

India



Name: Tunnelling Association of India

English name: Tunnelling Association of India

Type of structure: President, Vice President – 2 Nos., Secretary General, Treasurer and Executive Council Members.

Number of members: 300

2016 MAIN ACTIVITIES

Organization of: Conference, Seminar, Workshop, Training Programmes; Publication and Half yearly journal, TAI Awards.

Conference:

- TUNNELLING ASIA' 2017 – Tunnel Design, Construction and Risk Management: Issues & Challenges, 9-10th February 2017

Workshops:

- Innovation in Tunnelling Technology, 10th Feb. and 18th December 2016
- Workshop on Best Practices for Safe Cross Passage Investigation, Design and Construction 8-9th September 2016
- Tunnel Design and Construction - Issues and Challenges" 7-8th Feb. 2017

Training:

- Training Programme for NHPC officers on Health & Safety in Tunnel and Underground Construction, Risk Management in Tunnelling, Ventilation in Long Tunnels

Publications: Best Practices in construction of cross passage in Underground Construction

TAI awards: 6 Nos. TAI awards distributed during the Tunnelling Asia 2017

TAI journal – 2 Nos. (Half yearly)

- Tunnel development in India has accelerated in the past few years. This is driven by increased investment in the hydropower, railway, road and highway, metro rail, and water and sewerage sectors. Around 2,700km of tunnel length is either under construction or is planned to be taken up in the future.
- Several landmark and challenging projects are under implementation, the size and complexity of which have increased over the years. These include the 9km Chenani-Nashri tunnel on the Jammu-Srinagar national highway, the 8.8km Rohtang tunnel on the Leh-Manali highway, and the 11.55km rail tunnel on the Jiribam- Tupul-Imphal rail line.
- New designs, technologies and construction techniques for tunnelling are thus becoming a growing area of interest for the industry
- Advanced mechanised techniques such as the use of tunnel boring machines (TBMs) and the New Austrian Tunnelling Method (NATM) are gaining prominence. A variety of new trenchless

technologies such as micro-tunnelling and horizontal directional drilling are being deployed to undertake tunnelling in congested areas. The standards of tunnel design and engineering are continuously improving. New types of materials are also being used to improve the durability and strength of tunnels.

- Going forward, the outlook for the tunnel development market is promising and will be largely driven by the central government's focus on infrastructure development. One of the major growth drivers for tunnel construction will be the urban rail segment. About 2,050km of metro rail network is expected to be added in the next six to eight years. Heavy investments are planned for the construction of all-weather roads and new tunnels in strategic and sensitive areas. The railway capex target for 2017-18 is at an all-time high of Rs 1.3 trillion. Hydropower capacity is expected to increase by 13GW in the next five to six years.
- Going forward, the outlook for the tunnel development market is promising and will be largely driven by the central government's focus on infrastructure development. One of the major growth drivers for tunnel construction will be the urban rail segment. About 2,050km of metro rail network is expected to be added in the next six to eight years. Heavy investments are planned for the construction of all-weather roads and new tunnels in strategic and sensitive areas. The railway capex target for 2017-18 is at an all-time high of Rs 1.3 trillion. Hydropower capacity is expected to increase by 13GW in the next five to six years.
- The tunnelling segment is thus expected to offer significant business opportunities for contractors, technology providers, and equipment and material suppliers. However, there are many factors that can slow down implementation and execution. These include geological complexities, inadequate investigations, deficiencies in contract documents, complexities of the Himalayan region and the Western Ghats, safety risks, etc

TAI Journal - Half yearly

TAI Publication:

- Best Practices in Underground Construction
- Manual on Rock Mechanics

Proceedings of the Workshops

- Best Practices for Safe Cross Passage – Investigation, Design and Construction
- Tunnel Design and Construction: Issues & Challenges
- Risk Management in Tunnelling
- Ventilation in Long Tunnels

Proceedings of Tunnelling Asia Conference

TUNNELS – UNDERGROUND WORKS

North East Frontier Railway

- As per Vision 2020 of Indian Railways, North East Frontier Railway (Construction) is executing a number of new line projects to connect the capitals of the North Eastern states. Apart from projects for connecting state capital, several projects such as gauge conversion and doubling have been undertaken to improve the connectivity and mobility in this area. Since alignment of these connectivity projects mostly pass through difficult terrain having deep gorges and high hills, construction of these railway lines involve construction of a large number of tunnels.
- The north-east region is geologically one of the most complex formations. The major rock formation consists of sand; silty clay and shale with limestone. The formation in this part is mostly immature and there are several thrust and faults.
- Out of 188.6km tunnelling identified in various sanctioned projects, 12.6km tunnels have since been commissioned for train operation and another 42km tunnelling has been completed where track linking is planned shortly.

