MMRC
ADDING NEW DIMENSIONS

VOLUME 30
MARCH 2019

METRO CUBE

A MUMBAI METRO RAIL CORPORATION NEWSLETTER

Content

MD Speaks

Ms. Ashwini Bhide, IAS

Keeping up with the pace of construction activities, the project achieved 3 TBM breakthroughs by Wainganga-1 at MIDC, Krishna-3 at Worli and Godavari-3 at Vidyanagari stations. On the stations' front, excavation at MIDC Station box has been completed in pkg 7. It took 537 days to excavate 1,42,000 m^3 station box at 264 m^3/day. 2nd pour of MIDC Station concourse slab of 456 sq.m was also completed thereby completing 13% of concourse and 67% of base slab. Steel deck for traffic diversion at Dharavi and Grant Road metro stations have been opened making way for excavation activity. Similarly, works at BKC, Marol Naka, CSMIA T2, Vidhan Bhavan, Vidyanagari, Siddhivinayak stations are also progressing at reasonable pace.

All the TBMs that achieved breakthroughs in last 2 months are being turned around for next stage of tunneling after necessary maintenance procedures.

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Shree Saurashtra Dashashrimali Jain Bhojnalaya
at Kamaniwadi in Chira Bazaar, Mumbai

Brief History

Shree Saurashtra Dashashrimali Seva Sangh is a charitable Trust established in 1957 and managed by *Saurashtra Dashashrimali Jain* community. Prior to establishing the Trust (in 1956) Sri. Ramjibhai Virani, a humanitarian and philanthropist from the community approached prominent persons of the community with a proposal to serve the needy members of the community, who migrated to Mumbai for livelihood. Most of them used to reside at their workplace and dine at local eateries. Sri. Virani proposed to setup a *Bhojnalaya* for these needy people and offered to contribute an equal amount as contributed by the members of the community. With community members' support, '*Shree Saurashtra Dashashrimali Jain Bhojnalaya*' was set up, wherein two meals were offered daily at a concessional rate of ₹15 per month to those working in Mumbai and regularly sending their savings to their native place. The beneficiaries were required to submit receipt of money orders sent to their native place to be eligible for the scheme. In 1957, the Trust was formally registered.

This initiative was upheld by the community and overwhelming support received from all corners. Members of the Trust/community contributed wholeheartedly to this cause especially during ceremonies, such as weddings, birthdays, engagements, etc. As per records, about 400 people benefited from this scheme at any given time.

Establishing Bhojnalaya at Kamaniwadi

As the Trust and its activities including the *Bhojnalaya* became popular, the trustees decided to purchase a plot to manage its activities. The existing *Kamaniwadi* plot along with its structure was purchased by the Trust through a public auction in the year 1970. Ever since, various activities of the Trust were operational from the same premises.

The Trust has total eight trustees and is currently headed by Sri. Shashikantbhai Badani. Prior to acquisition of *Kamaniwadi* property, lunch and dinner were served to the beneficiaries at a concessional rate of ₹26 per month. Those not belonging to the community would also avail meals at a minimal cost of ₹40 per meal. The quality and hygienic conditions of the food served and procurement of groceries were regularly monitored by the trustees.

Shree Saurashtra Dashashrimali Jain Bhojnalaya

Other Activities Undertaken

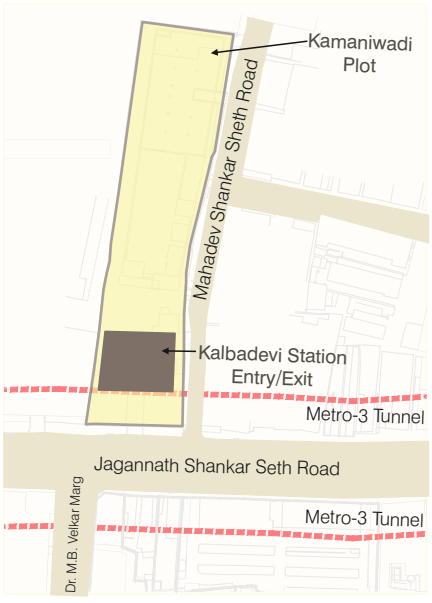
The Trust also provides aid to needy students for their school and college education, and monetary help for medical aid to needy persons. The poor widows from the community are also provided with monetary help every month. Apart from providing food grains and groceries to poor families of the community, the Trust also maintains an old age home at Kharghar in Navi Mumbai and functional sanatorium at Lonavala and Deolali. A journal named *Dashashrimali* is regularly published by the Trust, wherein the activities of the Trust are chronicled for information of the community.

