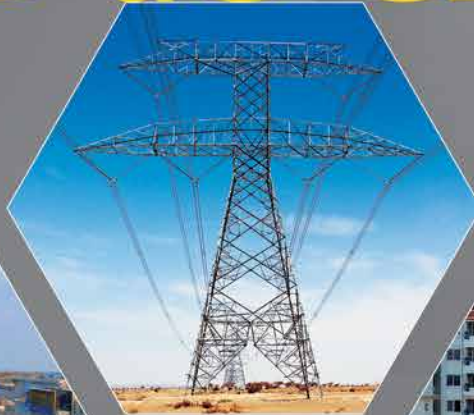


# ECC CONCORD

In-house Journal of L&T Construction | Volume - 40, Issue - 3 | Special Edition 'Speed & Scale'

*It's all about*

# **SPEED & SCALE**



# From the EDITOR'S DESK

As an organization, we have always dealt with size and scale. Our triumphs over the years have been projects successfully executed that others would have had second and third thoughts before even considering them. While implementation has never been an issue, timely delivery has unfortunately been an area of concern. Delays are very often beyond our control but at the end of the day if we are unable to keep our contractual delivery date then we have not delivered.

This issue of ECC Concord (and the next) celebrates projects that are both huge and being built to speed.

A team from Heavy Civil IC led by a mercurial Project Manager is endeavouring to arrest the flow of the mighty Godavari by constructing a barrage across the river at Medigadda to redirect its waters to the parched upper reaches of dry Telangana to quench the thirst of millions and irrigate thousands of hectares of land. Another team from WET IC is also helping about 10 lakh people of India's youngest state – Telangana – receive drinking water. Elsewhere, some of their IC colleagues are combating the climatic extremes of Rajasthan to create a water supply scheme that has converted a distant dream of some 4 lakh people into reality, winning the sobriquet of being 'L&T's Desert Warriors' in the process.

Prestige Lakeside Habitat is a wonderfully designed and executed housing complex – the largest in the country in a single campus – with more than 3,500 residences that will soon become enviable addresses thanks to the efforts of project team from B&F IC.

In our continuing effort to build a more 'powerful' Oman, a redoubtable team from PT&D IC have executed a composite 400 kV Over Head Line (OHL) across the desert spanning 265 km along with 400 kV reactors all within a schedule of just 28 months!

To push India's economy into higher gear, TI IC have constructed a road in double quick time, parts of which are so good that they can double up as a landing strip for the IAF in times of an emergency.

A young and dynamic team from the Smart World & Communications business unit has brought the city of Mumbai under the third eye by executing the country's largest city surveillance system.

Finally, as developers, we have built for the city of Hyderabad a world-class metro rail system that the Hyderabadis have embraced with relish.

Happy reading!

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A project so big that it aims  
to reverse the flow of the  
mighty Godavari!

Project Medigadda Barrage



*Telangana is thirsty. Its population requires water and a lot of it to realize the Hon'ble Chief Minister Shri K Chandrasekhar Rao's dream of converting the state into a "Hub of Seeds." Thus was born the idea of building a barrage across the river Godavari to reverse its flow and by flooding the upper reaches, the water will bring succour to the thirsty millions and irrigate vast hectares of land along its banks. With the CM and his government keenly involved in the project, the stakes are high for L&T's Heavy Civil IC to deliver this huge project to quality and time.*

The Medigadda Barrage project (named after a village of the same name that was washed away in a flood during the 80s) is like a runaway snowball that is rushing down a mountainside; as it rushes down not only does it gain momentum but gets progressively bigger. This is, however, in stark contrast, to the beginning of the project. Awarded in August 2016 by the Irrigation & CAD, Government of Telangana, nothing happened for nearly six months, as Project Manager, M V Ramakrishna Raju recalls, "We just sat here doing very little as the land acquisition by the Government for construction was still in progress." Raju's first project at the helm almost turned out to be a non-starter as the management expressed its concern due to the inactivity and drain on resources. "After a visit of the Hon'ble CM accompanied by SNS," the tide



slowly turned. Land became available and then it was all systems go. "Those long months of inactivity gave me the opportunity to study ground realities so that when we started, we could literally hit the board running!"

### Setting records to brake them

That they have hit the board running is evident from the records that the project has already set. On 21<sup>st</sup> April, 2018, Raju and his young team (with an average age of just 32!) set an Indian and, perhaps a world, record of pouring 7,212 cum of concrete in a single day! "We poured 20,291 cum in 72 hours and 1.52 lakh cum in a month which also must be records," enthuses Raju. The project has not only been doing numbers but also achieving them docking an average of Rs. 150 Crs of invoicing since January 2018. "Two of my personal objectives when I took over this site were to first cross a monthly threshold of Rs. 100 Cr of billing and then cross the Rs. 200 crore mark. Not only am I regularly crossing the Rs. 100 cr mark but was able to achieve the Rs. 200 crore mark too."

### Tackling scale with precise planning

The huge scale of the project is evident in its numbers. 4.92 lakh cum of concrete pour in four months since the 'famous visit' mentioned earlier. Scaled up from 1200 cum per day to an average of 5000 cum per day. 27,400 MT of reinforcement consumption, with an average monthly tying of 7,000 MT. Scaled up from 60 MT a day to 250 MT a day. Cement consumption of 400 MT per day has swollen to an average of 1,500 MT, consumption of aggregates from 1540 MT to 6,400 MT and workmen from 1,245 to an average of 3,000 in the period of Jan'18 - Apr'18.

All this is to build a barrage across the mighty Godavari that ambitiously aims to reverse the flow of the water back upstream to irrigate thousands of arable land and provide drinking water to many, including the people of Hyderabad. Once completed, the barrage will convert the Godavari into a perennial river that today, at the end of summer, is nothing more than a sluggish rivulet. Even though at the



**M V Ramakrishna Raju**  
Project Manager

"I therefore split the project into 2 and started work simultaneously on the both the right and left banks. These two sub-projects were completely separate with their own sets of equipment, P&M, resources, people and leaders and we have created an ecosystem that works with clockwork precision."

river's narrowest point, the barrage is still 1.6 km long from bank to bank and will feature 85 vents or gates which are further divided into 8 blocks. The total

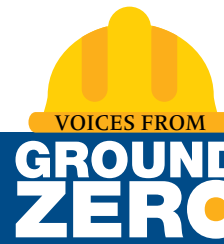
width of the barrage is 259 m inclusive of aprons and will ultimately have the capacity to store 16.17 TMC of water.

Standing at a wall-mounted map, Raju explains his meticulous and bold planning. "Such projects normally take easily from 4-5 years to complete because effectively you are working only about 8 months a year. Operations are not possible during the monsoon when working from one bank to the other. To achieve our deadline of just 24 months, we had to approach the construction unconventionally. I therefore split the project into 2 and started work simultaneously on the both the right and left banks. These two sub-projects were completely separate with their own sets of equipment, P&M, resources, people and leaders and we have created an ecosystem that works with clockwork precision."

Everything has to work to plan; there is no room for error. The supply of material, the availability of resources, the number of workmen all have to be readily

available on time because the nearest source is Hyderabad that is 280 km or 5 and a half hour fast driving away. It is a balancing act for Quality In-charge, Gurram Srinivasulu, who at 47, is perhaps the senior most employee at site. "For concrete, we have to plan the logistics for sand, cement and aggregates and in aggregates, we require 3 types of 40 mm, 20 mm and 10 mm in a ratio of 25:50:25 and that calls for some precise planning." As many as 90 concrete mixers keep scurrying like busy ants across the site day and night carrying Gurram's pour.

Ram Dutt Joshi's formwork yard is a veritable forest of equipment but one look at his very orderly cabin inspires confidence that nothing of the 236 components that he handles will miss his eagle eye. Apart from the 8 batching plants, P&M In-charge Ashish Goel, has Rs. 86 Crores worth of in house assets to manage including ice plants, water chilling plants, tower cranes and "the secret," smiles Goel, "is to plan for what is needed day after tomorrow!"



**Ashish Goel**  
P&M In-charge

"The secret is to plan for what is needed day after tomorrow!"

