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DESIGN OF A NATM CROSSOVER AT MUMBAI METRO LINE 3

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ABSTRACT

With the development of human societies and technology, there's continually a good constraint concerning the house's utilization owing to constant areas and a positive rate of growth for population and technology. Despite scientists' efforts in terms of group action and utilization, house limitation could be a pleasant concern in such a way that even the thought of living on Mars is approaching the truth in recent years, despite impossibilities and difficulties that have been baby-faced even in theory in recent decades. As a result, astrologists are looking for Mars for lodging; farming scientists are looking for sea and submarine facilities for agriculture, and transportation engineers are looking for abstraction and underground structures. The development of underground structures in railway systems is often difficult because the project works usually have an effect on a sizable number of adjacent surface structures with demanding settlement criteria and protection needs. Project implementation becomes even a lot more complicated once the overburden is shallow and therefore the space of the crosswise is relatively massive. This paper describes such a challenge at city railway system line three, where a crossover structure had to be enforced throughout the elaborated style as an amendment of scope. The ab initio planned crossover cavern was re-arranged throughout the elaborated style. The main aim of that paper is to elucidate soil conditions around the NATM cross over on line-03 of the city railway system. The changed construction sequence was doled out in accordance with the principles of NATM style.

***Keywords**: Design of NATM; crossover*

1. INTRODUCTION

As outlined by the Austrian Society of Engineers and designers, the NATM"... constitutes a technique wherever the encircling rock or soil formations of a tunnel are integrated into an overall ring-like support structure. A cut crossover has been projected at the look stage in Package UGC-06 of urban center railway line three in the Republic of India, with shallow overburden (7 to 12 m), in moderately to extremely worn rudaceous rock. As cut and canopy construction wasn't potential because of the inconvenience of open houses and dense surface structures, NATM excavation was proposed. The "New Austrian tunneling methodology" (NATM) was developed between 1957 and 1965 in Austria. It was given its name in the urban center in 1962 to tell it apart from the recent Austrian tunneling approach. Ladislaus von Rabcewicz, Leopold Müller, and Franz Pacher were the main contributors to the NATM event (Wikipedia). The current plan is to use the geologic stress of the surrounding rock mass to stabilize the tunnel itself.

2. LITERATUREREVIEW

In cities around the world, commuters spend a considerable part of their work day traveling to and from their workplace. In India, commute times can stretch up to 45 minutes a day, which is the case in the Mumbai Metropolitan region. Multi tasking during commutes provides opportunities for riders to make good use of their travel time.

First, to understand the theoretical framework for NATM and TBM, a background on the concept of positive utility of travel (PUT) is introduced. These days the sole mass transit possibility in Mumbai city is bus and therefore the service provided is little all told aspects of safety, capacity, comfort and convenience.

3. BROAD PRINCIPLES OF NATM

1) Mobilization of the strength of rock mass - the tactic depends on the inherent strength of the rock mass being preserved because the main element of tunnel support. Primary support is directed to alter the rock to support itself.

2) Shotcrete protection - Loosening excessive rock mass deformation ought to be decreased by applying a layer 25-50mm of waterproofing shotcrete at once gap of the face. Measurements - each deformation of the excavation should be measured. NATM needs installation of subtle measure instrumentation. It’s embedded in lining, ground like load cells, extensometers and reflectors.

4) Primary Lining - the first lining is skinny. It's active support and also the tunnel is strong not by a thicker concrete lining however by a versatile combination of rock bolts, wire mesh and Lattice girders.

5)Closing of invert – Early as so much as potential closing the invert thus on complete the arch action and making a bearing ring is vital. It's crucial in soft ground tunnels.

6) Rock mass classification - The participation of skilled man of science is extremely necessary because the primary support moreover because the additional coming up with of supports throughout the excavation of rock requires the different types of the rock mass.

7) Dynamic style – The deigning is dynamic throughout the tunnel construction. Each face gap classification of rock is finished and also the supports square measure elite consequently.

Fig.1. NATM Portal Face Entrance

4. ORIGINAL PROPOSAL

By TBM and the crossover was excavated by conventional Method (NATM). The crossover arrangement had three Major cross-sections. The cross-sections are marked as Section AA, BB, and CC, and are shown in Figure3.

a) Proposed alternatives

The alternatives were conceptualized by the Designer in consultation with the Contractor and the Client. The basic idea behind each alternative was to provide an optimization for the proposed (conceptual design stage) crossover in terms of construction feasibility, excavation geometry and geotechnical stability.