Kamaniwadi

Acquisition of Kamaniwadi property by MMRCL

The *Kamaniwadi* (CS No. 662, 1/662 of Bhuleshwar Division) premises was required for Metro Station construction and rehabilitation of PAPs under in-situ rehabilitation committed by State Government. The trustees co-operated with MMRCL, and *Kamaniwadi* property was acquired by way of negotiation with mutual consent and due compensation was paid to the Trust.

Currently the Trust office is shifted to a rented premise in Dadar West and the *Bhojnalaya* activity is discontinued for want of appropriate facility in a location suitable to patrons. Awaiting the re-establishment of *Bhojanalaya*, monetary help is being provided to the existing beneficiaries. MMRCL highly appreciates the cooperation extended by the Trust in project implementation.



Location of Kamaniwadi Plot - Acquired by MMRC

Types of TBM

This article is in continuation with the series on 'Types of TBM', in February 2019, Volume 29.

Cross Over/Dual Mode TBM

Cross Over or Dual Mode TBMs, 7 in number will excavate approximately 15 km of the 33.4 km dual running tunnels and will be supplied by manufacturers Robbins and Terratec (2 numbers and 5 numbers respectively). Cross Over or Dual Mode TBMs were the machine of choice along this section of the alignment primarily because of the enhanced and more favourable geological conditions, which allows greater excavation rates to be obtained in open mode operation with the use of belt conveyors instead of screw conveyor. It also reduces risk associated with less congested areas and the effectiveness of operations compared to other TBM types. Typical geology along the tunnel alignment is simplified and summarised below:

Dual mode TBM – Summary of geological conditions

Geological Description	Unconfined Compressive Strength
Fresh Basalt with volcanic rock in whole face of the tunnel. Basalt comprises infillings of silica and	85 MPa
Fresh Basalt and volcanic Tuff	15-85 MPa
Mixed face with volcanic Tuff, Fresh Basalt and moderately weathered Breccia	Up to 125 MPa
Fresh greyish Basalt	100 MPa

Design features of the cross-over or dual mode TBM

With enhanced ground conditions over a greater distance along the alignment, design of the TBM still had to cater for the possibility of the following geological conditions:

- Variations in ground type
- Possibility of running ground and/or face collapse
- Flowing and faulted ground
- Possible water inflow

Based on these and other mechanical properties obtained from the ground investigations, Dual mode/Cross Over Single Shield machine with special features were considered appropriate. These special features include heavy duty main bearing and modified cutter head structure to cater for hard rock conditions, quick change over from open to close mode by changing from belt conveyor to screw conveyors to cater for unexpected water conditions, inclusion of high capacity heavy duty 17" disc cutters with an efficient method of cutter disc change incase of interventions during closed mode operation which would result in the least amount of downtime.

Other special feature attributed to this type of TBM is the ability to "close off" the machine whenever soft flowing ground, faulted ground or high water inflows be encountered. The Dual Mode/Cross Over TBM is equipped with a screw conveyor. This screw conveyor can be activated to prevent any material or water from exiting cutter chamber and entering into the machine. The system can also operate in a "semi-EPB" mode, in which as the pressure in the cutter head chamber rises, the screw conveyor discharge gate is opened and material is discharged on the conveyor belt located on TBM backup system.

Additionally in extreme conditions, once the muck chamber is sealed against material or water inflows, the probe/grout drill can be utilized to forward drill and grout, for ground consolidation and to seal off the inflow of water or poor ground.

MD Speaks

Continued from Page 1

The private land acquisition process for Kalbadevi and Girgaon stations is nearing completion and 90% PAPs relocated to transit accommodation or paid rent. Provisional plans for redevelopment of 3 blocks to rehabilitate 712 Project Affected Families (PAF) from 30 buildings in 20 properties to 3 modern buildings were reviewed by Hon. Chief Minister. Hon. CM advised MMRC to deploy latest construction technology to expedite the construction of buildings. The plans are proposed to be discussed with the stakeholders before finalization.