### Planning to cheat the river

Raju is perhaps the only person in the entire country who may not be praying for a good monsoon! "If the monsoon is not good, the flow will not be very heavy and we can continue working," for which Raju and his team are frantically erecting coffer dams on both banks to arrest the water and create dry working zones. Civil In-charge, Right Bank, Siva prakasam's statement that "We have to complete 3 blocks before September '18," therefore looks achievable though his assignment is tougher as his bank is 1 meter lower than Civil In-charge, Rupesh Mishra's left bank.

### Labour the perennial problem

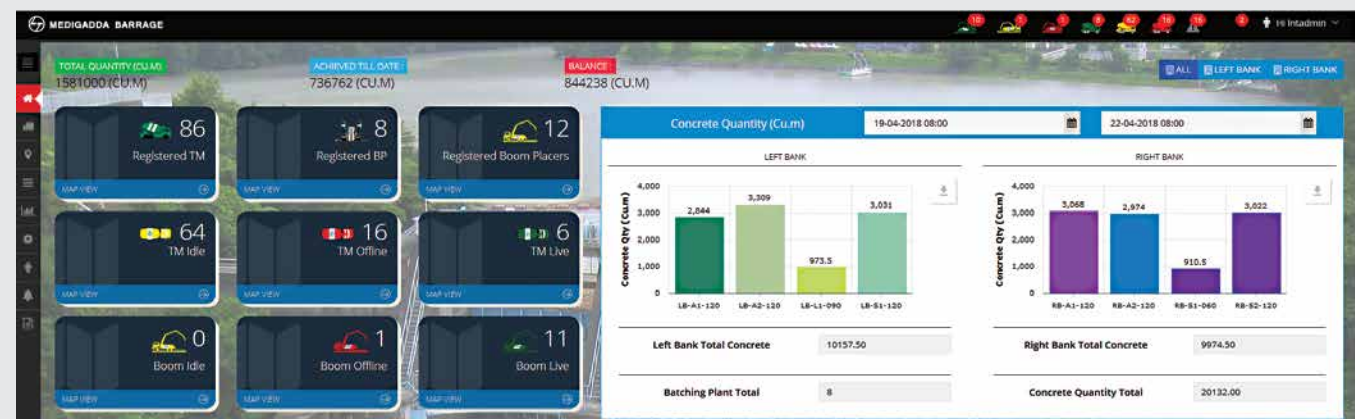
Although surrounded by villages, very little of the local population are interested to work at site. "We have only about 1% of the locals," that increases the pressure on Raju and his Planning Manager – Rajnish Chauhan – to source labour from elsewhere and trust multiple sub-contractors. "We have developed about 80-90 of them, some of them working with L&T for the first time and new to our systems but they are delivering," offers Chauhan, "which is also because we pay them in time," adds Raju. "It is all a chain: we invoice the customer, they pay in time and we pay our suppliers and contractors in time. If you break the chain, then you are in trouble!"



One of the eight batching plants



## Medigadda is digital



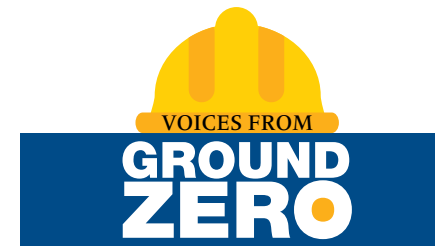
An informative dashboard that presents real time information on the activity that is most prevalent at site - concrete pour.

“We created facilities for our workmen that are amongst the best which is why we are able to get them,” informs Raju, like decent, clean, airy living quarters, good, wholesome food and RO water for drinking. With their camps situated close to the work front, they can actually “go home for lunch and have their siesta in their rooms!” chips in Chauhan.

The problem for IR man, Suryakant Agashe is a trifle more severe on the left bank, which is actually in Maharashtra. “Beyond our site there are the dense forests of Gadchiroli district leading to Chhattisgarh state that are Extremist Zones and labour is understandably reluctant to come but we are managing,” he adds with steel in his light eyes. Their

treatment is important too. “We always call our workmen by name,” says Joshi “and that makes a huge difference.”

The continuous flux is obviously a headache for Safety In-charge, N Ramesh Kumar. “We need to constantly train and retrain workmen because of this floating nature and



**Ram Dutt Joshi**  
Formwork In-charge

“We always call our workmen by name and that makes a huge difference.”

have even sent some to our Safety Innovation School for special training.” He obviously has been doing a good job because the project has already clocked 5 million safe man hours as of May '18.

“I have learnt that a Project Manager has to get into administrative matters because only he has the big picture to address those issues,” says Raju, folding his tall, lean, spare frame into his chair. “I think projects have cost and time overruns

because leaders don't step in and solve admin matters quickly. We had many issues with the locals initially who saw a chance to make a big killing but we did not relent. We engaged them, promised them help under CSR but nothing more and that has worked for us.”

## Youth power to the fore

Fuelled by youth power, Raju is driving the project forward at speed thanks to his young and agile work force. “I want to create a team of experts who after completing this project can go anywhere and make a difference!” He has boldly heaped huge responsibilities on young shoulders and they have not let him down. Sai Aditya, his Man Friday, is a 2-year-old GET who assists him in planning. Sai has attended the interview for BIS and although Raju is loath to see him go, he has agreed to release him because as he says, “Yes, he is critical for the project but BIS is critical for his career!” A group of 6 DETs and 4 GETs are getting their hands dirty on

this project. “We invite parents to site to see how their children are working and they are full of praise for our systems,” says Raju. So far away from civilization with Warangal the closest town 120 km away, the youngsters are struggling. “Sir, there is no chance for socializing,” complains young Ushaid Anjar, smiling through his well-kept beard but he, like the rest are enjoying the challenges that can only make them stronger and better construction professionals.

There is still a lot to achieve but with things proceeding smoothly, the team is hoping to make significant ground during the monsoon. We traverse a road cut across the riverbed that reduces a 60-km drive to just 1.5 km but “once the rains begin, this road will go which will be our first warning!” Raju grins. He is restless, ever inspecting, monitoring, admonishing but it is all for a great cause and soon the people and farmers of Telangana will have a lot to thank for when this team finishes their job!

The triumphant Medigadda Barrage team that set an Indian and, perhaps a world, record of pouring 7,212 cum of concrete in a single day on 21<sup>st</sup> April, 2018. They have also set records by pouring 20,291 cum in 72 hours and 1.52 lakh cum in a month!



A wonderfully constructed  
prestige statement  
Project Prestige Lakeside Habitat, Bengaluru



With names like 'Tarzan Square', 'Leroy Club House', blocks named after 'Andrina', 'Duncan', 'Humbert', and 'Jasper' and a bird's eye view of quaint, slanted roofs reaching up into the sky, one could be forgiven to suppose that one was in Disneyland. Actually, there is some truth in that supposition for Disney has designed Project Prestige Lakeside Habitat that bears the inimitable Disney touch in its attractive and unconventional architectural themes and elevation features. With aesthetics seamlessly married to size and scale, it is the largest housing project in India residing in a single complex spread over

102 beautifully sculpted acres with a total built-up area of 9.2 million sq. feet. Overlooking the scenic Varthur Lake, the project is conveniently located on the Hoskote-Sarjapur state highway near Whitefield that will be metro-connected in another 6 months.

## A 'tall' design-and-build project

"This is not a normal residential project," begins Project Director, T Chandrasekar (TCS), settling into his chair in his sparse but functional site office cabin. "Being a design-and-build order, we have had to

adhere to some very demanding design norms set out by Disney, the designers and RSP, the architects from Singapore." A 34-year old L&T veteran, TCS is all praise for the design team from EDRC, led by Ramgopal, and the weight of a huge and prestigious project sits quite easily on his square shoulders. "There are no flat roofs in any of the villas or club houses and the sloping parapets at the top of the towers lend an European feel," he chuckles though the construction of 24 towers ranging from 18 to 29 floors, 269 villas of six different types and 4 clubhouses in a single-phase execution would have been no laughing matter!