Jiribam-Tupul – Imphal New Line Project (110.62km): Out of total 59.5km tunnelling involved, 42km of tunnelling has been completed. Construction is in full swing to complete the balance of 17.05km. The longest tunnel is between Tupul - Imphal, which is 11.55km.

Bhairabi – Sairang New Line Project (52.35km) in Mizoram: There are 23 tunnels with total length of 9.26km. The longest tunnel is 1.76km. Out of above, underground excavation and primary support in 5.20km has since been completed and final lining is in progress.

Dimapur – Kohima New Line Project (88km): About 30km of tunnelling is involved in this project.

Barnihat – Shillong New Line Project (108km): There are 31 tunnels with total length of 39.06km. The longest tunnel is 4.11km. Sevok-Rangpo New Line Project: About 38.55km of tunnelling is involved in this project.

Salonia – Khumtai New Line Project: (99.00 km): About 17.65 km of tunneling is involved in this project.

Delhi Metro Phase- III project

- For the first time on Delhi Metro, two of the tunnel drives have been completed by dragging the TBMs through a station. Naraina station box was completed with a temporary base slab on which both the TBMs were dragged through the station for completing a small length of tunnel on the other side of the station.
- Two stage grouting after erection of the lining segments has been used for minimizing the ground settlement. Total quantity of earth excavation by TBMs is approximately 21 lakhs cubic meter. This earth is being used to fill low lying areas of various government departments in Delhi. Proper arrangements for fresh air for workers has always been made using tunnel ventilation systems. Only controlled access to tunnels during tunnelling has been allowed so that only the authorized persons can go inside.
- Total 45 Earth Pressure Balancing Tunnel Boring Machines (TBMs) have been deployed by the contractors. 26 TBMs had been working simultaneously at the peak period. 20 TBMs are still working. Cranes up to 800 metric ton capacity were used for lowering the Tunnel Boring Machines. Some contractors used 125 metric ton capacity gantry cranes for lowering of the TBMs

Geology: The geology of Delhi can broadly be divided into two types of ground.

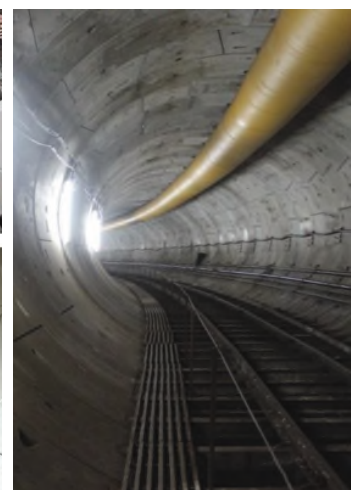
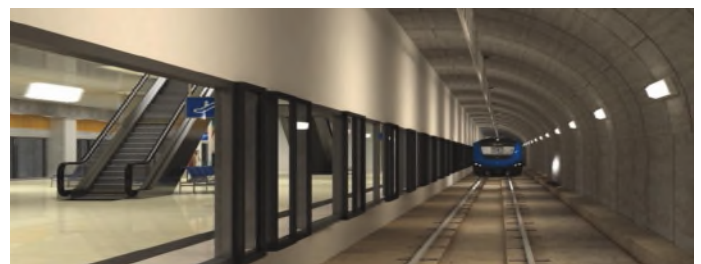
- Firstly, the zone in the vicinity of the River Yamuna basin comprises

alluvium, made up of fine to medium sands, silts, clay and gravel plus kankar. This geology is normally described as 'Delhi Silt', which is cohesive in nature and is an ideal medium for bored tunnelling.

