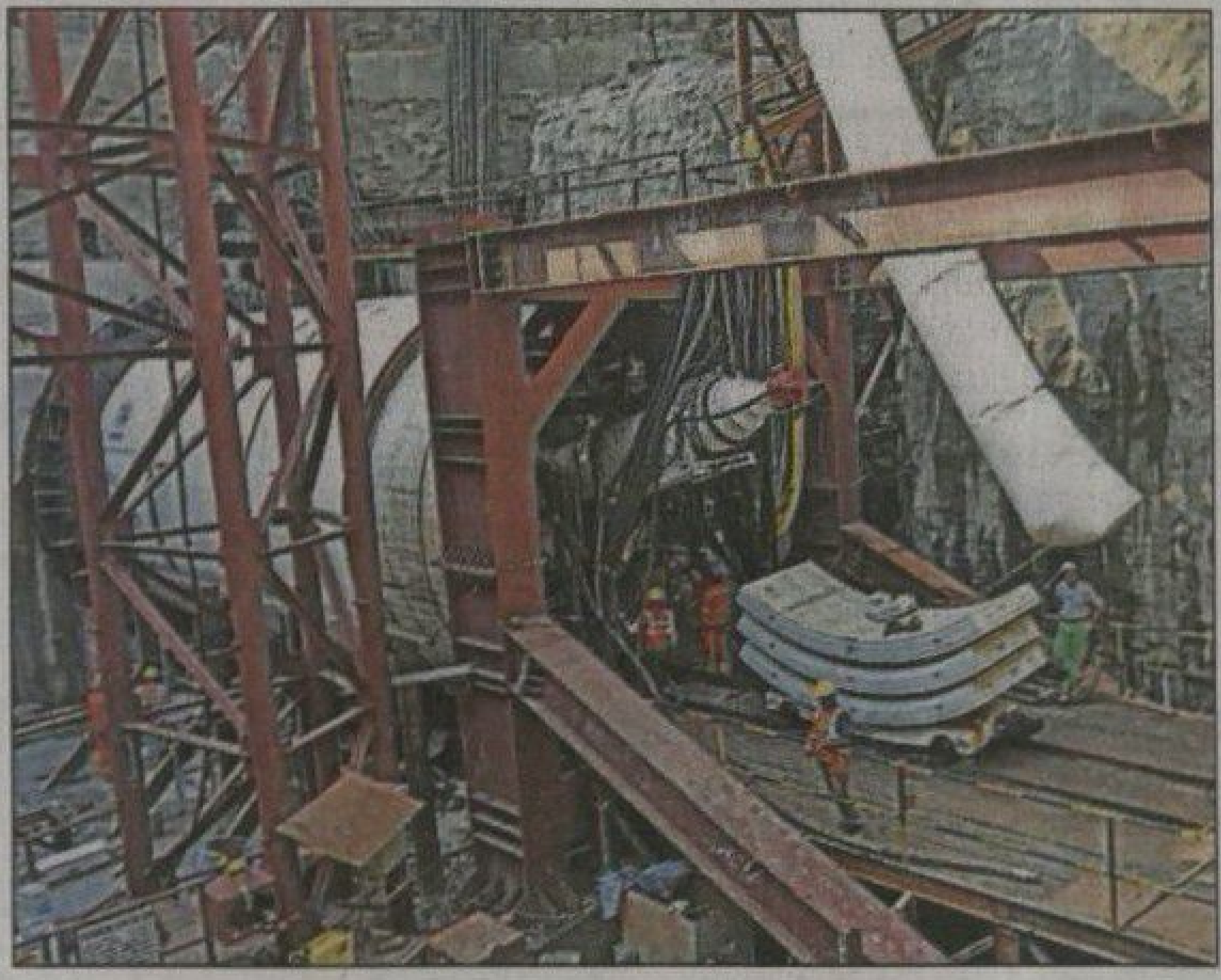
METRO TUNNELING BEGINS



- **MMRCL started digging a tunnel for the 33.5-km Metro 3 line (Colaba-Bandra-Seepz) using a tunnel-boring machine at Mahim on Friday.** SATYABRATA TRIPATHY//HT

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Metro-3 finally gets a tunnel vision

GOING UNDERGROUND Tunnel boring machine, which started work in Mahim, will cover a distance of 2.5km in a year

HT Correspondent
htmetro@hindustantimes.com

MUMBAI: The Mumbai Metro Rail Corporation Limited (MMRCL) has started digging the first tunnel for the 33.5-km underground Metro- 3 line (Colaba- Bandra-Seepz) using a highly mechanised tunnel boring machine (TBM) at Naya Nagar in Mahim on Friday.