"Construction is all about aligning the 5 Ms – Men, Material, Method, Monitoring and Money," offers TCS, sounding almost professorial, "and we were able to align all these to a large extent at this project!" For better, more focused management, the project was broken up into several smaller mini-projects each with its own exclusive teams and project managers. "In fact, we had project managers specifically for towers, for non-tower areas and for finishes," elaborates TCS and the fact that the teams are ready to hand over two out of four parcels of multiple towers and 35 % of the villas to the customer by June 2018 is testament that their plans of action have been spot on.

## Scope of Works

### Construction involved:

- 1) 24 high-rise towers with 3426 residential apartments
- 2) 229 two-storied villas
- 3) 40 three-storied villas
- 4) 4 club houses
- 5) 4 swimming pools
- 6) External hard landscape works (roads and pavers)



**T Chandrasekar**  
Project Director

"We were able to achieve a cycle time of just 10 days for the shell which is why we were able to complete a tower structure of 30 floors and two basements in about 12 months."



### Major quantities of works

Concrete - 4,50,000 Cum

Reinforcement - 40,000 MT

Aluminium formwork - 25,36,000 Sq.m

Conventional Formwork - 9,00,000 Sq.m

Masonry - 20,00,000 Sq.m

Plastering - 6,36,000 Sq.m

Waterproofing - 3,40,000 Sq.m

Marble/Granite - 85,000 Sq.m

Tiling - 10,00,000 Sq.m

Wall Cladding - 95,000 Sq.m

## Speed as vital as scale

TCS's mandate was to build to scale and speed and the first vital step to address speed was to adopt aluminium formwork for construction. "We were able to achieve a cycle time of just 10 days for the shell," he declares proudly, "which is why we were able to complete a tower structure of 30 floors and two basements in about 12 months." Aluminium formwork gave the project team several

advantages: speed, standardization of construction, less labour since the wall and slab were casted together and less wastage. "The repetitive nature of job reduced our requirement for skilled labour, which anyway is always in short supply! We adopted a scheme and activity driven process: for example, the concreting team only poured concrete as they progressed from tower to tower, floor to floor." To achieve scale and speed, exclusive teams of project engineers, foremen and workmen were formed to manage the repetitive nature of activities better.

The project team cleverly executed the construction of the elevation and intricate architectural features along with the main structure. "There are many elevation features like horizontal bands, columns, vertical fins, arches, projections," says G Suresh, Project Manager – Tower Structures, "and doing these along with the main structure saved time and greatly improved finishing." Keeping the wall thickness to just 160 cm was another thoughtful step which required less material, increased floor space for the occupant and for the customer, more floor space to sell!



## Combating workmen attrition and streamlining mobilization

“At peak time, we had nearly 4,500 workmen, but we have trained and mobilized nearly 40,000 which shows the level of attrition that we have had to face,” laments TCS. With almost no labour available from either Karnataka or the neighbouring Southern states, the Project had to depend on labour imported from the northern belt of Bihar, Jharkhand, Odisha and West Bengal. “Drawn largely from the agricultural sector, they would remain for just about 3 months before returning to their fields to harvest their crops. Most of them never returned,” he shakes his head. Thanks to Holi,



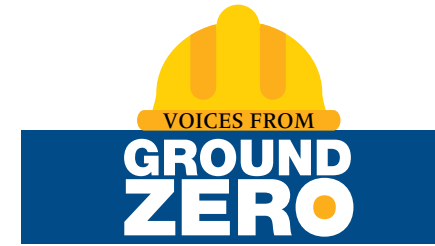
**A Vijay Babu**  
Planning Manager

“Mobilization was always on the critical path since at any given point we had around Rs. 80 Crores of P&M assets and Rs. 30 Crores of formwork assets.”

Durga Puja, Diwali, harvest and an unending list of Indian festivals, the site lost many people and as TCS

reiterates, “Mobilization of human resources was the toughest challenge for the project team.” Fortunately, the repetitive nature of work of doing structure, super structure, block plastering, tiling and so on did not require the new hands to undergo too much of training.

A certain amount of training was of course necessary as Resource Manager, Manoj Kumar shares: “Cut and bend reinforcement supply was a major task. Material Planning had to be perfect because any slippage could throw the schedule completely haywire. Reinforcement planning starts with preparation of bar bending schedules, fabrication of cut & bend steel, making the correct gauges and training the workmen to handle them well.”



**G Suresh**  
Project Manager - Tower Structures

“There are many elevation features like horizontal bands, columns, vertical fins, arches, projections.”

Mobilization was always on the critical path for Planning Manager, A Vijay Babu, “since at any given point we had around Rs. 80 Crores of P&M assets and Rs. 30 Crores of formwork assets.” The three quarries located within a radius of 50 km of the site could meet only about 20% of its material requirements necessitating the bulk of materials to be sourced from elsewhere. “Our planning was quite good,” smiles Vijay Babu, “for not a day’s work was lost due to lack of material. We even touched a high of 800 cubic meters of concrete pour per day and 16000 cum per month during peak time.” Two factories were set up at site to meet the reinforcement demands which was to the tune of 800 – 1,000 tonnes per month, (80% of which of a smaller dia) “out of which our Steel Service Centre could cater only 50%,” points out Vijay Babu. An optimum design mix was developed for the project and regular testing at a fully equipped field lab helped maintain quality across concreting and finishing works. Of the nine formwork sets planned, only four were outsourced; the other 5 were internally sourced and modified. There are site-based facilities for formwork modification too.



## Creating a level playing field

The terrain of the project was not flat having a slope of 9 M from one end to the other. In an effort to level it, the customer had completed about 5 M of back filling in the area earmarked for the villas. The project team therefore faced the arduous prospect of re-excavation, but thinking innovatively, they resorted to the piling method to lay the foundation. "The foundation is now at formed ground level instead of at 5-6 M below the formed ground level," informs TCS. Prefabricated gauges for the tower walls using the lift-and-tie method further speeded up the construction process. The use of the economic beam-slab construction technique for the non-tower areas "translated



**A Subramanian**  
Project Manager - Tower Finishes

"Our construction and finishing is dictated by the fact that we will be catering to 3,675 customers who will be occupying the 3,426 flats and 269 villas."

into appreciable savings in both cost and time" according to F&A Head - B Ramakrishna.

## Tackling the softer issues

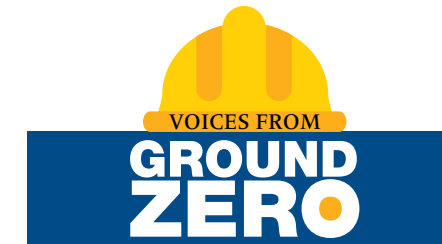
To maintain a strict cycle time, TCS refers to one of his 5 'M's - Monitoring which was crucial. "Monitoring is an imperative but then that's true for all sites," shrugs TCS. "We monitored progress on a monthly, weekly and even daily basis which is why we are on time in our delivery and were able to touch monthly invoicing levels of Rs. 35 Crores at times!"

A Subramanian, Project Manager, Tower - Finishes brings in a slightly different perspective. "Our construction and finishing is dictated by the fact that we will be catering to 3,675 customers who will be occupying the 3,426 flats and 269 villas," and true to his word all the units have stood up to the searching scrutiny of personnel from the client, the Prestige Group.



## The Clubhouse - a signature in luxury

The main clubhouse attached to the villas is a massive structure with sturdy, white, round columns that reminds one of some medieval architecture! Entering the glass doors, a set of semi-circular staircases greet one that lead up to the upper floor. Further inside, a huge atrium serves as a comfortable sit out area bathed in natural light from the high ceiling. Built lavishly, acres of space gives a sense of openness. The clubhouse is equipped with badminton courts, squash courts, billiards rooms, card rooms, a library and a reading area, two theatres and a huge hall for large gatherings that lead out onto a lush, green lawn. There is a giant swimming pool and a children's pool and there are facilities for sauna, Jacuzzi, massage and steam.



**S Lakshminarayan**  
Safety In-Charge

"The workmen who come at 8.30 am should return safe and sound to the labour camp at 8.30 pm."