- Secondly, there is the Precambrian formation comprising quartzite rock inter bedded with mica schist, varying from intact to highly weathered in nature and often in the form of loose boulders. This geology is a very abrasive tough rock which presents extreme challenges for tunnelling. It is often found in combination with loose boulders, which further makes the tunnelling difficult and extremely slow

Water Table: The water level varies from 2m below ground level in the Yamuna floodplain to 30m below in the areas on the west and south of Delhi.

- There are total 74 tunnel drives out of which 57 drives have been completed and remaining 17 are in progress. Thus, overall present progress of tunneling is 91%. The internal finished dia. of all the tunnels is 5.7 to 5.8m.
- Precast segmental lining has been used. Each ring comprises of 6 segments including one key segment. Length of ring varies from 1200mm to 1500mm. The precast tunnel lining segments are with M-50 concrete with use of mero silica. These have been cast in 13 state of the art segment casting yards developed by different contractors with steam curing facilities to reduce the de-molding time and increase the production capacity.
- Total 53725 no. of lining rings have been used in Phase-III.
- Underground lines in Phase-III have crossed below the existing operational underground metro line at two locations (Yellow line at Hauz Khas and INA) and crossed below the operational elevated metro lines at 8 locations (Kashmere Gate, Pragati Maidan, Azadpur, Netaji Subhash Place, Lajpat Nagar, ramp of Airport Line, Kalkaji and Janakpuri West). Tunnel drives have crossed operating Indian Railway Tracks at 4 locations.
- All such crossings involved very meticulous planning and execution to avoid excessive settlements and damage to the operating lines.
- Tunnel drives below old buildings have been completed with minimum effect on a structures.
- Tunneling in line No. 6 has been successfully completed through an area with many heritage buildings.



COMPLETED TUNNEL SEGMENT ERECTION TUNNEL & UNDERGROUND WORKS

Chennai Metro Rail Project Phase I of the Metro consist of two corridors approximately 45km in length, comprise 32 stations of which 19 are underground and 13 are elevated. The route within the main city area is proposed to be underground with twin tunnels connecting the underground stations whilst the southern section will be constructed on viaducts between the elevated stations. Generally the underground stations have two levels with a concourse above platform level and the tunnels are at about 12m to 16m below ground level. Twin tunnels are bored using state of the art Tunnel Boring Machines. There will be a total of 37km of tunnels, of which 36km (single tunnel length) will be bored using Earth Pressure Balance Tunnel Boring Machines (TBMs) and 1km will be constructed by cut and cover. **As part of Phase II, CMRL will be developing an underground network of 80.5km as part of Corridor 3, 4 and 5.**