On the systems' contracts front, the team mobilization and design activities are progressing in the awarded contracts. As the works start taking shape, the same will be disclosed for public consumption.

The month of March witnessed the visit of Parliamentary Standing Committee on Urban Development to Mumbai. The committee visited Metro-3 project site, Cuffe Parade station under construction for a first hand review and toured the tunnel works in progress. The committee appreciated the progress achieved and expressed satisfaction about the ongoing works.

March 1st week was observed as National Safety Week jointly by MMRC, GC and CJV staff reiterating "Mission Zero Accident" with an emphasis on safety in project execution. We need to make safety a culture and discipline in all aspects of the work that we do.

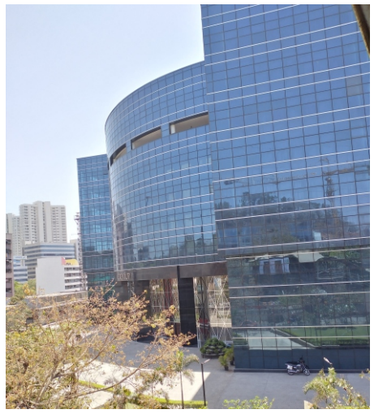
ORF arranged a lecture on Metro-3 for engineers, architects and planning students on 8th March. The presentation was well attended by students that also helped in clearing certain doubts in their minds. To source ideas on station planning and integration, a competition was jointly declared by ORF and MMRC for engineering, architecture and planning students.

The Financial Year (FY) 2018-19 has been quite satisfactory in terms of achievements and team MMRC is expecting to take a big leap on all fronts of project implementation in the new FY 2019-20.