Working at heights and work progressing simultaneously on multiple fronts spread over 100 acres were Safety In-Charge, S Lakshminarayan's two main concerns. "Some of our towers rise to a height of 100 meters so every precaution had to be taken and my simple objective was: The workmen who come at 8.30 am should return safe and sound to the labour camp

at 8.30 pm." He has been doing his job well, for the site has regularly clocked 90%+ scores in the SOP/ EHSMS audits and has received appreciation certificates from the client for achieving 15 million safe man hours.

That the project won the Quality Trophy for 2016-17 is no surprise for a robust QMS system was put in place from Day 1. Over a 48-month period (July '14 - June '18), nearly 4.5 lakh cum cement was produced and poured with Zero rejections and Zero concrete failures. A stage-wise inspection system for typical floor structures and finishing works ensured high quality standards.

Although the first set of towers are ready for handover, the task for TCS and team is not yet over. They are in the slog overs aiming to 'push' forward aggressively and complete the project with handsome margins. If their performance thus far is any indication, we can rest assured that they will deliver!

A world-class superhighway  
in just 22 months!  
Imagineering at play!

Unnao-Lucknow Expressway



With more than 5 million km, India has the second largest road network in the world of which its highways account for more than 40% of freight and passenger traffic. However, congested highways and considerable transit snags have created a growing need for dedicated transit corridors with approximately 1,455.4 km of expressways now operational in India. The National Highways Development Project of the Government of India plans to expand the highway network and add an additional 18,637 km (11,580 mi) of expressways by 2022. Taking a cue from the government's ambitious transportation infrastructure scheme, states are coming forward to partner and develop accelerated portals of connectivity to cash in on a range of benefits and investments opportunities that come along with such initiatives.

## UPEIDA initiates a life line for development

The Uttar Pradesh Expressways Industrial Development Authority

(UPEIDA), the nodal agency set up by the UP government for developing expressways, conceived to build the Agra to Lucknow Access Controlled Expressway (Greenfield) project on a 'build, own, operate and transfer basis' in 2013. With no takers, the scheme was reinitiated in 2014 with the state government financing to build India's longest expressway across 302 km divided into 5 key packages of approximately 63 km each.

Implemented under the Engineering Procurement and Construction (EPC) mode, the expressway primarily aims to reduce travel time between Agra and Lucknow from 6 to 3.30 hours. This high-speed corridor will connect the state capital, Lucknow with New Delhi and thus open up avenues for industrial and urban development along the way. It will also significantly save time, fuel, reduce carbon footprint and aid socio-economic development of the area by stimulating the setting up of handlooms, food processing units, cold storages, warehousing and milk based industries.



## Taking up a composite mandate

L&T's Transportation Infrastructure business was awarded the 5<sup>th</sup> package i.e., from Unnao to Lucknow to be constructed within 36 months. Apart from the usual requirements that come along with a road infrastructure project, what made this task special was the onus of building a 3.2 km airstrip runway (rigid pavement) for the IAF. Other scope of works included construction of a 6 lane green field expressway across 63 km (flexible pavement), a toll plaza, a flyover, 4 major bridges, 11 minor bridges and 120 culverts. The alignment accorded to L&T passes through three major districts, Lucknow, Hardoi and Unnao with the span running along industrial, agricultural regions adjacent to cities and towns of Kanpur, Auraiyya, Kannauj, Etawah, Firozabad and Agra.

Procurement of land commenced in May, 2014 and within six months, 90% of land was acquired with the consent of land owners.

## Realigning to a 22 month timeline

"The entire plan had to be reworked before we could finalise the resource strategy," begins Manish Samtani, Chief Project Manager, on the challenges of the project, "as the client insisted that the main carriage way had to be completed in just 22 months." However, he assures, "The best thing about this timeline change was that it was told right at the beginning just a month and a half into execution which meant that we could realign the strategic resources according to the revised execution plan." To hit the ground running, we chalked out a secure fast track mode, highlights

Mayank, the Planning Manager, "The entire alignment was spilt into two major 30 km sections with exclusive teams dedicated for the respective milestones. Further, to speed up the task, close to 20 agencies were identified to take up the various ground works across 3 km subsections right through the alignment." Certainly there were many gains by adopting this breakdown structure, affirms Manish, "From the logistics point of view, we could address issues simultaneously while at the same time focus on critical activities."

## Accelerating procurement

The crushing of the timeline from 36 to 22 months had a telling effect on our major resource procurement, plan, reveals Ramesh Chand, the Project Manager, "With such a tall

asking rate, we decided to source from nearby regions as that was the only way we could sustain the momentum. The bigger onus was in finding ways and means to stack such mountains of resources along the alignment." Pointing to specific sections, Manish relates, "A separate procurement team at site was put in place to source quality aggregates which constituted bulk of the resource and also to plan storage at appropriate places along and across the alignment." Three more stores were set up, one at the crusher location, Mohoba, specifically to cater to the requirement of crushing activity with two others along the stretch.

### Tacking stock of the sublayers

While the total scope of earth work along the alignment was close to 1,30,00,000 cu.m, the other major resources comprised 12 lmt of granular subbase, 5.5 lcm of wet mix macadam and

3.5 lcu.m of asphalt with 7 lmt of aggregates for which the necessary logistics provisions were made. Additionally, a dedicated team ensured safe passage way of these essentials to the respective locations along the alignment. It was a hectic fleet movement, acknowledges Mayank, "Almost close to 300 trucks ferried materials through the single lane village roads though we had taken thorough precautions by installing signboards, speed breakers and raising awareness among the local population. Adequate parking areas were developed to avoid traffic congestion on the village roads which enabled fulfilment of our daily average requirement of 8000 t."

### Surging ahead with the right approaches

Establishing access ways across and along the alignment was never an issue, avers Mayank, "Our heavy duty trucks

with tonnes of material could easily reach any point along the span thanks to the meticulous planning that went into building the support access ways. Though this is a familiar setup across all road infrastructure projects, what really worked in our favour was that we carefully earmarked zones which were vulnerable during the monsoon and further stabilized the paths so that work could continue even during the rainy season."

### In line with the statutory obligations

The project team was spot on in aligning to the statutory requirements for various works which included Consent to Establishment & Operation of Plants from the Pollution Control Board, Labour Licenses, Insurance Policies for Workmen and Project, Mining Approval for Borrowing Earth, etc. to facilitate the works. As a Greenfield project, it was more or less a smooth ROW transaction,



affirms Manish, except for a small stretch, “The clearance of 5.5 km of forest area was cleared by the client only in February 2016 but that was not under the critical alignment scope.”

## Process innovation overcomes constraints

L&T’s distinct technical prowess in executing such projects with state-of-the-art plant & machinery provided the edge especially when it came to soil stabilization of the subgrade. Elucidating on innovation, Ramesh shares, “There were some critical stretches for which suitable earth was not available and hence we decided to complete the stabilization using cement with specialized equipment such as soil stabilizer and cement spreader achieving a near perfect finish.” While these were more of a process kind of achievement, Manish throws light on a deftly handled specific challenge. “We integrated the structure for a 15 m x 5 m span



**Manish Samtani**  
Chief Project Manager

“We had to build an airstrip that too for the Indian Air Force whose standards and specifications were different when compared to commercial requirements. However, we were able to raise the bar for this special task by aligning with the Federal Aviation Administration Standard and built a first-of-its-kind landing base for fighter jets.”

bridge across a river which involved 120 piles by eliminating the scope of pile cap through extension of piles from the foundation level to

the pier cap level which resulted in considerable time and cost savings.”

## Raising the bar for an airstrip construction

With the throttle on speed and scale well established, Manish and team had a unique task that was beyond road construction. It was something never done in the annals of Indian road infrastructure chuckles Manish, “We had to build an airstrip that too for the Indian Air Force whose standards and specifications were different when compared to commercial requirements. However, we were able to raise the bar for this special task by aligning with the Federal Aviation Administration Standard and built a first-of-its-kind landing base for fighter jets.”

