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Government of India

India's Tunnels: Engineering Marvels Beneath the Surface

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Key Takeaways

- With landmark projects like the **Atal Tunnel**, India is rapidly expanding its tunnel infrastructure.
- Record-breaking rail links led by the 12.77-km **Tunnel T50** are reshaping India's freight and connectivity network.
- Upcoming **mega-tunnels** like **Zojila** will provide all-weather access to Ladakh, boosting mobility, defence reach, and regional growth.

Carving Connectivity: The Story of India's Tunnels

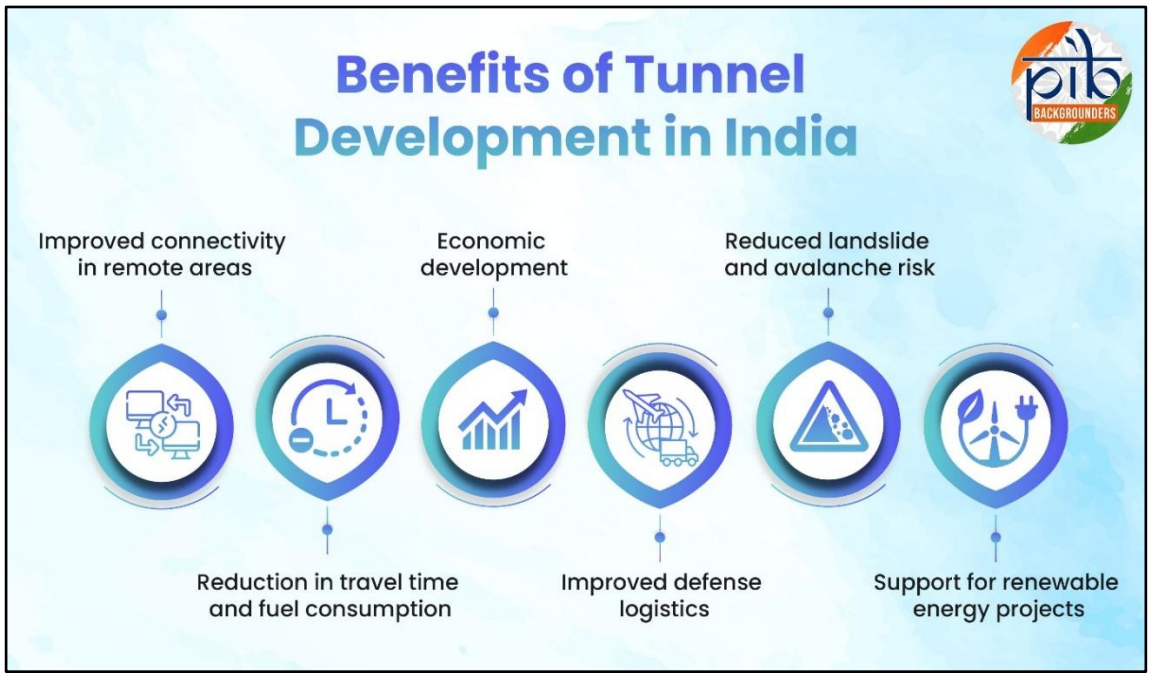
Tunnels in India represent more than infrastructure development; they reflect the nation's determination to overcome geographical challenges. By cutting through mountains and terrain that once limited connectivity, tunnels have enabled year-round transportation. They have also improved access to remote regions and strengthened links between communities. From strategic Himalayan tunnels to urban metro networks, these projects are transforming how India moves people, goods, and resources. Built using modern engineering and innovative planning, tunnels play a vital role in economic growth, national security, and regional development. They are shaping a more connected and resilient country.

India's tunnelling boom is being propelled by national highway expansion, alongside strategic border infrastructure, metro rail growth, bullet-train corridors, and all-weather connectivity initiatives in

remote regions. As infrastructure scales up, tunnelling has become one of the fastest-growing construction domains.

Why Tunnel Infrastructure Matters More Than Ever

Tunnels are rapidly reshaping India's developmental map, offering smarter, safer, and more sustainable alternatives to traditional transport routes. Their impact goes far beyond engineering. They catalyse regional development, enhance strategic preparedness, and improve the daily lives of millions.



India's Evolving Tunnel Technology

Over the past decade, India's tunnelling capability has transformed. It has progressed from traditional drill-and-blast methods to sophisticated technologies. This enables faster, safer, and more complex underground construction. Modern projects now rely on **advanced geological mapping** and **real-time monitoring systems**, allowing the engineers to construct longer and deeper tunnels even in harsh conditions.

Contemporary Indian tunnels are designed as high-tech, safety-integrated corridors equipped with engineered ventilation systems, emergency escape routes, fire-suppression units, LED lighting, CCTV surveillance, and centralised tunnel control rooms. This modernisation has significantly improved both operational reliability and disaster readiness.

Key Technologies Driving India's Tunnel Revolution

- **Tunnel Boring Machines (TBMs)**
  Used extensively in metro networks and long rail/road tunnels, TBMs provide high precision, reduced vibration, and enhanced safety in densely populated and geologically complex regions.