Know Your Station - Aarey Depot Station

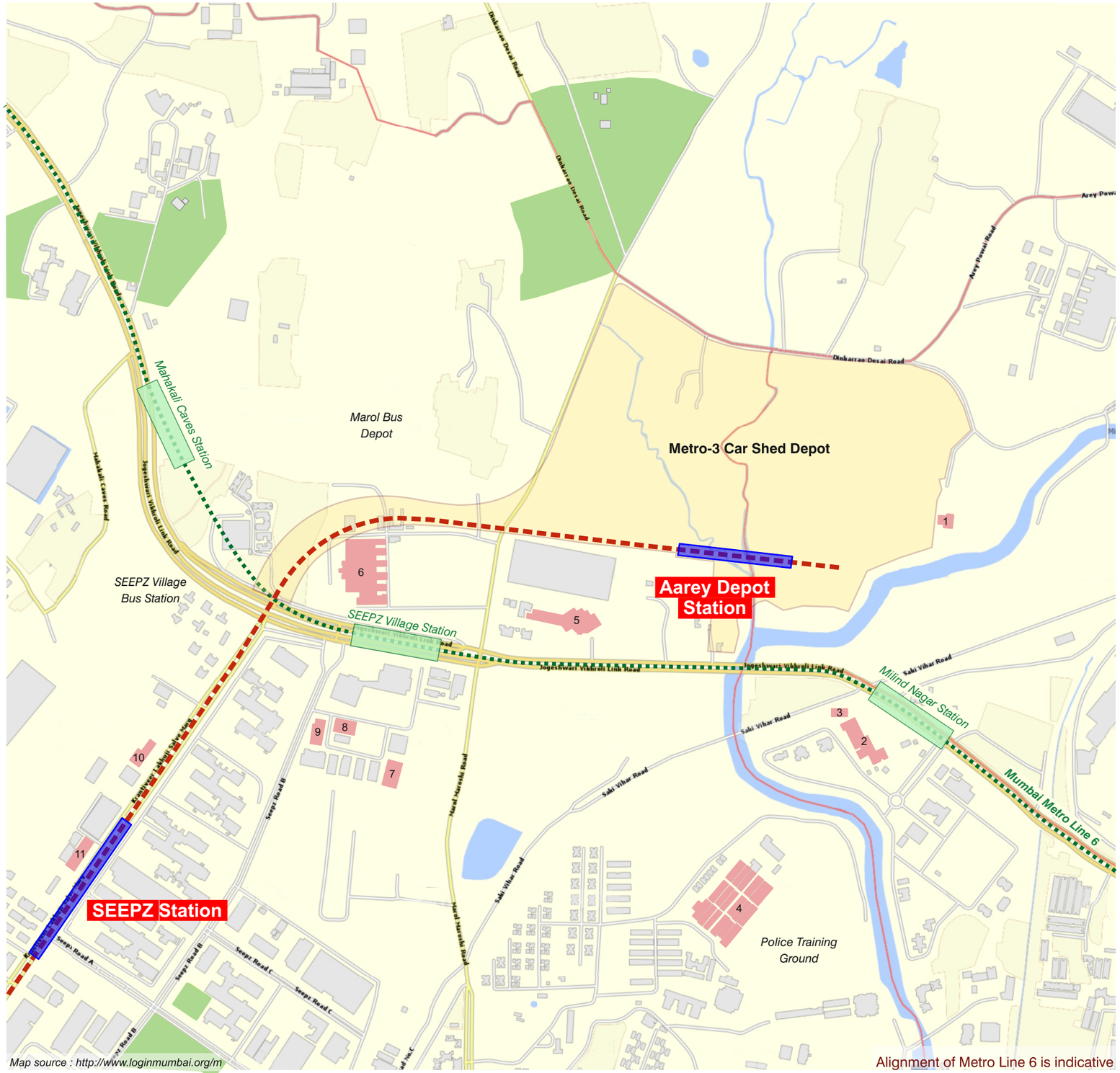
Shree Shubhananda Ashram

Aarey Milk Colony



Chromium, Powai

1. Aarey Om Temple
2. Indian Educational Society
3. Shree Shubhanand Aashram Powai
4. Marol Police Camp
5. Adani Electricity Management Institute
6. Aarey Milk Colony
7. Directi SEEPZ Office
8. Sun City Hotel
9. Hotel Suncity Premiere
10. Western Regional Power Committee
11. Dr. Susan Sodder Pvt. Hospital



Map source : http://www.loginmumbai.org/m

Alignment of Metro Line 6 is indicative

Aarey Depot Station is the 27th and last station on Metro-3 corridor from Colaba side, which is the only at-grade station. It is located at Metro-3 car shed depot, Ganesh Nagar, Goregaon East. So far, this area is being accessed by BEST buses, auto rickshaw and taxis for connecting nearby areas/stations.

The nearest stations on Mumbai Metro Line 1 are Chakala (JB Nagar), Airport Road and Marol Naka which are 4 to 5 km from proposed Aarey Depot Station. And on Western Railway, Jogeshwari and Andheri which are around at a distance of 5.5 km from proposed station. But still, this area is far off from direct reach of Central Railway. Now, with introduction of Metro-3, this area will be directly connected to South Mumbai.

Aarey Colony (Aarey Milk Colony) is established in 1949 to transform the processing and marketing of dairy products in the city, located at Goregaon East. In 1951, Prime Minister Pandit Jawaharlala Nehru inaugurated the dairy at Aarey.

The colony is spread over 1280 ha having milk plants, cattle farms, area for cultivation of quality fodder and grasses, gardens, nursery, lakes, an observation pavilion and picnic facilities. Among the popular attractions in Aarey are Chota Kashmir with a lake and a picnic spot. In 1977, about 200 ha of land was carved out from Aarey village to establish Film City. Apart from all these activities, some portion of land is leased out to various organizations and institutions of the Government of Maharashtra and Government of India. Aarey authority is also looking after the other primary essentials, like running primary school and 24 bed hospital for the residents.