## Banking on assets

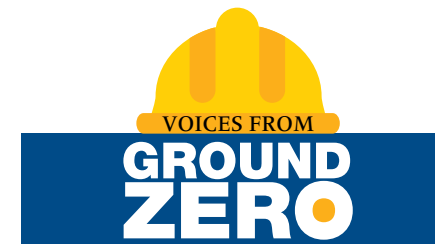
Plant & Machinery played a vital role in enabling the various milestones with



*First-of-its-kind landing base for fighter jets*



*A fighter jet landing on the expressway*



**Ramesh Chand**  
Project Manager

“There were some critical stretches for which suitable earth was not available and hence we decided to complete the stabilization using cement with specialized equipment such as soil stabilizer and cement spreader achieving a near perfect finish.”

critical equipment such as multiplex asphalt pavers, soil stabilizers and cement spreaders deployed to achieve quality finish. Other significant P&M

deployed included hot and wet mix plants, batching plants and a fleet of transit mixers. The P&M team ensured 24/7 running of the equipment with back-up services for maintenance through service vans. During peak operations, close to 4000 workmen and a team of 200 plus professionals were engaged across fronts.


## Opened to traffic in style

With more than 10 million safe man-hours on track, team L&T delivered one of the fastest road infrastructure projects across the country. A feat, that was cherished and reverberated in a befitting manner on 21<sup>st</sup> November 2016 with the landing of six fighter jets (Sukhoi & Mirage) on the expressway. The ultimate endorsement came from Shri. Mulayam Singh Yadav, Ex-Defense Minister and President, Samajwadi

Party, along with Shri. Akhilesh Yadav, the then Hon’ble Chief Minister of UP, who commended L&T on completing the six-lane expressway 14 months ahead of the contractual schedule while acknowledging that the expressway would now serve as a model project for the entire country to emulate.

## Advantage cruise mode

The IAF performed an encore on 24<sup>th</sup> October, 2017 by landing 9 fighter jets and a jumbo jet ‘Super Hercules’, which is testimony to the world-class road quality. It’s now advantage cruise mode across India’s longest expressway. How about taking a drive and getting a feel of the future of Indian motoring!



Engineering a high voltage  
265 km OHL in just  
28 months!

400 kV Ibri-Izki transmission line

The Sultanate of Oman is a country on the move with the government rigorously pursuing infrastructure development across various domains. Among recent developments, the power sector in particular, has seen phenomenal growth driven by the Oman Electricity Transmission Company (OETC) which controls the transmission of electricity at high voltages across the governorate. A trendsetter, OETC, has upgraded power infrastructure with several power transmission and distribution schemes across key regions to meet increasing power requirements and, at the same time, minimize voltage fluctuations. L&T, as a frontrunner in powering the economies of the Middle East, has been ably realizing OETC's objective of building a more 'Powerful' Oman by executing significant projects over the last two decades. The latest is the execution of a composite 400 kV Over Head Line (OHL) across Ibri and Izki spanning 265 km along with 400 kV reactors within a tight schedule of just 28 months!

## A pressing mandate to fulfill

In recent years, the thrust on infrastructure development, emergence of new manufacturing industries and establishment of an international airport have increased Oman's power requirement. Further, the power outflow across the predominant load centers of Muscat, Salalah and Sohar is on the rise with increasing population. The 400 kV Ibri-Izki OHL scheme is conceptualized to meet the power demands by transmitting close to 1500 MW of power thereby providing sufficient backup to the grid. The mandate for team L&T was to raise this powerful corridor in quick time that was fraught with a range of on-field challenges. Apart from a crushing deadline, the scope of works was extensive! It involved the design, type test & supply of 400 kV towers of

24418 MT, installation of AAAC Yew conductors across the 265 route km, 48 fiber OPGW across 265 km, lowering the existing 132 kV OHL to facilitate crossing of lines, supply of 400 kV reactors and other associated works. Further, there was the construction of 645 tower foundations, 24418 MT of tower erection, stringing of 400 kV DC quad conductor and two OPGW for 265 km, installation of 4 sets of 100 MVAR with auxiliary equipment.

## Networking with multiple stakeholders

Project Manager, S. Ayyappan, picks up the threads from where it all began, "Before we hit the ground, we had to align with multiple stakeholders as the OHL spanned across two regions and called for some deft networking skills with three ministries of housing, 6 municipalities and other utility service providers. While the client gave preliminary route approval, the onus on L&T was to ascertain the predominant portions of the survey, which called for re-profiling wherever route diversion/ modification was applicable. The entire route profiling task was finalized after six months but it was well worth the wait as the team had a clear chart of the profile to plan the execution."

## Bridging the span

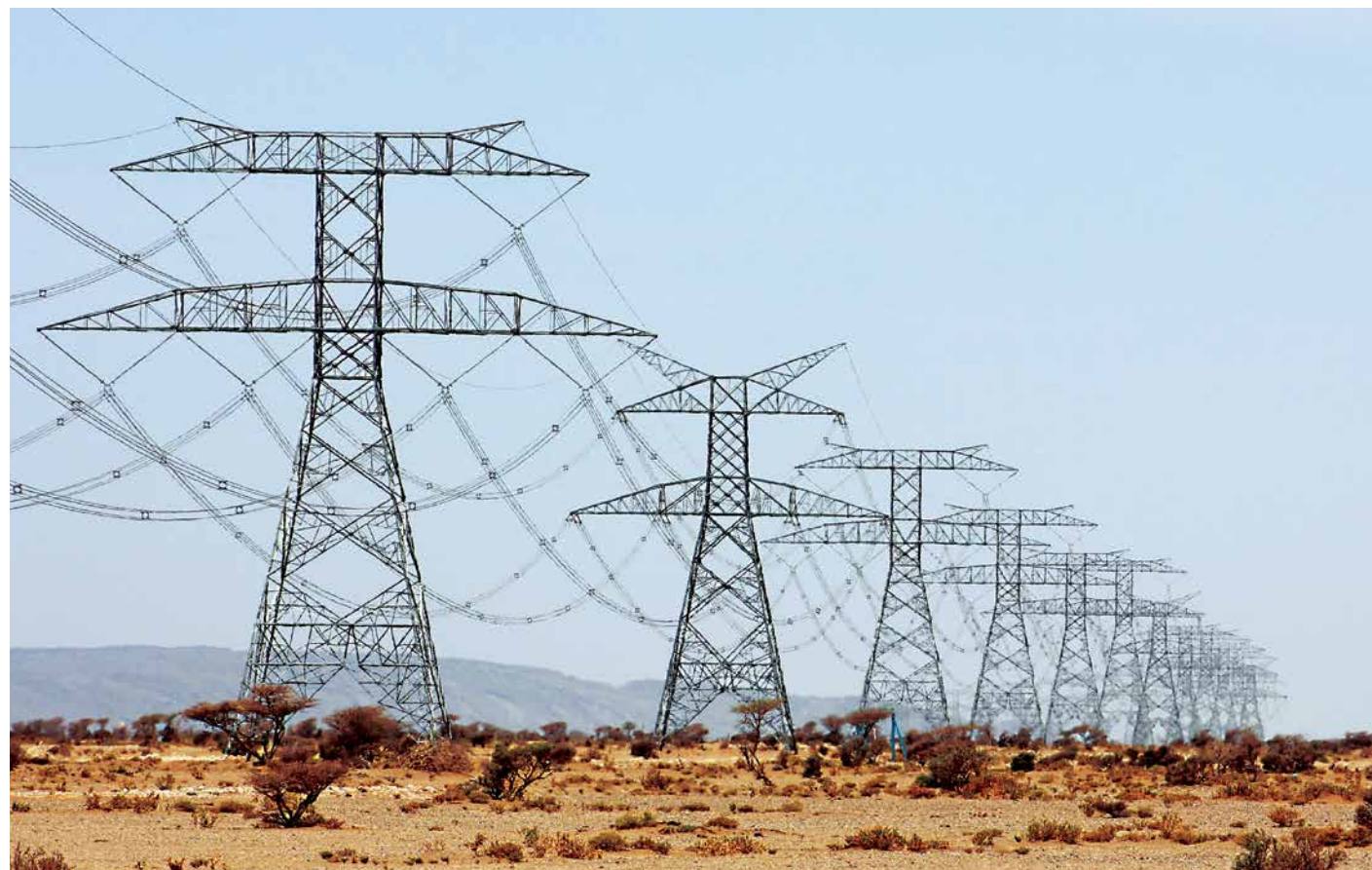
The team came up with a time-tested approach normally followed across large scale infrastructure projects in L&T by establishing two strategic sections – the Ibri Section and the Izki section, headed by respective construction managers. The Izki section was headed by Durga Prasad Sathpathy, while G. Saravanakumar headed the Ibri section. The ploy, according to Ayyappan, "Was to address the sections as individual sites and work towards a feasible delivery timeline to eventually integrate the entire package." Essentials such as site offices and stores were established at both locations and to facilitate tower element handling, the project team deployed section and bundle



Pit dressing in progress for tower foundation



Completion of pad 1 & 2 concreting for tower foundation



400 kV OHL Stringing





wise categorization as the tower parts were sourced from L&T's TLT factory in Puducherry and Zamil Steel Plant in Saudi Arabia. Similarly, installation of the hardware accessories and OPGW, insulators were lined up section wise to facilitate the stringing works.