- **New Austrian Tunnelling Method (NATM)**
  Widely adopted in the Himalayas, NATM allows engineers to adapt excavation support in real time, making it ideal for variable and fragile rock formations.

- **Integrated Tunnel Control Systems (ITCS)**
  Critical for modern road tunnels, ITCS combines ventilation control, fire detection, communication networks, CCTV, and emergency management into a centralised digital platform, ensuring 24/7 safety.

India's Landmark Tunnels: Defining Modern Infrastructure

India's expanding infrastructure has given rise to a series of remarkable tunnels that redefine how people and goods move across the country. Each tunnel stands as a testament to innovation and problem-solving on a grand scale.

Atal Tunnel

Tucked beneath the snow-laden peaks of the Pir Panjal ranges, the Atal Tunnel stretches **9.02 km**, providing a high-altitude passage that bypasses Rohtang Pass. Its completion has transformed connectivity, enabling seamless, year-round travel between Manali and the remote valleys of Lahaul-Spiti. The tunnel's strategic significance also lies in ensuring safe, reliable access for civilians and defence movement alike under challenging mountain conditions. It is officially recognised as the **World's Longest Highway Tunnel above 10,000 feet** in 2022 by the World Book of Records UK. The tunnel has cut the Manali–Sarchu distance by 46 km and reduced travel time by **four to five hours**. Built in harsh Himalayan conditions where winter temperatures dropped to **-25°C** and the tunnel interior sometimes reached **45°C**, its construction demanded exceptional resilience. Engineers faced fragile geology, Seri Nala seepage that once flooded the tunnel, heavy overburden, and intense snowfall, all of which were successfully overcome by the Border Roads Organisation's (BRO) dedicated Karmyogis.

Z-Morh/Sonamarg Tunnel

The **Sonamarg Tunnel**, a 12-km engineering feat carved through mountains at an altitude of over **8,650** feet above sea level, is set to transform travel in Jammu & Kashmir. It is built at a cost of **₹2,700 crore**. It includes a 6.4-km main tunnel, an egress tunnel, and modern approach roads creating an **all-weather lifeline** between Srinagar and the golden meadows of Sonamarg, and further towards Ladakh. No longer will avalanches, landslides, or heavy snowfall cut the region off. The tunnel keeps the route open improving access to major hospitals and ensuring the availability of essential supplies. Constructed using the **New Austrian Tunnelling Method (NATM)** for challenging Himalayan geology, the tunnel is a major technological milestone. It features an Integrated Tunnel Management System (ITMS) with advanced systems such as Public Address System, Electrical Fire Signalling System, Radio Re-Broadcast System (FM), Dynamic Road Information Panel (DRIP), etc. It is designed to handle about 1,000 vehicles per hour. Once paired with the upcoming **Zojila Tunnel (2028)**, the journey will shrink from **49 km to 43 km**, with speeds rising from **30 km/hr to 70 km/hr**, boosting defense logistics, winter tourism, adventure sports, and the livelihoods of the people who call these mountains home.

Sela Tunnel

The Sela Tunnel, dedicated to the nation during the Viksit Bharat Viksit North East programme in Itanagar, Arunachal Pradesh, is built by the BRO at **13,000 feet** on the Tezpur-Tawang route. The tunnel is constructed at a cost of **Rs 825 crore**. It ensures all-weather connectivity and holds immense strategic value for the Armed Forces while boosting socio-economic growth in the border region. Built using the **New Austrian Tunneling Method (NATM)**, it stands as a powerful reminder of how perseverance and regional commitment can reshape the future of remote mountain communities.

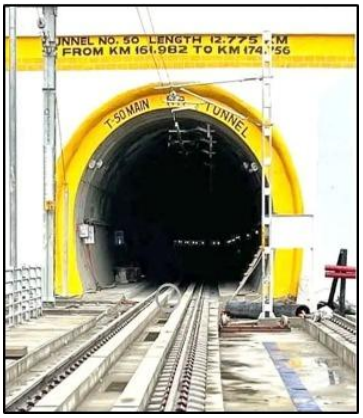
Banihal–Qazigund Road Tunnel

The Banihal–Qazigund Road Tunnel, constructed at a cost of over **₹3,100 crore**, is an **8.45-km-long twin-tube tunnel** designed to significantly improve connectivity between Jammu and Kashmir. The tunnel has reduced the road distance between Banihal and Qazigund by **16 km** and has cut travel time by approximately **one and a half hours**. Built with two separate tubes, one for each direction of traffic, the tunnel is interconnected by cross passages at every **500 metres** to facilitate maintenance and emergency evacuation. It has established an all-weather road link, thereby strengthening accessibility and bringing the two regions closer.

