turnkey solutions for
rail and urban transit infrastructure
Seventy five years of UNDISPUTED LEADERSHIP

Larsen & Toubro is a major Indian multinational in technology, engineering, construction, manufacturing and financial services, with global operations. Its products and systems are marketed in over 30 countries worldwide. A strong, customer-focused approach and the constant quest for top-class quality have enabled L&T to attain and sustain leadership in its major lines of business for over seventy five years.

- Construction
- Heavy Engineering
- Hydrocarbon Engineering
- Power
- Metallurgical & Material Handling
- Ship Building
- Infrastructure Concessions
- Realty
- Electrical & Automation
- Construction & Mining Machinery
- Valves
- Infotech
- Technology Services
- Financial Services

Building landmarks, setting benchmarks

- 400 high rise towers
- 11 airports
- 53 IT parks
- 17 automobile plants
- 28 cement plants
- 45 hospitals
- 231 km of metro rail corridors
- 19.5 km of monorail corridor
- 8315 MW of hydro power projects
- 8080 MW of nuclear power projects
- 18300 lane km of highways
- 7.49 million sq.m of runways
- 3275 tkm of railway track laying
- 12510 tkm of railway electrification
- 585 substations
- 29380 MW of E-BoP
- 20600 ckm of transmission lines
- 40000 km of water & waste water networks
- 3400 MLD of water & waste water treatment plants
- 400 MW of solar plants

*The track record information published here is as of September 2015*
### TRANSFORMING RAIL AND URBAN TRANSIT INFRASTRUCTURE

Across geographies

Railways are the lifeline of nation’s economy and urban transit is key to sustainable urbanisation. L&T offers Turnkey Design-Build/EPC solutions with single point responsibility encompassing design, engineering, supply, project planning, quality control and execution.

Our range of services include:

- Integrated / Composite Railway Projects
- Dedicated Freight Corridors
- Conventional and Ballastless Trackworks
- Railway Electrification
- Signalling and Telecommunication Systems
- Urban Rail Mass Transit System (Metro/Monorail)
- Bridges, Tunnels, Underground and Elevated Stations

By applying project management competencies, L&T engineers introduce new technologies, mechanise execution and accelerate schedules.

<table>
<thead>
<tr>
<th>India</th>
<th>Metro Civil Works</th>
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<tbody>
<tr>
<td></td>
<td>Over 40 km of tunnels, 130 km of viaducts and 135 stations for metros in New Delhi, Chennai, Bengaluru, Hyderabad, Kochi and Lucknow.</td>
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<thead>
<tr>
<th>India</th>
<th>Metro Systems Works</th>
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<tr>
<td></td>
<td>84 tkm of ROCS</td>
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<td></td>
<td>271 tkm of Ballastless Trackwork in Delhi, Mumbai, Hyderabad and Chennai Metro</td>
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<tr>
<th>India</th>
<th>Concessionaire</th>
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<tr>
<td></td>
<td>Hyderabad Metro - 3 high density corridors (71 km, 66 stations and 3 depot)</td>
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<tr>
<th>India</th>
<th>Integrated Transit System</th>
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<tr>
<td></td>
<td>Mumbai Monorail 20 km</td>
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<tr>
<th>India</th>
<th>Dedicated Freight Corridor</th>
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<tr>
<td></td>
<td>Civil &amp; Trackworks (623 rkm), 2x25 kV Electrification (914 rkm for Western and 66 rkm for Eastern)</td>
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<tr>
<th>India</th>
<th>Rail connectivity</th>
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<tr>
<td></td>
<td>Dhamra Port, Nabha Power, Maithon Power, Sterlite Energy, Lafarge Cements, Tata Steel, BALCO</td>
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<tr>
<th>India</th>
<th>Mainline</th>
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<tr>
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<td>1200 tkm trackworks</td>
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<tr>
<th>India</th>
<th>Railway Bridges and Tunnels</th>
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<td>6 km of tunnels and viaducts in Western Ghats, Asia’s tallest railway bridges in lower Himalayan ranges</td>
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<th>India</th>
<th>Maintenance Workshops</th>
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<td>Established 2 state-of-the-art facilities for Indian Railways and 4 Metro depots</td>
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<th>Middle East</th>
<th>Riyadh Metro Line 3 (41 km)</th>
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<td></td>
<td>Complete Metro System (11 km tunnel, 22 stations, 26 km viaduct, 2 depots)</td>
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<th>Middle East</th>
<th>Doha Metro, Gold Line (11.6 km)</th>
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<tr>
<td></td>
<td>22 km of tunnels and 10 stations</td>
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*Image: Integrated Solution Provider - Railway Link for Dhamra Port*
L&T has the expertise to construct rail beds and permanent way works involving embankments, bridges, associated civil works including station buildings, passenger amenities and staff quarters. Mechanized methods for track linking result in high quality, speedy execution and high accuracy.