### Getting the right team on board

Planning Manager, Anandkrishnan N, chips in exuberantly, "We planned

it perfectly from the beginning and one of the first steps that the senior management of L&T Oman took was to get the right set of project professionals on board as OHL jobs are a composite mix of multidisciplinary activities covering civil, electrical and mechanical works. Quickly, a core team with sufficient OHL expertise was formed and subsequently the roles and responsibilities of the on-field crew were determined. To facilitate on-ground works, the risks

and challenges along the alignment were chartered out in the initial stages of the project itself and a timely action plan was evolved across both the Izki and Ibri ends."

### Realigning where it mattered the most

While most of the alignment was lined up seamlessly, there were a few critical stretches that called for interfacing with locals for realignment. "We had to chart an alternative route due to strategic reasons which meant that the length of the line increased by close to 4 km with some additional tower scope," shares Ayyappan. "While this was manageable, what really deterred the progress was the objection raised by the Heritage Ministry as a part of the route was passing through heritage sites. As a result, the clearance was withheld for almost 4 months but the go ahead was finally given fortunately without any major cost implications."

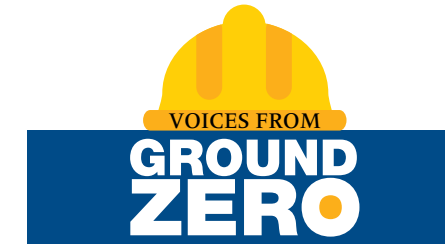
### Strategizing to accelerate

Working in tropical regions is always demanding and it was no different for Ayyappan and his team. "It is so especially in long span transmission projects but what worked for us was our ability to strategize vital tasks to achieve the overall deliverables." Some of the significant modus operandi followed at site included subcontracting the excavation activities, formulating an efficient dewatering plan, finding an approved concrete supplier to consistently supply to all remote locations of the tower, roping in a third party testing agency for backfilling tests and adopting a curing compound instead of water to mitigate risks.

### Banking on inherent expertise

"Transmission line projects are all about integrating various elements and here we had a whopping quantum to scale,"

exclaims S. Ayyappan. Giving an insight on the scope, he lists out: 645 towers spread out across varying terrains with a total excavation scope of 1,28,000 cu.m, concrete quantity of 18,100 cu.m and 1700 t of steel rebar works. "Innovation at every level was the only way to keep pace with the project milestones and it began right from the design stage with the tower foundations conceived as per actual soil parameters against the norm of fixed parameters thereby considerably reducing the foundation volumes. Further, at the initial stage itself, each tower was marked and inspected and the risky locations across the Wadi and watercourses were avoided. Tower materials received from factories were categorized bundle wise/ tower wise that facilitated sorting and minimized manual allocation."

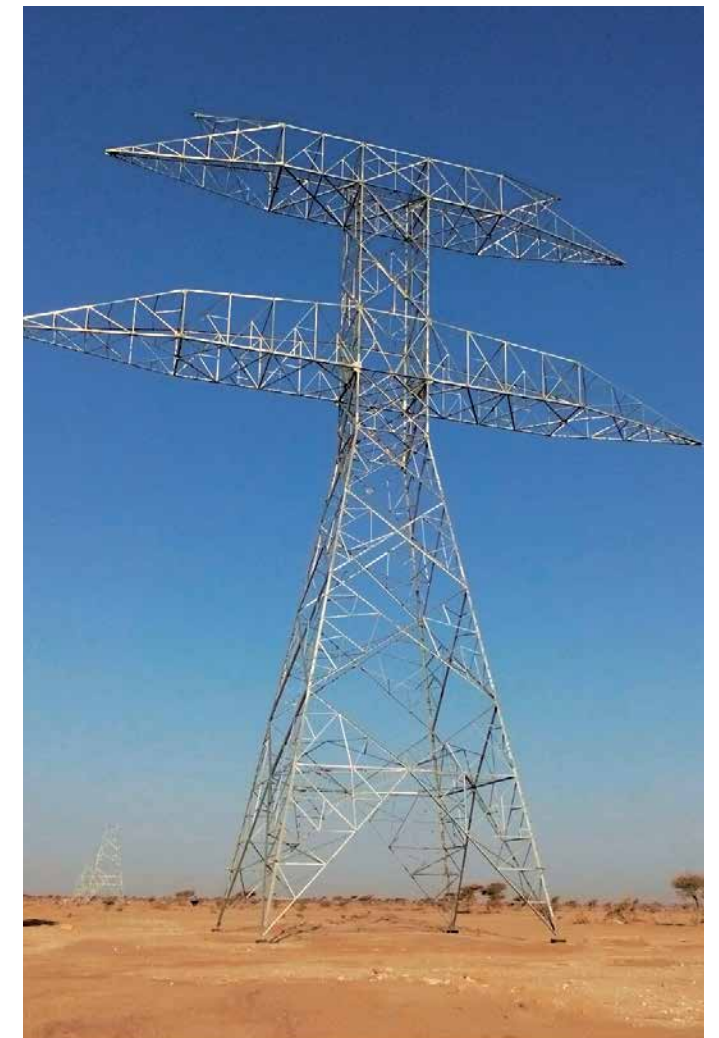


**S. Ayyappan**  
Project Manager

"Innovation at every level was the only way by which we could keep pace with the project milestones and it began right from the design stage with the tower foundations conceived as per actual soil parameters against the norm of fixed parameters thereby considerably reducing the foundation volumes."

### On course with a time mission

For every activity, a fixed asking rate was set that at times seemed very demanding. "Getting the third party to conduct the backfilling test was a colossal task as close to 20 tests were required for one tower location which meant approximately 12,900 tests for 645 towers," shares Ayyappan. Likewise, cube compression tests at a frequency of 3 cubes for 8 cu.m of concrete poured consolidated to 6787 cubes. To streamline the tests, the project team convinced the client to set up a laboratory thereby saving considerable cost and time for testing procedures. Another area of concern was the concreting activity as the locations were spread far and wide



but had to be addressed with regard to quality and delivery for curing. While fixing a reliable vendor, Ayyappan adds, "We did some ground work on far off alignments and as a foolproof measure convinced the management to engage a few transit mixers at our service in case there was a necessity. This was a brilliant move as it countered the occasional gaps."

## Monitoring through 'Nadhi n Pulse'

Knowing the pulse of the project is important as it can foretell the course of deliverables especially in a long span assignment. "I can now monitor various fronts across the alignment through a customized mobile app 'Nadhi n Pulse' for tower erection, assembly and stringing activities," Anandakrishnan reveals and adds that platforms like WhatsApp and Workplace have also facilitated



**Anandakrishnan N**  
Planning Manager

"Thanks to the digital initiatives, we now have the advantage of monitoring various fronts across the alignment through our customized mobile app 'Nadhi n Pulse' for tower erection, assembly and stringing activities."

communication, transfer of data and gave alerts that has kept the entire team updated on site activities.