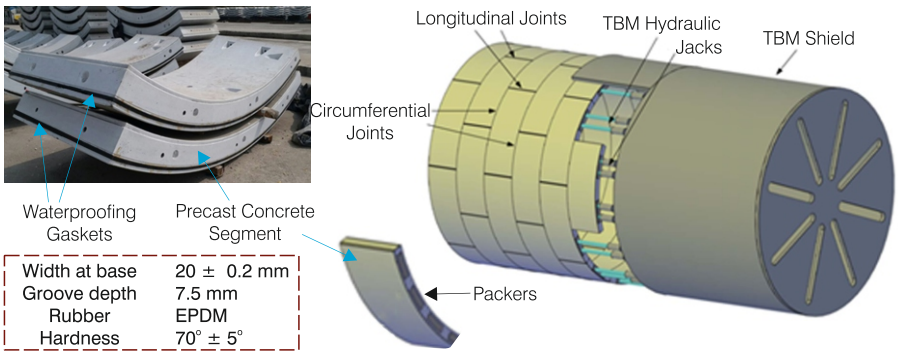
Metro-3 will cross the Mumbai Metro Line 6 near proposed station. Two stations of Line-6, SEEPZ Village and Milind Nagar are situated very close to proposed station, hence, Aarey Depot station may act as an interchange and would ease the passengers' movement. The station will serve the landmark like, Aarey Om Temple, Tapeshwar Mandir, India Educational Society, Shree Shubhanand Aasharam, Marol Police Station, Chromium Powai, National Motor MFG. Co., etc.

Waterproof Metro-3

This is a second article on waterproofing for Metro-3, preceded by introductory article in previous issue, February 2019 Volume 29. Metro-3 tunnels are being constructed by Tunnel Boring Machine (TBM) and New Austrian Tunnelling Method (NATM). This article talks about waterproofing techniques used in TBM tunnel.

Majority of the tunneling is done using Tunnel Boring Machine (TBM). The TBM does the mining for one ring width in single go and then ring segments/lining erection is done. The tunnel's final lining consists of precast concrete segments which are erected with a fast and fully automated procedure to form complete support rings. Along the periphery of the segments, special polymeric (EPDM), water-proofing gaskets are attached.

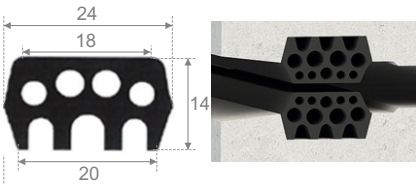
EPDM Gasket Specification: The gasket is Ethylene Propylene Diene Monomer (EPDM) formulated to provide good retention of elasticity and low stress relaxation. Embedded into the gasket will be a vulcanized polychloroprene rubber hydrophilic strip formulated with hydrophilic polymers.



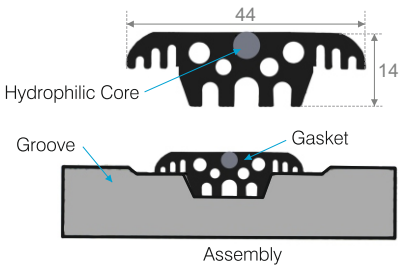
Typical Illustration of TBM Tunnel Segmental Lining

Installation: The EPDM gasket is glued-in tunnel segments using contact adhesive. The adhesive is applied to the gasket and groove around the whole perimeter made in permanent lining segment with the help of brush. Adhesive is left on segment and gasket until it is touch dry, then the gasket is fitted in the groove firmly using rubber hammer. During segment placement, adjacent segments are pressed against each other and secured with screws. Thus, gaskets are also pressed against each other, preventing ingress of water and rendering the tunnel watertight in the long term.

Gasket for stretch under Mithi river: Precast concrete segments under Mithi River incorporate specialized, improved waterproofing gaskets almost double in size compared to those used on the typical segments in order to ensure safety and long lasting water tightness of the tunnel's lining at this sensitive area. The specific gaskets have indeed been thoroughly tested in a specialized laboratory in the UK, to verify their performance under water conditions similar to those expected under the Mithi River. For additional safeguard, hydrophilic gasket will also be used along with this polymeric gasket.



Typical Gasket



Gasket below Mithi River

Backfill Grouting: After erecting the permanent lining, the annular space between the tunnel excavated face and lining outer face is filled with primary grout and secondary grout. The fundamental basics of primary grouting behind the segmental lining is to ensure that full and immediate support is given to these rings as they emerge from the rear of the TBM. If the void were not to be filled immediately the inward ground movement would translate upwards and cause surface settlement. The other major function of grouting behind the segmental lining is to ensure that the lining is watertight.