Along with consortium partner, Sojitz Corporation, Japan, L&T is executing India’s largest design & build railway project for a 626 km section of the ‘Western Dedicated Freight Corridor’ which will feature 110 major bridges, 1188 minor bridges and culverts. The project envisages mechanised track laying using state-of-the-art fully automated new track construction machines at the rate of 2 km per day, which is far quicker than conventional methods.
POWER OF SPEED
Progress through railway electrification

L&T holds the unique distinction of having energized major trunk routes in the Indian Railway network in record time since 1981. Turnkey capabilities in the overhead catenary system include design, supply, erection, testing and commissioning of:

- 25 kV, single phase 50 Hz, traction overhead equipment
- Traction substations, switching stations including 25 kV gas insulated switchgears
- Modification of the overhead catenary system
- Rigid overhead contact systems for electrification of underground tunnels with rigid overhead equipment

India’s largest design & build railway electrical & mechanical works.

Along with consortium partner, Sojitz Corporation-Japan, L&T is executing a 914 rkm Railway Electrical & Mechanical Works for a section of the “Western Dedicated Freight Corridor”.

SIGNALLING AND TELECOMMUNICATION

L&T’s experience and expertise spreads to the handling of major turnkey projects for railway signalling and telecommunication services. Strategic alliances have been forged with leading signalling manufacturers to provide state-of-the-art system engineering for automatic train control systems for train supervision, protection and operation including electronic interlocking.

The range of services offered includes design and commissioning of:

- Panel / route interlocking
- Solid state interlocking of stations
- Interlocking of level crossings
- Block working and control communication
- Fiber Optic Transmission Systems (FOTS)
- Radio Systems (GSM-R / TETRA / VHF)
- Public Address Systems (PAS)
- Passenger Information Display Systems (PIDS)
- Master Clocks
- Data Networking Systems (DNS)
- CCTV Surveillance Systems
- NP-SCADA Systems

Over 50 stations with relay and solid state interlocking have been commissioned by L&T.
ENERGISING CORE SECTORS
Dedicated rail links and merry-go-round systems

L&T offers end-to-end rail connectivity solutions for coal links and core sector developers viz; power, steel, aluminium, cement plants along with installation of associated bulk material handling equipment.

Port Connectivity
66 km link from mainline to port including centralised traffic control and associated bulk material handling for Dhamra port at Odisha.

Coal Links
- 45 km coal link to 4x600 MW thermal power plant - Sterlite Energy, Odisha
- 21 km coal link to 2x525 MW thermal power plant - Maithon Power, Jharkhand
- 45 km coal link to 2x700 MW thermal power plant - Nabha Power, Punjab
- 48 km coal link to 2x210 MW Thermal Power Plant, Odisha Power

Core Sector Developers
- 25 km link to 0.5 MTPA cement plant for Lafarge Cement at Chattisgarh
- 7.1 km link to 10 MTPA iron ore processing unit for Tata Steel at Joda iron ore mines
- 28 km link to bauxite mines for Bharat Aluminium (BALCO) at Chattisgarh

BRIDGING IDEAS
All types of steel / concrete bridges

Having executed over 220 km of bridges and viaducts of various kinds, L&T has introduced several innovations in the construction of major steel and concrete bridges for rail infrastructure and possesses extensive experience in executing a wide range of bridges and viaducts of different span lengths using ingenious construction techniques such as:

- Incremental launching
- Segmental construction
- Cable-stay
- Precast, pre-stressed concrete
- Steel, concrete composite construction

Some of the landmark railway bridges built by L&T include:

- Panvel Nadi viaduct in the hilly tracts of the Western Ghats for Konkan Railways
- Halladi bridge for Konkan Railways
- Bridges across Himalayan ranges, Gambhir Khad and Jhajar Khad on the Jammu-Udhampur rail link which are among the tallest in the country
TRANSFORMING URBAN COMMUTE

Mumbai Monorail - India’s first urban transit project on design-build basis

Leveraging its domain expertise, L&T has an impressive track record of setting new benchmarks by executing major urban mass rail transit systems in the country conforming to world-class standards.

