Difficult Terrain, Rocky Soil Await Tunnel Boring Machines, But CMRL Confident It Can Meet 2026 Deadline

Hard rocks could slow down tunnelling work of metro rail phase-2

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Construction of the ambitious phase-2 metro rail corridor, which will link several suburban areas to the heart of the city, is likely to pose an engineering challenge as the rail lines would cut across rocky soil conditions.

The rocks also pose a risk of slowing down construction work and causing delays. Tunnelling work for a part of phase-2 is likely to begin by mid-2021.

Engineers have identified three locations with hard rock soil that would be tough to bore through and build tunnels at depths varying from 15m to 30m. Metro rail officials said three locations -- KMC to Chetpet on corridor 3, Nandanam to Panagal Park on corridor 4 and Retteri to Nathamuni on corridor 5, which are part of the underground section -- have rock formations at varying depths. Apart from this, the priority corridor from Madhavaram to CMBT and from Madhavaram to Sholinganallur have hard rock soil like charnockite, black granite and quartz.

"Those stretches will be challenging, but soil conditions can only change the speed of tunnelling to ensure noise and vibration are within limits. Tunnelling method across all soil conditions in the phase would be the same," an official said.

At Nandanam and Kilpauk, there will be intersections of phase 1 and phase-2 stations with twin tunnels of the phases built one below the other.

Between KMC and Chetpet, twin tunnels will be built at a depth of 29m below the existing phase-1 tunnels, which connect Kilpauk metro on Poonamallee High Road. At Nandanam junction, where tunnels were built by cutting through hard rock at a depth of 18m in phase-1, another set of twin tunnels will be built at a depth of 30m. On this stretch, tunnels will be 20m deep at Adyar Gate junction station on Chamiers Road, with the depth increasing as the tunnels reach Nandanam signal. The depth will reduce to 20m under Venkatanarayana Road and 15m near Panagal Park station.

Not all locations with hard rock, however, are going to be this tough. "There's a combination of loose soil on top and hard rock at shallow depths of 10m along OMR, but it won't be that tough as we are going to build an elevated corridor that will be held by a row of friction piles supported by the rock below, to bear all the load," an official said.

CMRL has mapped soil conditions for every 25m along the 119km stretch instead of 50 to 100m they did in phase 1 to ensure a stretch with tough soil doesn't go unnoticed and end up surprising contractors when construction is underway. "We are also giving the option to contractors to do their own soil investigation, as they can plan their work and machinery accordingly," a metro rail official said.