Dragging of TBM across government estate station box in progress

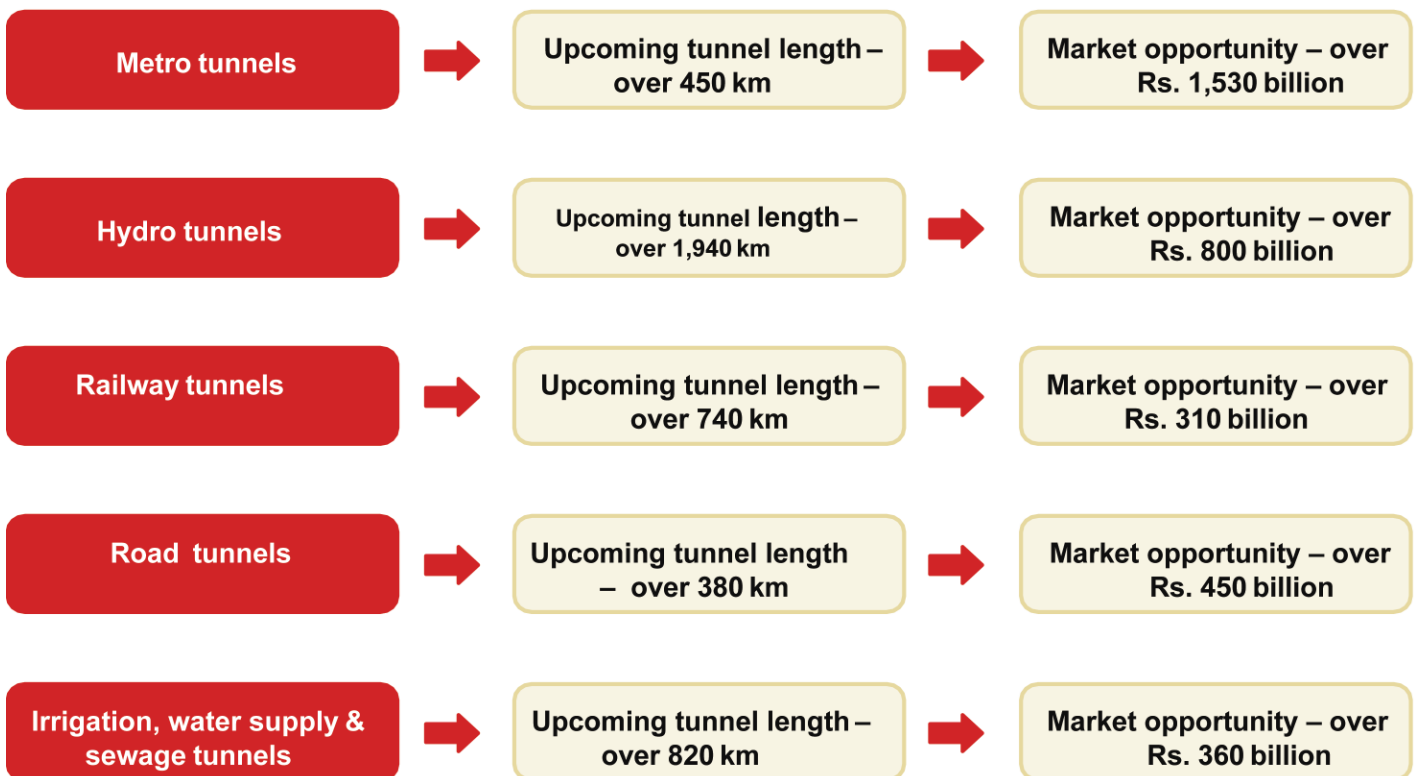
- Plans for metro network in Mumbai are dynamic and will have the following corridors:
1. Versova-Andheri-Ghatkopar (11km)
 2. Charkop-Bandra-Mankhurd (33km)
 3. **Colaba-Bandra-SEEPZ (33.5km) under construction**
 4. Charkop - Dahisar (8km)
 5. Wadala-Ghatkopar-Teenhath naka (21km)
 6. SEEPZ-Kanjur Marg (7km)
 7. Andheri(E) - Dahisar(E) (18.0 km)
 8. Andheri - Ghatkopar – Mankhurd (16.5km)
 9. Sewri – Prabhadevi (5.0km)
- Total: 153km**



HIGHWAY TUNNELS

- Zojila Road Tunnel in J&K to Leh: Length of Tunnel is 14.1Km**
Single tube road tunnel with two traffic lanes in bi-directional traffic and parallel egress tunnel (14.2km) Maximum overburden: approx. 660m; Civil Construction Cost: Rs 5486 Crore without approaches & Const. period is 7 years
- Pir-Ki-Gali Tunnel in J&K, NH-244:** Main tunnel length: approx. 8.508km and Egress tunnel length: approx. 8.508km; Maximum overburden: approx. 660m; Civil Construction Cost: Rs 4185 Crore; and Construction Period: 79 months
- Vailoo Tunnel in J&K :** Length : 8.5km Approximate and Cost: 3500 Crore
- Daranga Tunnel in J&K on NH - 244:** 4.5km long.
- Kiratpur-Neharchowk:** 5km
- Pandoh:** 10km
- Shimla By-Pass:** 6km