Mumbai Monorail, India’s first urban transit project on design-build basis was executed by a L&T-led consortium. The 20 km line (Jacob Circle-Wadala-Chembur) features 17 stations, a maintenance depot and the project scope involves operation and maintenance for a period of 3 years.

- Passenger-friendly stations, automated fare collection systems and optimised station design
- Casting and erection of high-accuracy guideway beams to provide excellent ride quality
- Constructing one of India’s first 750 V DC traction-based urban transit systems
- System interface management with rolling stock, signalling, telecom, civil and electrical works
- Automated signalling system with centralized control
DELHI METRO

A reliable partner for the successful implementation of Phases 1, 2 and 3

Tunnel / Viaduct / Stations
- Underground corridor of 6.6 km between Kashmere Gate to Central Secretariat along with key stations building complexes such as Rajiv Chowk, Chawri Bazar, Malviya Nagar
- Airport expressway link to Terminal 3 of Delhi international airport
- 554 m long Metro rail bridge across River Yamuna

Traction / E&M
Design, supply, installation, testing and commissioning of:
- 25 kV Rigid Over Head Electrification (OHE) for major portion of Phase 3
- Rigid Overhead Contact System - ROCS (for entire tunnel section of Phase 2 and major portion of Phase 3)
- Underground electrification, fire suppression and utilities

Depots
- Construction, testing and commissioning of Najafgarh depot-cum-workshop

For Phase 3, L&T is currently executing four elevated sections and two underground sections along with two contracts for traction systems involving OHE and ROCS.
HYDERABAD METRO
World’s biggest mass transit project on concessionaire basis

L&T, through its Special Purpose Vehicle, L&T Metro Rail (Hyderabad) Limited, is developing the entire metro network for the city of Hyderabad with a concessionaire period of 35 years which is considered as one of the world’s most prestigious and biggest contracts on a BOT basis in the Metro sector.

The scope comprises building the entire Metro alignment for three high density corridors spread over a distance of 72 km along with 66 ultra-modern station buildings, 3 state-of-the-art depots, overhead electric traction systems and ballastless track works. This world-class transit system will be operated by Keolis - France using Rolling Stock from Hyundai-Rotem, Signalling & Train Control along with Communications Systems from Thales and Automatic Fare Collection from Samsung.
For Chennai, L&T is constructing two elevated stretches covering a length of 9.5 km, an underground stretch of 3.35 km using sophisticated tunnel boring machines, 6 elevated and 3 underground stations, an expansive depot involving 22 structures and 110 km of ballastless trackwork for the entire operational section and depots.
BANGALORE METRO
At the IT capital of India, L&T has constructed 4.8 km of elevated viaduct structures and three elevated Metro stations (Outer Ring Road, Pennya industrial area and Peenya village) employing innovative construction technologies.

MAKING TIER II CITIES SMARTER

Kochi Metro
L&T has been involved in two packages of the Kochi Metro. The first package involves construction of elevated viaducts measuring 6.93 km and 6 elevated stations including architectural finishing on the Alwaye Petta Line. The second package, on the same line, involves construction of 6.78 km of elevated viaduct and 6 elevated stations including architectural finishing works of stations.

Lucknow Metro
At Lucknow, L&T is constructing 7.3 km of viaduct and 8 elevated stations.
RIYADH METRO

Line 3 - Design Build of Complete Metro System

L&T is part of the ArRiyadh New Mobility Consortium and along with Ansaldo STS, Salini-Impregilo, Nesma & Partners and Bombardier Transportation is executing a 41 km stretch - Line 3 of the Riyadh Metro. The design and build contract includes implementation of the complete metro system including construction of bridges, tunnels, elevated and underground stations and depots.

DOHA METRO

Design Build of Gold Line Civil Works

L&T, along with Aktor, Yapi Merkezi, STFA and Al Jaber Engg. is constructing 22km of tunnels and 10 underground stations along with architectural finishes and MEP works.

State-of-the-art construction machinery and safety aspects ensured to the highest standards
SWANKY STATIONS WITH COMPLETE AMENITIES

L&T provides comprehensive design and build solutions from concept to commissioning for building stations and depots, comprising MEP works, vertical and horizontal transportation, building automation systems, IT systems and system integration.