## Raising 645 monoliths of steel

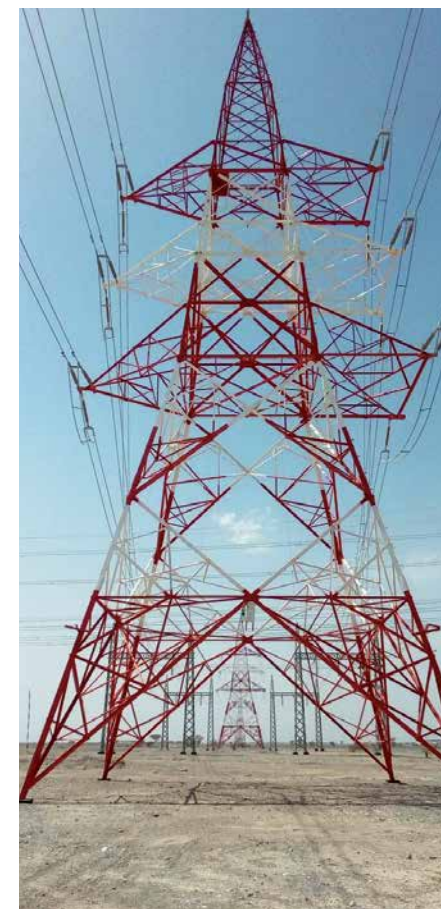
For a layman most transmission towers may seem to look the same but there is a lot of precision involved before scaling up these steely elements. "Depending on the ground profile most of the towers are configured aligning to deviations with heights ranging from 69.18 m to 57.20 m," informs Anandakrishnan. "The erection procedure was routine as per our operational guidelines and split into a two stage activity that involved the services of a 50/75 t crane for panel wise assembly and thereafter a 100/120 t crane for section wise integration. To minimize height works, cross arms were tightened at the ground level and mechanized spanners were used to speed up works. The balance portions were manually done and the final checking was ensured through torque wrenches."



Lowering of existing 132 kV OHL using underpass gantries to cross 400 kV OHL



Stringing work in progress



12 cranes of capacities ranging from 25 t to 160 t were utilized for tower erection and during peak works close to 850 workmen were engaged.

## Unravelling the cross over matrix

Scheduling power corridor crossings are always critical as it largely depends on the status of Permit To Work (PTW) and calls for stringent safety measures. At this project, there were 3 EHV cross overs and two underground lines that had to be mitigated. Although the way forward was achieved through meticulous paper work aligning to the distribution requirements of the existing grids, Ayyappan divulges, "One of the crossings was a high density power corridor where closure was not possible. We therefore had to opt for a complex bifurcation plan of securing one of the outages while the other circuit was shut down for the cross over works." Stringing works were done with a 16 t puller and tensioner covering 9 km of pulling

across a single section while the final sagging was done using sag bridges.

## Ensuring a safe passageway

Ayyappan and team are a delighted lot having delivered a project of considerable scale to time as committed. What has made this job more unique has been the prudent safety and quality measures implemented for carrying out tower erection and stringing works across a terrain that was largely exposed to sandstorms enabling the team to achieve 2 million safe man-hours and raise one more 'powerful' landmark in the Middle East.

# Building water lifelines for India's largest utilitarian project in just 23 months!

Adilabad Water Supply Scheme



A new beginning brings with it the promise for a better tomorrow and it is certainly so for Telangana, India's youngest state. Over the past three years, the government has initiated a slew of infrastructure development projects across various fronts significant among which is Mission 'Bhageeratha', a dream project of the Chief Minister that aims to provide piped water to 2.32 crore people in 20 lakh households in the urban and 60 lakh in the rural areas. The project, which encompasses setting up of a range of water infrastructure utilities across 26 segments in the state involves laying of over 100,000 km of pipeline network thereby making it one of the largest such schemes to be constructed in India. L&T's Water & Effluent Treatment IC was entrusted a major portion of this scheme that covered nearly 8% of the project involving 21 mandals across 3 districts - Komarambheem, Mancherial and Adilabad - connecting 1819 habitations.

## Partnering a significant milestone

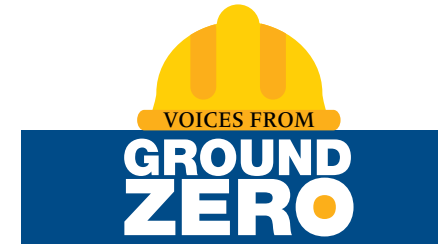
The scope of work comprised construction of comprehensive water infrastructure essentials commencing with the laying of various pipelines across more than 2700 km, BWSC gravity mains, 3775 valve chambers, 42 sumps, 13 GLBRs, 42 pump houses, a 30 MLD water treatment plant and other associated works. Here, the challenge for the team was in channelizing the network that was aligned predominately through forest areas.

## Taking the lead through DGPS survey

In a long span project, finalizing the alignment is critical, avers R.K Subramani, the Project Manager,



Rapid gravity sand filter beds



**R.K Subramani**  
Project Manager

"A tall order of constructing 179 structures was brought down to 125 as the design review affirmed that additional structures could be done away with by maintaining enough pressure at the tail end habitations."

"We took the help of Differential Global Positioning System (DGPS) to capture the altitude, latitude and longitude coordinates up to 8 decimals and subsequently uploaded the inferences onto google maps. Through this, we developed a comprehensive mapping of the pipeline alignment, its length and the structures which largely mitigated any likely errors in the survey."

## Re-designing the L&T way

While speed of execution was always a key factor, what really made a big difference in the deliverables was the way in which we looked at the entire project from the design feasibility point of view, reveals Subramani. "A tall order of constructing 179 structures was brought down to 125 as the design review affirmed that additional structures could be done away with by maintaining enough pressure at the tail end habitations. Likewise, we sourced DI pipes over HDPE conduits that were initially proposed in the scope as it could withstand higher pressure." These were significant value additions endorsed by the client which worked in our favour in closing in on the milestones, vouches Kaushal Puthran, the Planning Manager.



90 KL OHBR at Devaguda



Pipe encasing for river crossing



MS Pipeline (Pumping and Gravity Mains)

## A two way mission to accomplish

The project team chartered a two way execution course across the right and left bank of the Komarambheem dam which was the source of water. "We earmarked these regions as separate sites with dedicated teams depending on the nature of work," highlights Kaushal. "The left alignment comprising 929 habitations was mostly across forest areas while the right section connecting 890 habitations was largely approachable."

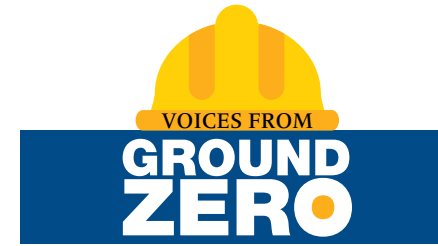
## Working out a head-to-tail approach

Connecting the tasks along the span, Subramani reveals, "Lining up water

lifelines was the top most priority as it constituted a major portion of the works running across terrains. We started with the procurement of major diameter pipes as they had to be laid at the water source and then progressed towards the minor pipes which were aligned along the beneficiary locations." There was a logic in this method, relates Kaushal beaming, "It enabled speedy completion of the various fronts and gave us the advantage of early commissioning of the pipelines across specific sections while negating wastages which would have happened had the pipes been procured earlier." Additionally, critical structures such as Over Head Balancing Reservoirs and a 30 MLD Water Treatment Plant were taken up at the initial phase considering the time required for any likely constraints during execution.

## Steering the way forward

Paving the way forward was like working through an intricate maze, shares Kaushal, "We had forest areas, railway crossings, and agricultural fields that called for unique right of way approaches. In most of the cases, we worked closely with the client to expedite the approvals by preparing maps to break down the multiple segments, aligning shifting of resources in line with the local requirements especially across agricultural fields and railway crossings." Citing some specific cases, Subramani, points out, "Approval for almost 700 km of the alignment across forest areas was given in phases which meant that we had to plan our resource deployment accordingly. Similarly, there were areas which required strengthening of the



**Kaushal Puthran**  
Planning Manager

"We divided the span across 4 zones - Asifabad, Kaghaznagar, Bellampally and Utnoor - so that close to 2700 km of pipes were unloaded at strategic locations along the alignment."

approach roads especially across hilly terrains which delayed the process."