Dr Syama Prasad Mookerjee Tunnel

Dr Syama Prasad Mookerjee Tunnel, formerly known as the Chenani–Nashri Tunnel in Jammu & Kashmir is a **9-km-long**, twin-tube, all-weather road tunnel connecting Udhampur and Ramban. Built at an elevation of about **1,200 metres** in difficult Himalayan terrain, it has reduced travel time between Jammu and Srinagar by nearly two hours while bypassing **41 km of road length**. The tunnel features advanced ventilation, safety, and intelligent traffic systems operated through a fully integrated control mechanism with minimal human intervention, along with enhanced security measures. Developed in line with the **Make in India** and **Skill India** initiatives, the skill sets of local people were improved, and they were engaged for construction of this tunnel. The project generated employment for over **2,000 local workers**, with nearly 94 percent of the workforce drawn from Jammu and Kashmir.

Tunnel T50 under USBRL Project



Tunnel T50, a **12.77-km** engineering feat connecting Khari and Sumber in Jammu & Kashmir, stands as one of **India's longest transportation tunnel constructed under the Udhampur–Srinagar–Baramulla Rail Link (USBRL)** project, forming a crucial rail lifeline between the Kashmir Valley and the rest of the country. Constructed using the **New Austrian Tunnelling Method**, it cuts through challenging geology ranging from quartzite and gneiss to phyllite, with engineers overcoming high-water ingress, landslides, shear zones, and jointed volcanic rock. The tunnel features a main tube paired with a parallel escape tunnel, linked every 375 metres for

safety. Enhanced with CCTV cameras placed every 50 metres and monitored from a central control room, T50 is designed for secure, seamless rail operations.

Kolkata's Underwater Metro Tunnel

In 2024, India marked a historic breakthrough with the launch of its **first underwater metro tunnel in Kolkata**, linking Esplanade and Howrah Maidan beneath the Hooghly River. This engineering feat not only showcases the nation's rising technological and infrastructural capabilities but also redefines urban mobility for one of India's busiest metropolitan regions.

India's Next Wave of Tunnel Projects

A new generation of tunnels is preparing to take shape. These forthcoming projects promise to redefine how the nation moves and connects. The following upcoming projects highlight the scale of progress underway.

Zojila Tunnel

The Zojila Tunnel is emerging as a monumental achievement in India's infrastructure landscape, cutting through some of the most formidable Himalayan rock formations to establish a dependable, all-weather link between Ladakh and the rest of the country. With nearly **12 kilometers already completed**, the project integrates advanced safety measures and a semi-transverse ventilation system designed to maintain steady airflow deep within the mountains. The project incorporates a Smart Tunnel (SCADA) system constructed using the **New Austrian Tunneling Method**. It is equipped with facilities such as CCTV surveillance, radio control, uninterrupted power supply, and ventilation systems. The adoption of modern technology in this project has resulted in **savings of over ₹5,000 crore** for the government. Once completed, this ambitious undertaking will become **India's longest road tunnel and Asia's longest bi-directional tunnel**, reinforcing its national significance. Rising at an altitude of **11,578 feet** and unfolding across over **30 kilometers**, the project is on track for a **2028 completion**. As a critical component of the Srinagar Kargil–Leh National Highway, it promises to enhance both civilian and military mobility across the region.

Mumbai-Ahmedabad High-Speed Rail Tunnel

India's Mumbai–Ahmedabad High-Speed Rail corridor has marked a futuristic leap with the breakthrough on its **4.8-km undersea tunnel section**. It is a defining feature of the nation's first bullet-train route. Excavated simultaneously from the Ghansoli and Shilphata ends, the tunnel posed extraordinary challenges. The teams advanced through difficult underwater terrain before meeting with precision, an achievement hailed as a landmark in India's engineering history. The project utilizes the advanced **New Austrian Tunnelling Method (NATM)**, supported by comprehensive safety measures. Designed using **single-tube technology capable of housing two high-speed trains**, this tunnel stands at the forefront of cutting-edge rail construction and reflects the innovation driving India's next-generation transport infrastructure.

Rishikesh-Karnaprayag New Rail Line Project Tunnels

The **Rishikesh–Karnaprayag rail line** in Uttarakhand is a landmark tunnelling project in the Indian Himalayas. Spanning about **125 km**, the alignment passes through some of the most geologically complex and environmentally sensitive Himalayan terrain. This has resulted in the project being predominantly tunnel-based. It comprises **16 main line tunnels** with a cumulative length of approximately **105 km** and **12 parallel escape tunnels** totaling about **98 km**. Overall, **199 km** of tunnelling has been completed against a total scope of **213 km**. A major technological milestone of the project is the deployment of a **Tunnel Boring Machine (TBM)** in Himalayan geology for the first time in Indian Railways. It is used for the 14.8 km-long Tunnel T-8, where a successful breakthrough has been achieved. Advanced tunnelling techniques and continuous monitoring have been adopted to minimize ecological impact while ensuring safety and long-term stability. This makes the Rishikesh–Karnaprayag tunnels a defining example of high-altitude railway tunnelling in India.

Light At the End of the Tunnel

India's tunnel infrastructure reflects a clear shift toward smarter and more resilient development. These projects solve long-standing connectivity challenges while supporting economic growth and national priorities. Advances in technology and execution have strengthened India's ability to build safely in complex terrain. As new tunnels come into operation, they will continue to improve mobility, reliability, and regional integration. Together, they signal a future where geography is no longer a limitation to progress.

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