cover, instead of using whole area of excavation only small proportion of area is used (Fig. 2). After the excavation of this portion, all the overhead support system is installed. This system of strut and waler, support the load acting on the remaining portion and excavation can be continued without affecting the working area above it. In traffic congestion city like Mumbai the area required for construction are not easily available. In such circumstances, construction can be carryout by cut and cover method, without affecting the traffic flow above it. Cut and cover having two types of methods:

- Bottom-up Method
- Top-down Method

The method used in Mumbai Metro line 3 is Top-down method. Before excavation, the side of excavation has been retaining by Secant piling. After placement of cross beamback cable insertion waler beams are used. Overlapping length of 150mm between hard pile and soft pile is maintained between them. The Diameter of pile used is mostly of 800mm. The grade of concrete used for hard and soft pile is M50 and M10. Secant pile was drilled until hard rock is available with minimum anchorage of 1m under hard rock (Fig.3).

In Domestic Station, the hard rock is available at few meters below itself, hence secant piling was done not more than 8m. In one of the face of this station, Micro pile were used, in which hard pile is not reinforced with any spiral stirrups, instead of that, ISMB250 steel member is used in hard pile and overall diameter of micro pile is 342mm. The piles are continuously having 150mm overlap to prevent water seepage and hard pile in micro pile are place little ahead with respect to soft pile toward waler beam side. The reason of using Micro pile was to avoid higher diameter pile which can get obstacle into spread roots of tree and less area availability. A tieback is a structural element installed in soil or rock to transfer applied tensile load into the ground . The tieback has been done by using HT cables tendons, drilled into waler-pile-soil.

Launching Shaft:

Launching Shaft is the large area excavated for TBM lowering and launching the TBM toward the desire direction. The Launching shaft also includes thrust frame required for initial drive of TBM. The lowering of segments and backup of TBM and transport of muck/spoil are the other major use of the launching shaft. In Vidyanagari Station, a

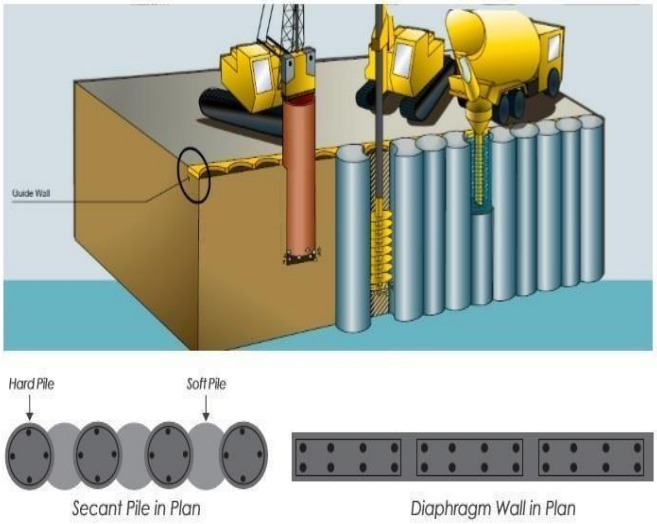

Fig.4: Secant Pile

Fig.5: Wadala Segment Casting Yard

42m diameter circular launching shaft has been constructed and have successive launch of two dual mode hard rock TBM, refer as Godavari 1 & 2. Mud Pit of capacity 700cum is constructed at Vidyanagari station.

Tunnel Boring Machine:

TBM is a machine used to excavate tunnels, with a circular cross section through a variety of soil and rock strata. Overall 17 TBM will be used in Mumbai Metro line 3, out of which 5 TBM will be required for Package 5 and 6. Earth Pressure Balance (EPB) and Dual Mode Hard Rock TBM are used in these packages. EPB has been used for slurry earth present at Dharavi and Hard Rock TBM has been used in Airport region, which is having hard rock availability at lesser depth.

Precast Segments:

Segments are used to enclose the excavated tunnel into smooth circular tunnel. Segments have been casted at Wadala (Fig.5). The major requirement of segment is to provide the required thrust by TBM hydraulic jacks for its forward movement along with resist other external pressure. In Metro line-3 project, 6 segments will be used to form the ring, 5 standard rings and 1 The grade of concrete used for the segment has been increase to M50 to achieve the strength of 12.5MPa within 12-day period required for concreting. Length of one ring is 1.4m.

3. DISCUSSION

Package 5 consists of Dharavi, BKC (BandraKurla Complex), Vidyanagari and Santacruz Station. Package 5 gets end at Mid Ventilation (tunnel) at Shanti Niwas. Packahe 6 consists of Airport region station which includes Domestic Airport, Sahar Road and International Airport. Package 5 and 6 has been executed by J Kumar Company and China Railway Tunnel group. In underground tunnel construction, selection of TBM launching station and retrieval station has to be planned initially in accordance with the site conditions.