Solution "A"
Cement - 320 kg/m^3
Bentonite - 25 kg/m^3
Stabilizer - 2 liter/m^3
Water - 770 liter/m^3

Solution "B"
Sodium Silicate - 70 liter/m^3

The TBM machine used in this Contract injects grout through the tail skin as the TBM advances, thereby providing the immediate support required. The double liquid grout consists of Cement, Bentonite, Water and Stabilizer, ("A" solution) and Accelerator ("B" solution). Both solutions, "A" and "B", are stocked in the storage tank and is delivered separately from the surface and supplied to the tunnel via separate supply lines (2" and 1 ¼"). They are only mixed at the point of discharge within the TBM tail skin. Once the A and B component are mixed the phase changes from liquid to jelly and is not possible to physically measure the actual pressure in this new phase.

The grout "A" solution is pumped from surface to the TBM where it is temporarily stored in an agitator tank prior to being pumped through the tail skin. Additionally, accelerator "B" solution is pumped from a surface tank in a similar fashion.

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Expert Speaks

Our author for 'Expert Speaks' section for this month is Mr. Shridatta Suresh Haldankar, President of Chetana Education Trust, Mumbai from 2011 to till date. He has been a part of multiple activities, like setting up factories to manufacture containers for all major Pharmaceutical, Chemical and Agrochsssemical companies. Then in 1998, he forayed into the Chemical Business where he started as a agent for their bulk drugs. In 2014, he entered into energy saving systems and green technology business. Apart from business and education interests, he is also deeply involved in music. Being the son of popular Hindustani classical vocalist Pandit Suresh Haldankar, he too gives recitals in Hindustani classical vocal music and has performed at several public programs all over India.

The expectation from the Metro Rail project is to provide new lease of life for gasping middle class commuters and the average fare should be within the reach of common people. The project should be completed on time and in case of any delay, there should be penalty in place for contractors. Once all Metro Lines are up & running, there will also be a shift from BEST and local trains to the Metro. The daily increase in new cars, bikes and other vehicles on roads has become a conundrum for those living in the city. The public transports, like BEST, Local Train have made lives easy for commuters to some extent but considering the current population, we should target more public transport services than private services like local Taxi, Ola and Uber.

In most of the countries, this has been a story of evolutionary change with new transport development replacing the old transport system in response to perceived socio economic needs of the people. Implementation of such modern transport system of Metro Rail facility to any metropolitan city is the ultimate aim of this project. Metro Route Maps are created as per traffic study and evaluated in accurate manner by using GIS, Global Mapper and find out shortest feasible route. Metro provides multiple benefits: reduction in air pollution, time saving to passengers, reduction in accidents, reduction in traffic congestion and fuel savings. There are incremental benefits and costs to a number of economic agents: Government, private transporters, passengers, general public and unskilled labour.

Mrs. Ashwini Bhide, IAS, Managing Director – MMRC has been very instrumental and committed to implement 'Metro Rail' projects to improve traffic & transportation scenario in Mumbai city. She has been working tirelessly in executing Metro-3 Project, the first underground Metro project of Mumbai connecting Colaba to SEEPZ with 33.5 kM long twin tunnels and 27 stations. I have personally met Mrs. Bhide at my institute during an International Conference and she gave such a nice & simplified presentation on Underground Metro System that even uneducated person could understand the subject matter.

The average fare should be within the reach of common people and rate should be left to be decided by local Government considering the middle class travelers.

The future looks great once we have all the Metro projects in place in Mumbai and in its suburban's and it will make life easy for daily commuters. It will also bring down the percentage for private cars occupancy, and people would prefer more of public transport than using their private vehicles due to easy accessibility.

The Metro projects are greenest mass rapid transit system across globe and the project not only brings down much needed traffic congestion but also helps in reducing carbon footprint & pollution. MMRC has already made efforts to plant additional trees along with transplanting existing trees wherever possible. This initiative is highly appreciated and projects a proactive approach of the organization towards environmental responsibility.

Being a President of one of the reputed Business Schools in Mumbai, I personally feel that due to easy & affordable availability of Metros, the students would save time and travel to their schools or colleges on time without any safety issues. They will stop using their bikes or cars to commute to their educational institute which will also help reduce the traffic on the road.