Structures for mass transit systems can be delivered complete with E&M installations and services such as automated fare collection, passenger information display systems and fire-fighting systems for railways and metro operations on a turnkey basis. L&T holds an enviable track record of being involved in the construction of over 170 stations across the country with more than 17.5 million sq.m of building spaces completed in the last 3 years.

Mumbai Monorail Stations

Underground Station Building for Delhi Metro

Hyderabad Metro Station

Nagole Station - Hyderabad Metro
DEPOTS AND MAINTENANCE FACILITIES

From concept to commissioning, L&T has the expertise to set up Rolling Stock Maintenance Facilities for Locomotives, Freight and Passenger coaches including procurement and installation of maintenance equipment, high tonnage gantry cranes, material handling systems and specialised utilities.

The company draws from its experience of setting up factories for various heavy industries to construct pre-engineered buildings and structures.

L&T has also set up depot and stabling yard facilities for various Metro/LRT transit systems at Delhi, Chennai, Hyderabad and at Mumbai for Monorail.
TUNNELING TECHNOLOGY

Powerhouse in Modern Day Transport Systems

For the Metro sector, L&T has executed over 22 km of tunnels and 13 underground stations in varying conditions involving all types of construction methods such as TBM, NATM and Cut & Cover.

In Delhi Metro project Phase 1, L&T has executed a 6.6 km UG section including a three level interchange station at Connaught Place (Rajiv Chowki) and India’s deepest station (Chawri Bazaar) at the historical old Delhi.

L&T is currently executing over 55 km of TBM and 31 UG stations for the Riyadh, Doha, Delhi and Chennai Metros.

For the railway mainline, L&T has built tunnels through some of the toughest sections of the Western Ghats for Konkan Railways.
Concourse and platforms levels constructed entirely from pre-cast sections for Hyderabad Metro stations

LEADERS IN PRECAST TECHNOLOGY

State-of-the-art precast technology is employed for faster completion of projects across several railway and urban transit projects. Concrete elements such as viaduct segments, full span ‘U’ girders, tunnel lining rings, armour units, deck element and guideway beams for monorail and even concourse and platforms of station buildings are prefabricated in the state-of-the-art casting yards.

Direct Fixation Resilient Track System (plinth type) - Hyderabad Metro

Ballastless track-
Key to a smooth ride

L&T has pioneered the construction of Direct Fixation Resilient Track Systems (plinth type) which is a cast-in-situ, top-down method of construction that offers excellent advantages on elevated corridors owing to lesser dead loads on the viaduct. The construction technique provides accurate construction and greater flexibility in execution planning.

Segmental Construction - Hyderabad Metro

Full Span U girder erection - Delhi Metro
GEOTECHNICAL ENGINEERING

L&T's geotechnical arm, L&T GeoStructure, offers engineering solutions to the entire gamut of geotechnical and foundation engineering, design and construction. L&T was the first to introduce trench cutter equipment in India for underground stations involving rock socketed permanent diaphragm walls. L&T GeoStructure has also installed India's first secant pile wall for the Delhi Metro Rail project at Hauz Khas.

Comprehensive Foundations and Geotechnical solutions

DELIVERING WORLD-CLASS DESIGN

A well-equipped design facility, Engineering Design and Research Centre (EDRC) at Chennai and Faridabad, provides a broad spectrum of design services ranging from concept to commissioning for all types of projects in the rail and urban transit sector.

EDRC provides construction engineering services for:
- Bridges
- Viaducts
- Guideway beams
- Permanent way works
- Overhead equipment including power supply and traction substations
- Ballastless track work
- Signalling and telecommunications
- Special infrastructure requirements
- Tunnels and underground structures
- Building services
- Hydraulic engineering
- Electrical and instrumentation system engineering
- Geotechnical engineering

Comprehensive Foundations and Geotechnical solutions
Comprehensive training for excellence in rail infrastructure

Towards fulfilling the demands in rail construction, L&T has established the Competency Development Centre (CDC), a first of its kind exclusive training centre for rail construction at Kanchipuram, near Chennai, for various activities based on the requirements of an integrated rail construction project.

Equipped with excellent infrastructure for practical and classroom sessions, CDC has the facility to impart on-site training to 300 technicians and 180 middle-level managers/engineers in a year. Specialised training is provided in permanent way works, overhead electrification, signalling & telecommunication and complete civil construction works.