Tunneling and alignment:

Package 5 and 6 allotted to J Kumar has total 5 TBM of Terratec company. In package 5, Two Earth Pressure Balance type (EPB) TBM will be used to construct the twin bored tunnels from Dharavi Station up to Vidyanagari Station and two Dual Mode Hard Rock (DMHR) TBM has been used from Vidyanagari station through Santacruz Station and will terminate at

Domestic Airport station having Mid Ventilation Shaft in between. Similarly, TBM will be launch from International Airport station to Sahar Road station and from Sahar Road station to Domestic Airport station as the part of package 6 tunnel planning (Table 1).

Major problems face and its solution:

Table 1. TBM Launching Details

TBM Launch at Package	Direction/ Destination Station	TBM Launching Station	TBM Retrieval Station	Type of TBM
5	Towards Colaba	BKC	Dharavi	EPB
5	Towards SPEEZ	BKC	Vidyanagari	EPB
5	Towards SPEEZ	Vidyanagari	Domestic Airport	DMHR
6	Towards Colaba	Sahar Road	Domestic Airport	DMHR
6	Towards Colaba	International Airport	Sahar Road	DMHR

a. Traffic diversion at Sahar Road Metro Station

As per the Detail Station Drawing, the station has to be constructed below the existing I.A (International Airport) road. I.A project road is one of the most traffic congestion roads in airport region. Solution of this challenge was construction an alternative road connecting the main road with the Warehouse bus station directly. The development of new road has been constructed right below the existing elevated Sahar - Airport Road. The new road is proposed to be 350m in length. MMRC has decided to connect this station with the new road along both the side and this is achieved by subway along the basement level 1, having open skylight top at center and other portion enclose by roadwork. To achieve the deadline of roadwork, the construction of subway has been completed. The subway provided is of 5.3m width and run through length of 29.6m. The clear height from floor to top of subway is 3.35m

b. HPCL pipeline at Domestic Airport Metro Station

The HPCL pipeline, backbone of Airport exists in proposed station plan. This requires high engineering skills for diversion without risking the Airport operation and moreover this operation is very sensitive. So, the tunneling work has been planned to proceed without disturbing the HPCL pipeline, by reducing the length of metro station by 20m. This length reduction also saves a huge tree in that location and avoids the demolition of existing road connecting to Western highway. Many unknown utilities of government were found during excavation at Domestic Airport station which was not present in Airport Drawing as well as the government authority drawings.

c. Tunneling alignment at runway The proposed alignment of the tunnelling was crossing the existing runway of Airport. Airport authority has suggested changing the alignment, such that it doesn't cross the runway. Solution is curving the proposed alignment to avoid the runway. Lesser radius curve alignment survey has been executed along the boundaries of the existing runway.

d. Mid Ventilation Shaft For ventilation purpose, a ventilation shaft should be constructed middle of every consecutive station having the distance more than 1.5km. The TBM launching from Vidyanagari station will retrieve at Domestic Airport station along the Santacruz Station. The distance between the Santacruz station and Domestic station is more than the allowance for ventilation. Thus, a Mid Ventilation Shaft has been constructed at Shanti Niwas, Santa Cruz.

e. Safety of Existing Building For city like Mumbai having many heritage structures and having important land throughout the alignment of TBM journey, Safety methods of this site has to be taken into practices. To check on heavy vibrations and any damage to heritage sites, the MMRCL has deployed specialized agencies of contractors to conduct detailed Building Condition Survey (BCS) to check their current condition, existing cracks & other defects/weaknesses of building in the influence, before initiating the construction work. On BCS report building and site are classified into several categories depending upon the impact limit.

Monitoring instruments are installed for ensuring the safety in the due course of construction activity. Regular monitoring during tunnelling has been carried out, to avoid any damage.

4. CONCLUSION

In this paper the underground tunnel construction of Mumbai metro line: 3 in Package 5 and 6 had been detailed. In this package, cut and cover method of construction has been executed. The launching and retrieval of TBM in both packages has been clearly stated. Moreover, the problems faced during construction along with the solutions have been detailed.

REFERENCES

[1] A K Acharya, P Nangia, "Population growth and changing land-use pattern in Mumbai Metropolitan Region of India", Caminos de Geografia, Vol.11, Issue 11, pp 168-185, 2004.

[2] Arshad and R. A. Abdullah: "A Review on Selection of Tunnelling Method and Parameters Effecting Ground Settlements".

[3] H Suroor, M Galagoda, C McGhee, "Design and construction of circular Secant Pile wall in soft clay", 6th International Conference on case histories in Geotechnical Engineering, Aug 11-16, 2008.

[4] K.N.Lee, H.W Ji, CK-SHEN, "Ground response to construction of Shanghai Metro Tunnel line – 2", Japanese Geotechnical Society Special Publication, Vol. 2 Issue 1, pp 10-24, Jan 2016.

[5] "Mumbai Cube", Mumbai Metro Rail Corporation Newsletters, Vol 8, May 2017.