Amid protests over how tunneling poses a threat to old and dilapidated buildings, the MMRCL began the gigantic task using a TBM procured from German major Herrenknecht AG's manufacturing facility in China in September.

By Friday afternoon, the TBM had drilled few millimetres into the ground. An MMRCL official said, "The TBM, which is 110 metre long, will on an average drill 10 m every day. Within 7-10 days, the machine would be completely inside the tunnel."

The TBM will drive through Shitaladevi Metro Station and will be retrieved at the proposed Dadar Metro station. The machine is expected to cover a distance of 2.5 km in a year.

The TBM being used at the Naya Nagar launching site is one of the 17 TBMs which will be used to construct the 33.5-km-long twin tunnels. Seven launching sites will be created for the Metro-3 line. The entire tunneling is expected to be done in two years. The second TBM at the Naya Nagar site will begin boring next month.

When asked about the difficulties faced in the project, Ashwini Bhide, managing director, MMRCL, said, "As compared to other cities, Mumbai doesn't have alternate routes and no road can be cordoned off for work. So we have to manage traffic and construction activity."

The Earth Pressure Balance (EPB) device will be used to construct tunnels in circular cross sections some 20m to 25m below the surface.

While the officials said they have monitored the health of vulnerable buildings, the project has seen few controversies. Residents of south Mumbai have expressed apprehensions over it affecting the structural stability of their buildings. Such tunnels are built in several cities across the world including London. "The tunneling will happen 20m to 25m below the ground and most of the shocks would be absorbed by rocks. There are scientific methods to monitor the health of structures," added officials.

DIGGING IN

The Mumbai Metro Rail Corporation Limited (MMRC) began the tunneling work for the underground Metro-3 line (Colaba- Bandra- Seepz) at Naya Nagar site in Mahim on Friday.

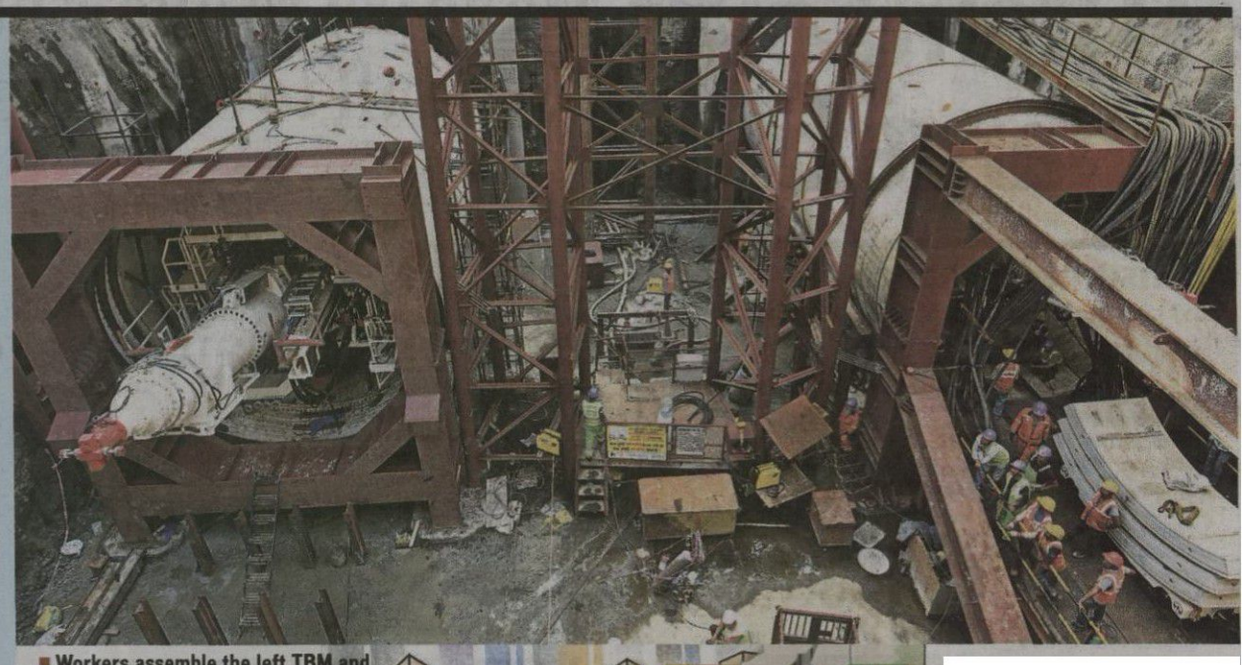
28 metre The depth at which the tunnel boring machine (TBM) has started digging at the Naya Nagar site. The second machine, which is being assembled at the same site, will start tunneling next month.