Waterproof Metro-3

Continued from Page 6

The pipes that transfer both solutions are installed in the tunnel at 6 m length. At the rear of the TBM a 20 m long flexible hose is fitted to allow the machine to move progressively forward. Secondary grouting of the segmental lining is done within 14 days of under taking primary grouting at the location and preferably at a time when tunnel face is at a distance between 30 m. to 100 m. from proposed secondary grouting location. The materials used for secondary grouting are Cement, Water, Bentonite and Stabilizer. The grout socket plug on the particular ring near the crown level is first unscrewed and removed. A hand-held drilling machine is used to drill the concrete behind the grout socket and drill through at least 150 mm behind the outer face of the segment. Drilled diameter is from Ø16 mm and Ø20 mm. The grouting will stop under the following circumstances:

1) Grouting pressure reaches 2.0 bars (not greater than 6.0 bars).

2) Grout returns from any one of the adjacent grout sockets.

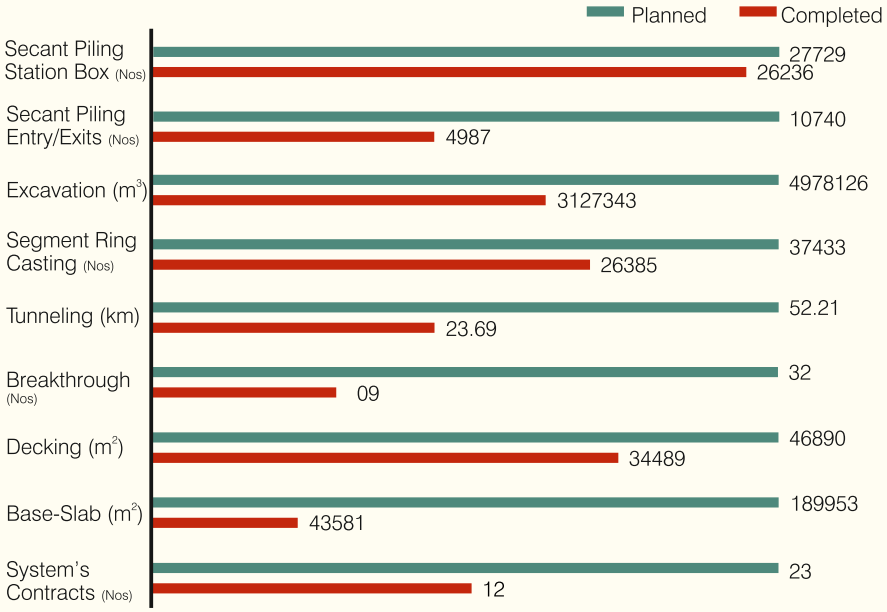
News @ MMRC

Station Area Design Competition - MMRC announces a competition for initiating ideas from students of Architecture, Urban Design, Urban Planning and Engineering to plan the station areas. It will include the last mile connectivity design in the form of skywalks, subways, bus stops, or any other mode of transportation. Observer Research Foundation (ORF) is co-ordinating with MMRC in planning and execution of this compitition. ORF will approach the institutes and coordinate on behalf of MMRC.

Hon. CM of Maharashtra, Mr. Devendra Fadnavis released the brochure of Kalbadevi - Girgaon rehabilitation scheme on 10th March 2019.

A team of MPs from Parliamentary Standing Committee on Urban Development visited the pkg-1, Cuffe Parade site on 1st March 2019. They reviewed the Metro-3 work along with the other mega projects being implemented with central funding.

Project Progress Update
As on 30th March, 2019



Tunnel Progress Update As on 29th March 2019

Package - 01	Package - 02	Package - 03	Package - 04	Package - 05	Package - 06	Package - 07
Cuff Parade to CST Metro Station **1853 m tunneling completed out of 5894 m**	CST Metro to Mumbai Central Metro station **4180 m tunneling completed out of 7640 m**	Mumbai Central to Worli Station **680 m tunneling completed out of 7290 m**	Worli to Dharavi Station **6267 m tunneling completed out of 10960 m**	Dharavi to Agripada (Near Santacruz) **4744 m tunneling completed out of 7992 m**	Agripada to CSIA T2 Station **1899 m tunneling completed out of 6937 m**	CSIA T2 Sariput Nagar Ramp **3417 m tunneling completed out of 7079 m**

Bored Tunnel Launching Shaft

Mumbai Metro Rail Corporation
NaMTTRI Building, Plot No. R-13
'E'- Block, Bandra Kurla Complex,
Bandra (E), Mumbai 400051.

Website Link

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