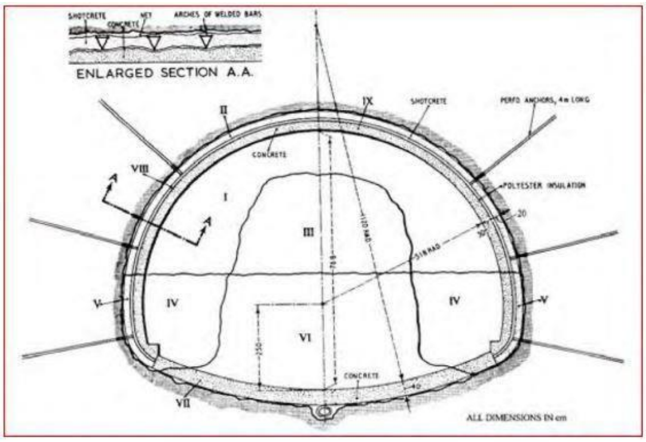
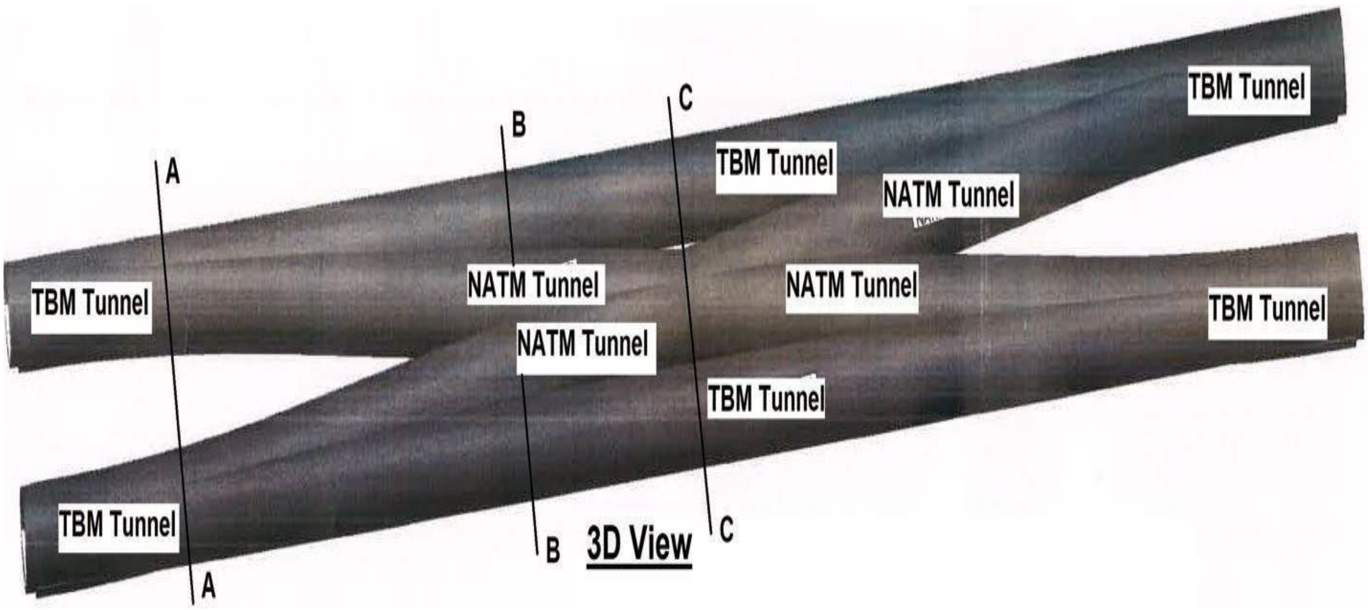


Fig.2. NATM section

Fig.3.3 Dview of the crossover (initial conceptual proposal, MAPLE/MMRC)