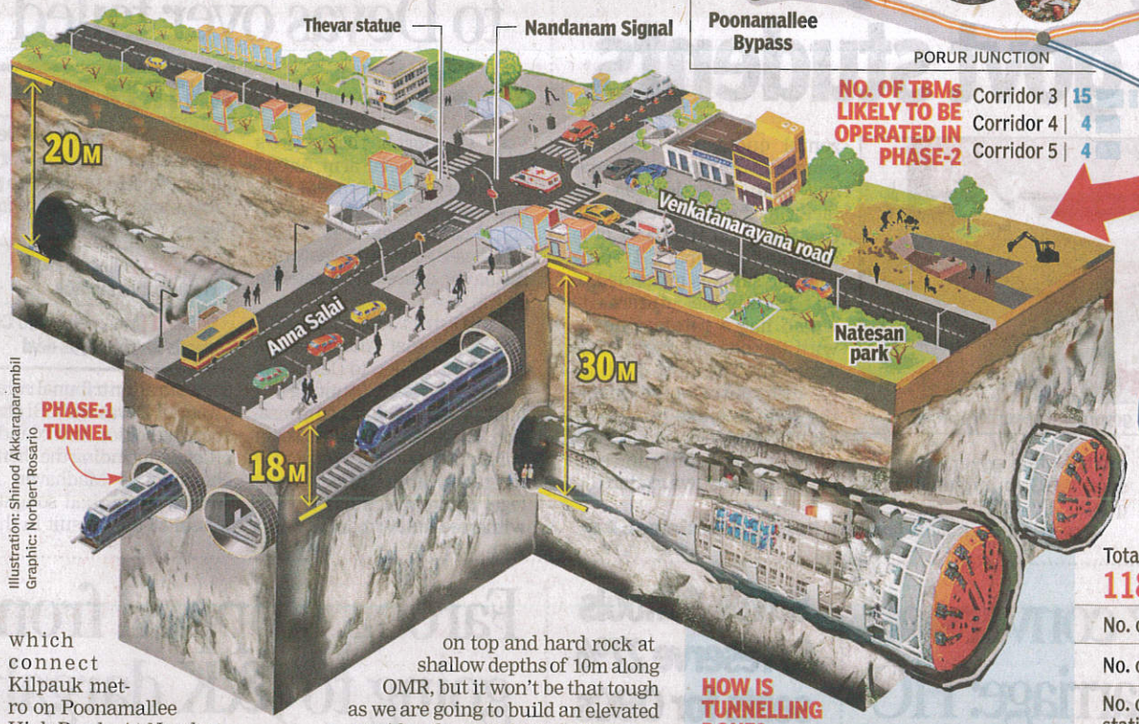

Illustration: Shinod Akkaraparambil
Graphic: Norbert Rosario

TOUGHEST AND DEEPEST STRETCHES IN PHASE-2

Corridor 3 — Corridor 4 — Corridor 5
Soil condition is rocky

Hard black rock soil like charnockite, black granite & a mix of quartz were identified in corridors 3, 4 & 5 at varying depths

NO. OF TBMs LIKELY TO BE OPERATED IN PHASE-2
Corridor 3 | 15
Corridor 4 | 4
Corridor 5 | 4

Phase-1 tunnels: Avg depth **was 18m**

Phase-2 tunnels: Avg depth varies from **15m to 30m**

In some of the locations along the rest of phase-2 corridors such as **OMR**, loose soil is found on top and rock at shallow depths of **10m**

Cost of construction of one km of underground line: **more than ₹650cr**

CORRIDOR 3
- Between **KMC & Chetpet** (Around 830m distance)
- **Soil condition is rocky** and **tunnels will be deeper at 24m to 29m below phase-1 tunnels** on Poonamallee High Road crossing Kilpauk station

CORRIDOR 4
- Between **Nandanam to Panagal Park** (Around 1.3km)
- One station in between. **Soil condition is rocky and tunnels will be deeper at 24m to 30m below phase-1 tunnels** on Anna Salai between Nandanam and Saidapet

CORRIDOR 5
- Between **Retteri & Nathamuni** (Around 5km)
- Six stations in between, **soil condition is rocky. Tunnels will be at 15m -21m depth**

HOW IS TUNNELLING DONE?

- Tunnel boring machines use **'earth pressure balance' technology**
- The cutters in the **cutter head on the front of the machine rotates and drills through the soil**, applying force and pressure
- Before boring, the **machine injects foam to soften the earth**
- It then holds up **a few feet of earth in front of its face by applying pressure before the machine bores** further and moves forward

Work to begin first for 52km priority corridor from **Madhavaram to Sholinganallur** on corridor 3 and **Madhavaram to CMBT** on corridor 5

Tenders floated for Power House to Porur Junction (7.9km), **Venugopal Nagar to Kelly's** (9km),

Total distance **118.9km**

No. of corridors	3
No. of stations	128
No. of underground stations	48
Distance of underground stretch	42.6km
Estimated cost	₹69,000cr

Corridor 3 | Madhavaram to SIPCOT (45.8km) (UG | 26.7km- 30 stations) (Elevated | 19.1km – 20 stations)

Corridor 4 | Lighthouse to Poonamallee (26.1km) (UG | 10.1km- 12 stations) (Elevated | 16km – 18 stations)

Corridor 5 | Madhavaram to Sholinganallur (47.0km) (UG | 5.8km- 6 stations) (Elevated | 41.2km – 42 stations)

Estimated year for construction | Estimated year for construction

PLANS FOR FASTER CONSTRUCTION OF UNDERGROUND SECTION IN PHASE-2

- Tunnel boring machines (TBM) will be **launched in one station and retrieved in the next.** It will be refurbished and launched again
- **Small stretches** for tunnelling will be **awarded to firms**
- **Construction companies can do their own soil tests** to decide how **at an average 8m a day. Depending on the soil** condition, it could be **slowed down to 6m or increased to 11m**