

Safety Measures undertaken for ensuring smooth construction activity

Construction Works: Civil construction activity for Mumbai Metro Line III can be broadly divided into station works and tunnelling

1. **Station Works:** Stations for Metro Line III are being constructed using Cut & Cover and New Austrian Tunnelling Method (NATM) construction technique. In both the techniques deep excavation up-to the base level which is 25-30 metre below the ground level will have conducted in cut and cover portions. For supporting this deep excavation Secant Piling is being carried out at all station sites using high capacity piling machine to create safe support system by embedding these piles into rock. Piling activity may create some vibrations in areas close to the construction sites. Vibrations level caused during piling work are being regularly measured by scientific instruments and recorded. These records show the vibration levels to be even less than 1/4th of the permissible safe vibrations limits that are allowed for heritage or weak buildings. The secant pile activity is likely to be completed in all stations in period of next 3-4 months.

In some areas excavation work has also started.

2. **Tunnelling:** Tunnelling activity for Metro Line III will be primarily conducted using 17 Tunnel Boring Machines (TBM). The machines will carry out boring 25-30 meters below the ground level and is always in rocky strata in the entire corridor.

Safety Guidelines: As a stringent protocol safety of all the building within the influence zone of construction activity (Stations and Tunnels) is being ensured by strictly following a step by step procedure:

1. Specialized expert agencies of our contractors conduct detailed Building Condition Survey (BCS) encapsulating their current condition, existing cracks & other defects/weaknesses of building in the influence zone before initiating the construction work
2. On the basis of the BCS the designers of the contractor evaluate the strength of these buildings for assigning allowable impact limit categories
3. Station designs & methods for tunnelling are finalized keeping in mind the impact limits of existing adjacent building categories
4. Appropriate monitoring instruments are installed for ensuring the safety in the due course of construction activity
5. Trigger levels are defined for respective adjacent buildings
6. Regular monitoring during construction so that at no stage the defined limits are breached
7. In case, the defined action limits are reached, the work is stopped & revised design and mitigation measures are undertaken before proceeding further

Monitoring Instruments: Best International instrument and monitoring process are followed for ensuring safety. Some of the Instruments that would be used are Building Settlement Marker, Soil Settlement Marker, Pavement Settlement Marker, Crack Meter, Inclinator, Rod Extensometer, Piezometers, Vibrating Wire, Tiltmeter, Vibration & Noise Monitor/ Seismograph, Total Stations & Targets, Load Cell & Strain Gauge, Shotcrete Creep Test Equipment, Water Stand Pipe etc. Frequency of measurement would depend on the nature of the work. For heritage and weak buildings 24X7 Online monitoring will also be undertaken when considered necessary.