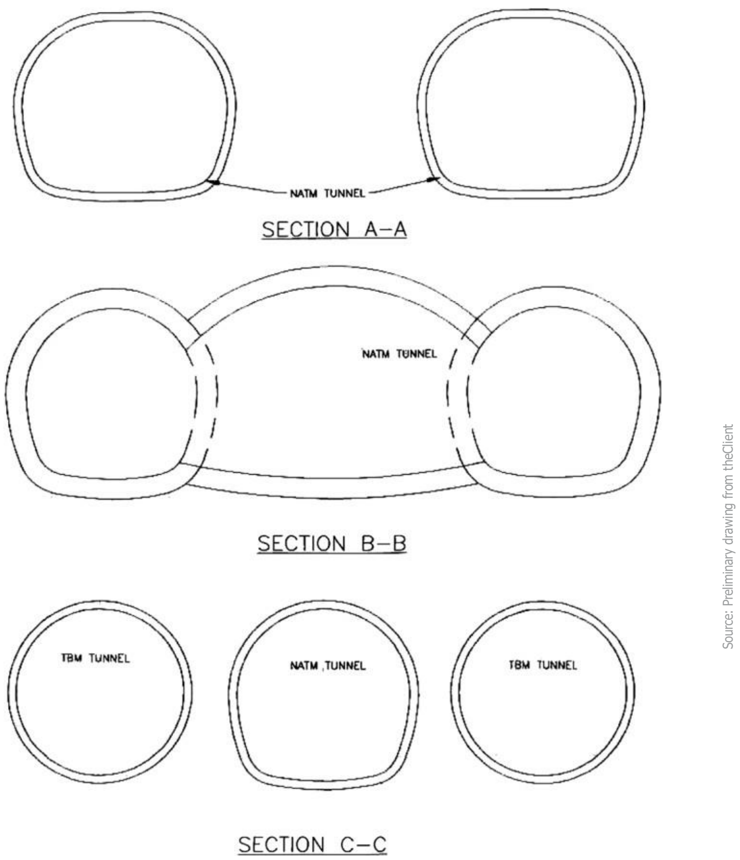


Fig.4 The cross-sections in the original crossover proposal (initial conceptual proposal, MAPLE/MMRC)

4.1. First alternative

The first alternative was based on the idea to separate the scissor crossover into two individual elements located at either side of the station as shown in Figure 3. By choosing this alternative, it was possible to reduce the maximum width of the cross-section to15 to16 m, compared to 26 to 27 m (in the original proposal). This would have made construction and stabilization of the ground easier.

4.2. Second alternative

The second alternative was based on the idea to keep the original scheme, but with the NATM excavations between the TBM tunnels combined into one large central cavern as shown in Figure 6. The large cross-section in the middle was not proposed as shown in the original proposal with three roof curvatures, but as a cross-section with one roof arch. However, the largest cross-section was still quite wide for the existing overburden.

4.3. Third alternative

The first alternative was most suitable for geotechnical stability, but the Client did not agree due to operational considerations. Therefore, the crossover had to be built on one side of the station.

Keeping this requirement in mind, a third alternative was proposed (Figure7).The basic idea was the same as the first alternative, i.e. to keep the width of the biggest cross-section as small as possible. To achieve this, the central point of the crossover (where the railway lines cross each other) was shifted towards one line (as opposed to being in the center in the original proposal), avoiding one large cross-section. Figure 5 shows the third and final arrangement, which was accepted by the Authorities, and which was finally developed and constructed.