The operational TBM was transported to the launching site in different pieces in September 2017. It was assembled over a period of 45 days.

10 metre The TBM's average tuinneling speed per day. It will will drive through Shitaladevi Metro Station and will be retrieved at the proposed Dadar Metro station.

2.5 km The total length of the drive and the diameter of the tunnel would be 5.8m. The TBM will take around a year to finish digging the tunnel.

The entire tunneling activity is expected to be done in next two years and the Metro-3 project is scheduled to be over by December 2021, says MMRCL.



■ **Workers assemble the left TBM and begin tunneling work with the right one at Naya Nagar in Mahim on Friday.** SATYABRATA TRIPATHY/HT

IN NUMBERS

17 **Total number of TBMs** to be used in the project

10 **Number of new TBMs** as seven will be refurbished

4 **Number of TBMs that have arrived** in the city; the other 13 are expected to arrive by February 2018

3 **TBMs that have been lowered;** one of them has stated tunneling

51 km **Total tunneling** work to be done for the Metro-3 project

2.8 lakh **Number of tunnel segments** that are to be erected

110m **Average length** of a TBM

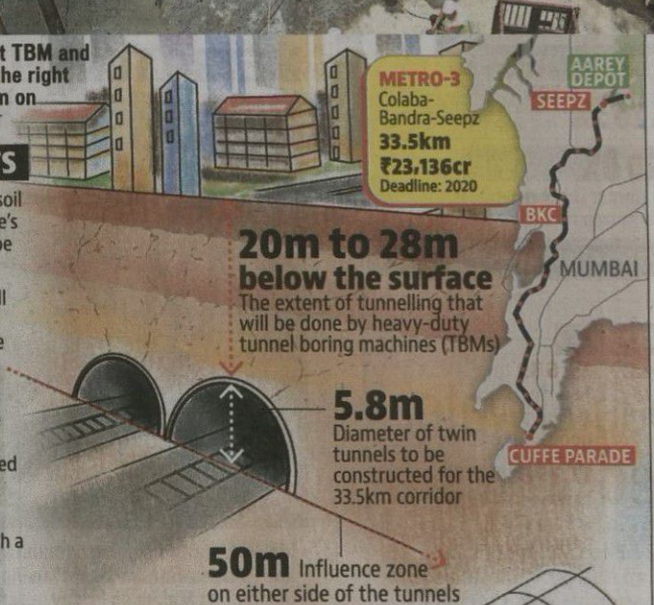
OTHER HIGHLIGHTS

Tonnes of crushed rock and soil will move through the machine's conveyor to muck buckets to be transported out of the tunnel.

The operators of the TBM will spend their shifts, including lunch-hour, in AC cubicle inside the machine from where the cutter head is operated.

To return to the ground, the operators will have to hitch a ride on the wagon—that is used to transport on the narrow gauge track.

The TBM is self-sufficient with a toilet and its own sanitation system.



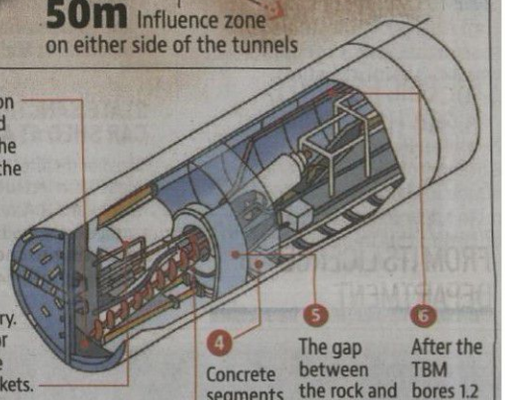
DIMENSIONS OF TBM

The average excavation diameter of a TBM is 6.5 m. Average length of a TBM is 110m.

The TBM types to be used in the project are Earth Pressure Balance (EPB) TBMs, Hard Rock TBMs, Slurry TBMs and Dual Mode TBMs.

The tunnelling process is scheduled to be done in 2 years

The depth of launching shaft at Naya Nagar, Mahim is 25m out of which 16m is in hard rock



1. The front portion of the TBM is called the 'cutter head'. The disc-cutters crush the rocks and soil.
2. Once the rock and soil are crushed, fluid is added to form slurry. The screw conveyor belt then takes the slurry to muck buckets.
3. As the cutters continue to bore into the surface, concrete segments are erected through the 'erector'. Six concrete segments form a ring that prevents cave-ins and it also forms the inner ring on which tracks will be laid.
4. Concrete segments are delivered using a special vacuum lifting device
5. The gap between the rock and concrete segments is filled with grout. This helps keep water out of the tunnel.
6. After the TBM bores 1.2 metres, the same process will be repeated.