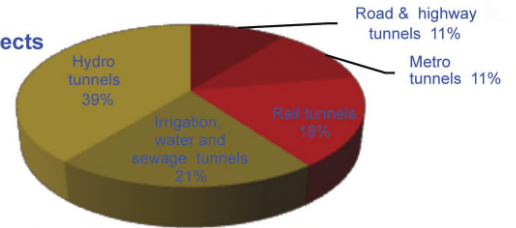
TUNNELLING BUSINESS IN DIFFERENT SECTOR



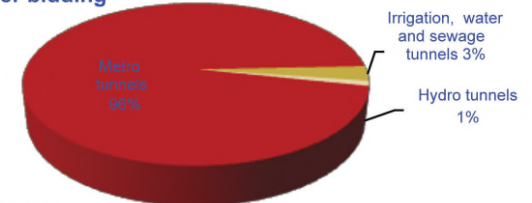
PROJECT PIPELINE

- According to *Tunnelling Association of India*, the overall project pipeline for the sector includes 1,287 tunnels spanning over 4,360 km.
- The hydropower sector has the largest number of tunnels and the longest tunnel length at 882 tunnels spanning 1,948 km. However, the sector also has the largest number of stalled projects.
- The metro rail sector will offer immediate opportunities for 65 km of tunnel length. The sector has a strong pipeline with a tunnel length of over 457 km.
- The railway sector has a pipeline of 275 tunnels spanning 746.0 km.
- The IWSS sector project pipeline has 43 tunnels spanning 822 km. A few tunnels will have diameters of less than 3.0 m.
- The pipeline for the roads and highways sector includes 87 tunnels covering 387 km.

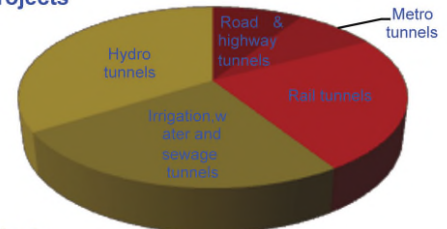
Planned projects



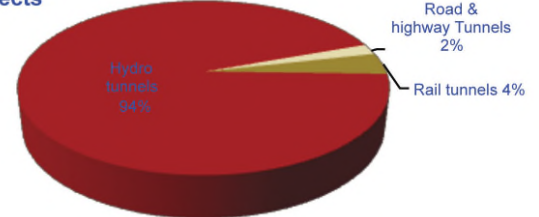
Projects under bidding



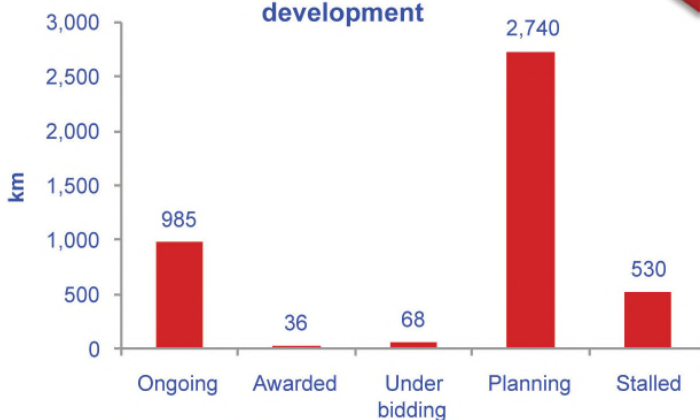
Ongoing projects



Stalled projects



Project pipeline by stage of development



FUTURE ACTIVITIES

Conférences:

- Tunnelling in Himalayan Geology: Issues and Challenges
- Conclave on Tunnelling in Infrastructure development: Issues and Challenges at Chennai

Workshop:

- Conventional and Mechanized Tunnelling
- Health and Safety
- Risk management in tunnelling
- Software application in tunnelling

Training Programme for Young engineers

- Tunnel Design and Construction

Publication:

- Guidelines: Fibre reinforcement for precast concrete segments for tunnel linings

TAI Journal:

- Half Yearly

2017

Sixth Annual Cutting Edge Conference

Advances in Tunneling Technology

November 13–15, 2017 | Seattle, WA

Seattle Renaissance Hotel

The Sixth Annual Cutting Edge Conference will convene in the Emerald City to look at the latest advances in tunneling technology and methodology and how they can be harnessed to assist the nation's major upcoming underground projects. Featuring a tailored high-end single-track program of subject-specific presentations that focus on innovation and practical experience, the two-day conference will continue the Cutting Edge tradition of in-depth technical discussion with extended question and answer time ... PLUS, don't miss the SR 99 Tunnel Project (Alaskan Way Viaduct Replacement Project) site visit! For more information visit:

www.ucsofsmecuttingedge.com