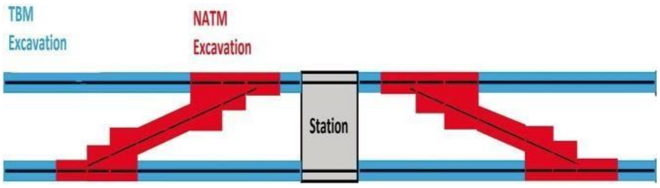


Fig.5 First alternative

Fig.6 Second alternative

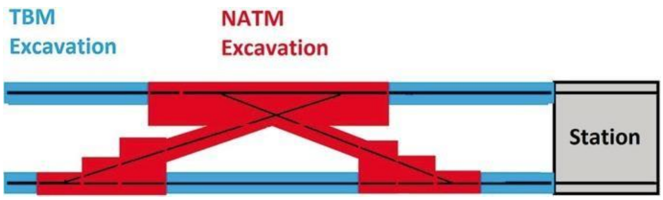


Fig. 7 Third alternative

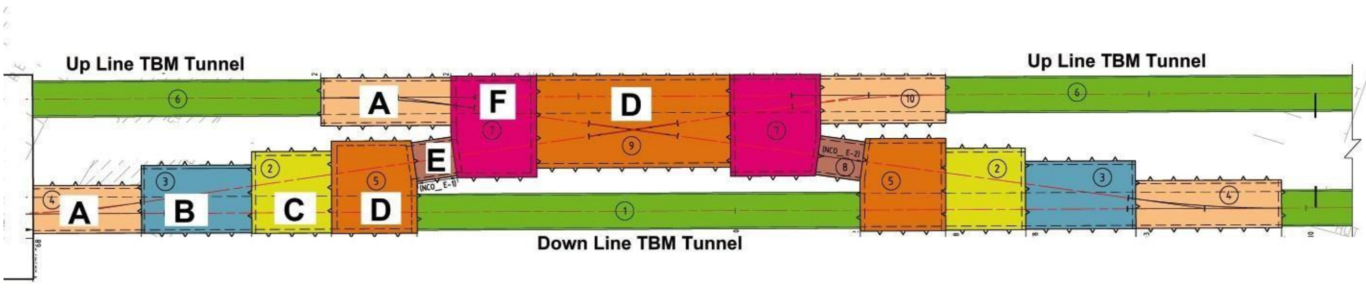


Fig. 8. Finalized arrangement of crossover

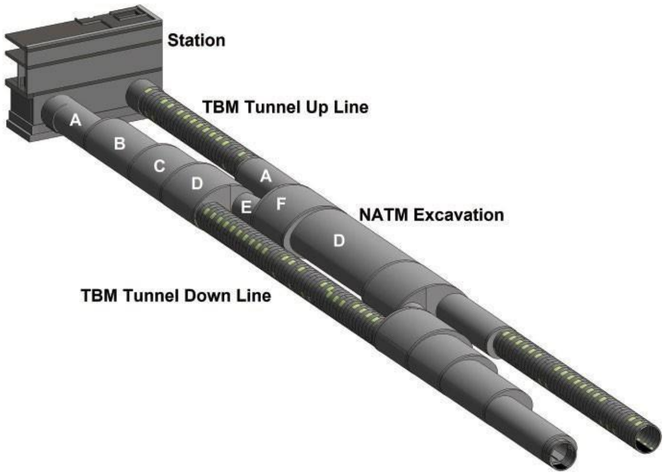


Fig. 9.3 Dview of the proposed crossover

5. CONSTRUCTION METHODOLOGY

In the NATM technique, every desired alignment is started by the excavation of the shaft, and because the shaft reaches to deepest depth of the tunnel, construction of the profile in each of the directions starts. Because the profile excavation is sustained, the structure of the tunnel is made likewise by a distance of a couple of meters.

5.1. Classification of Rock Mass

Type Rock mass encountered throughout excavation can't be same to be favorable or unfavorable solely on the idea of the kind of the rock. Many different factors put together play [*fr1] inside the rock mass behavior. The excavation within the rock relies on the rock category supported many factors like compressive strength of rock, water condition, range of cleavages, condition of cleavages, dip and strike of the rock etc.

5.2. Rock Quality Designation index (RQD)

The Rock Quality Designation index (RQD) was developed by industrialist (Deere et al 1967) to supply a quantitative estimate of rock mass quality from drill core logs. RQD is outlined because the share of intact core items longer than one hundred metric linear unit (4 inches) within the total length of core. The core should be at least compass point size (54.7 mm or 2.15 inches in diameter).

5.3. RMR Value

RMR worth depends upon the subsequent factors:

- Uniaxial compressive strength of rock material.
- Rock Quality Designation (RQD).
- Spacing of discontinuities.
- Condition of discontinuities.
- Groundwater conditions.
- Orientation of discontinuities.

Based on this the rock mass different types as per RMR Table

5.1 show different RMR values:

RMR Value	100-81	80-61	60-41	41-20<20	<20
Rock class	I	II	III	IV	V
Description	Very good	Good	Fair	Poor	Very Poor

Table.5.1. RMR Value

5.4. QFactor

It depends on the following:

- Block size.
- Inter block shear.
- Active stress
- Joint water flow Reduction.
- The Presence of weakness zones letter of the alphabet issue varies from zero.01 to 1000.

I.e. from exceptionally poor rock to superb rock

5.5 Components and Sequence of Execution in NATM

1. Shotcrete Protection – Shotcrete 25-50mm commonly used.
2. Lattice beam Fixing –A lattice beam is three steel reinforcement bars placed at the three corners of a triangle with an 8mm steel bar for affiliation. The comparison of steel ribs is simple to handle.
3. Fixing of wire mesh – Wire mesh is usually fixed with 6mm thick wires.
4. Primary Lining with Shotcrete – Each layers should not be thicker than 150mm
5. Rock Bolting
6. Pipe Fore poling – Used for crown support for next excavation cycle (for Rock category once III only).

Fig.10.NATM in Action, Shotcrete the end of section

6. BENEFITS OF NATM

a) Low cost
b) There are no uncertainty disruptions to the overall schedule.
c) Simple application
d) In-place solutions
e) There is no lack of higher than access
f) At grade diversion, no.
g) There is no disruption to utility or underground facilities.
h) No high-priced machinery or technology
i) Comes smart for each long or short, deep or shallow.
j) Full independence of foreign technology and labor
k) There are numerous cutting heads.

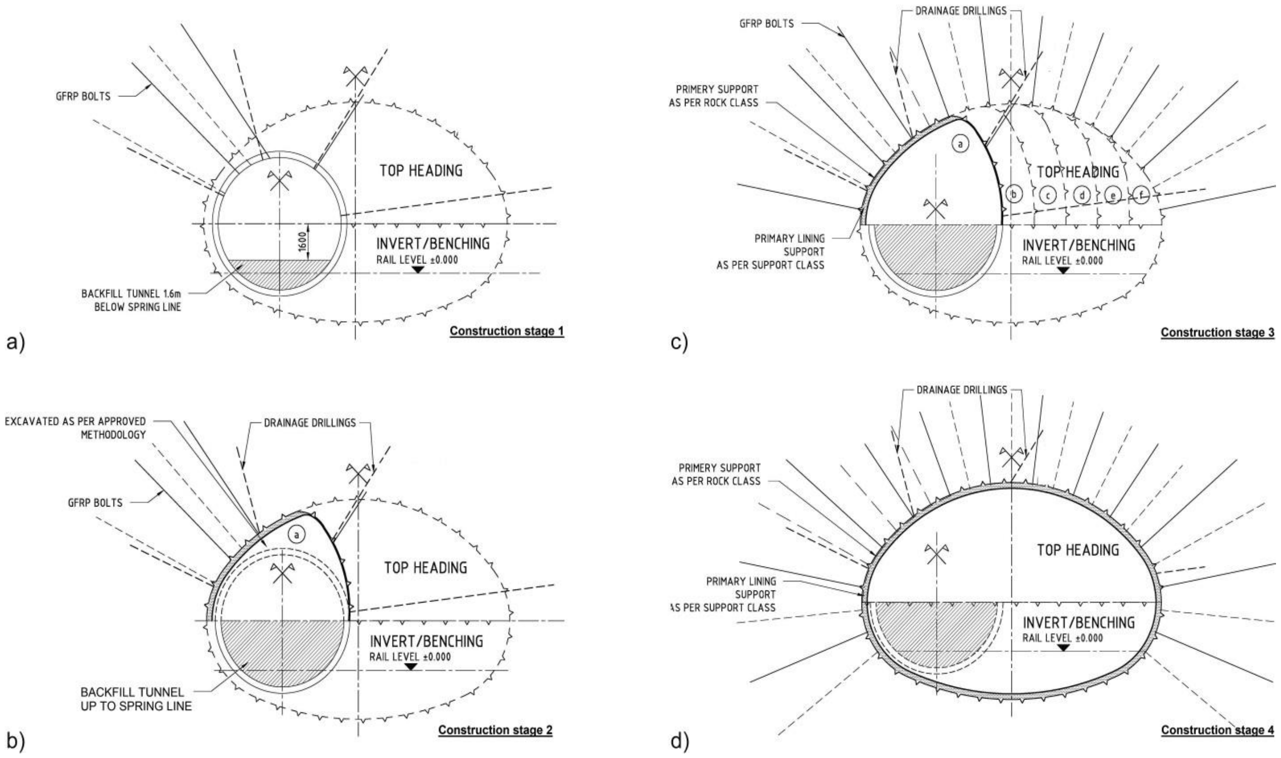


Fig.11 Construction stage 1 to 4 for crossover

7. CONCLUSION

1) Field survey clarified the difficulties encountered during the construction.

2) Arrangement and new methodology benefited the entire work in easier construction and provides geotechnical feasibility.

REFERENCES

[1] Golser J. (1976), "The New Austrian Tunneling methodology (NATM), Theoretical Background & sensible Experiences," ordinal Shotcrete Conference, Easton (USA), 4-8 October 1976

[2] EN 1992-1-1 (2004) Eurocode 2: style of concrete Structures – half 1-1: General rules and rules for Buildings. Austrian Standards, Vienna.

[3] Yash Kumar Mittal, Virendra Kumar Paul on Identification of important factors for delay in railroad rail comes in Bharat, IJSRTM, vol. 6. No.1.

[4] Rocscience package (2019) RS2 Version nine.0, Finite component Analysis for Excavations and Slopes. Rocscience opposition. Toronto..