## Zoning resource deployment

Kaushal highlights to a deft resource deployment that was put in place to facilitate execution. "We divided the span across 4 zones - Asifabad, Kaghaznagar, Bellampally and Utnoor - so that close to 2700 km of pipes were unloaded at strategic locations along the alignment. For certain tough terrain sections, a feasible round about routing was worked out taking into consideration the safety of the logistics." A robust stores management system along with a centralized unit was established along with 4 units across zones.

## Banking on 'Pragathi' for monitoring

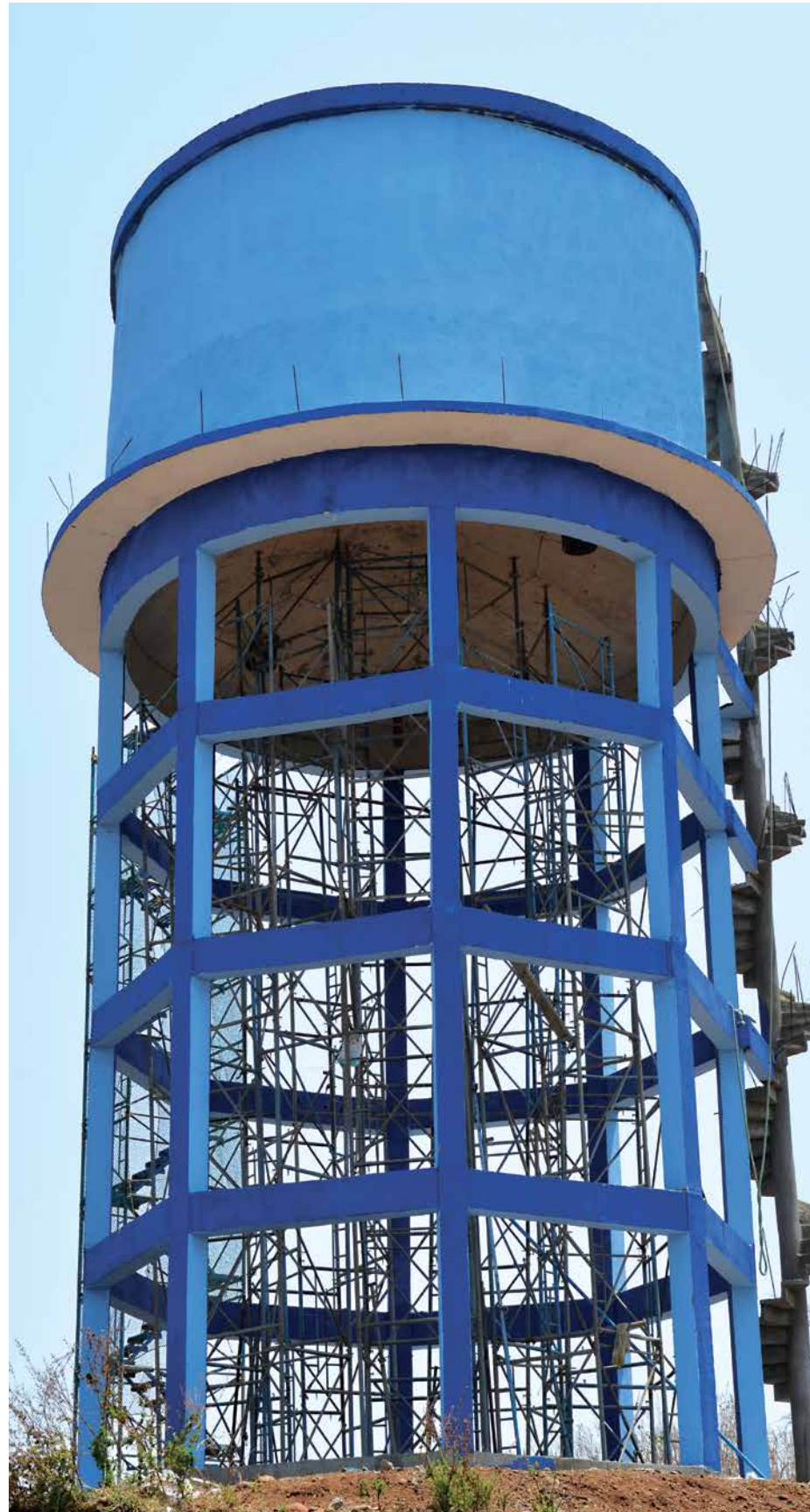
Due to the scattered nature of the site, several work fronts had to be established. "During the initial phase there were 25 different locations that later on had to be scaled up to 40 locations across 18 mandals," shares Subramani. However, monitoring the vast span was always



350 KL GLBR at Manikgudagutta



39 m Dia. Clariflocculator



250 KL OHBR at Pawarguda

in control acknowledges Kaushal, "Thanks to our digital project tool, 'Pragathi', day-to-day progress was closely reviewed along with the critical path inferences thereby facilitating planning of weekly and monthly activities in line with the deliverables."

### Accelerating through process innovation

Whenever we hit a road block there was a lot brainstorming, quips Subramani, "Ideas just flow and at the end of the day we become better and better in what we do. Take for instance, our plan to do precast chambers over the conventional mode fast tracked the entire process across the hilly segment with 90% of chambers casted in a yard thereby seamlessly facilitating transportation and erection. With close to 10335 valves under our scope, we just about managed to raise the bar ensuring that the butterfly and sluice valves were preassembled in a centralized yard to meet the delivery schedules." It was a perfect ploy that enabled the team achieve 100% quality and save considerable time while minimizing the errors in tightening to a large extent. The client was so impressed with this on-field value engineering exclaims Kaushal, "And endorsed it to be implemented across all water supply projects in Telangana."

Another facet where team L&T scored a vital point was in strategizing the river crossing for 1000 mm dia pipes across 3 junctions which had continuous water flow. Normally, welding activities of the pipe joints are carried out by diverting the water in the sandy beds of the river. However, this process involved additional cost and was time consuming. "We came up with a feasible alternative of adopting the sinking methodology as the number of crossings including the



House service connections

secondary lines were close to 20 which considerably saved time and cost," says Kaushal.

### Closing in with a 7 month lead

The good you do always comes back, ascertains Subramani with a big smile, "An operational project built by L&T a few years ago on the left bank gave us the edge as we sourced from its transmission main and used the water for trail testing of our primary lines and later the habitations." "It was brilliant move"

exclaims Kaushal, "We avoided the rigors of sourcing water across the hilly terrain which would have meant a lot of time and enabled completion of the main line 7 months ahead of schedule." While process innovation definitely tilted the scales in our favour acknowledges Subramani, "Tipping the asking rate from 30 to 23 months was possible only by adhering to stringent safety and quality standards all along the way which ensured the site clocked more than 3 million safe man-hours and received a slew of quality accolades from the client."

### Fulfilling a vital need

For the water messiahs of L&T, the joy of accomplishment is large having enabled access to potable water to households and close to 10 lakh residents and for having transformed a dream project into reality in such a short span!



Integrating India's largest  
CCTV based City Surveillance System  
6000 CCTV cameras across 1510 locations for Mumbai



A daunting task, quips Lakshdev Gupta, the Planning Manager, "We had to race against time as the scope was spilt across three strategic phases with the Southern Region earmarked for 1415 cameras covering 408 locations, the West & Central Regions had to be equipped with 2952 cameras over 666 locations, the East & Northern Regions involved 1596 cameras across 428 locations. The challenge all through was to integrate the components while adhering to the phase wise milestones across a largely uncontrolled environment with multiple stakeholders."

covering an average of 18 police stations per jurisdiction that were correlated to the major crime spots across the city. The survey involved a vehicle running at 20 km/hr with a frequency emitter capturing all the features of the roads/junctions which necessarily required many approvals within the city limits." The survey took us only 28 days that threw light on some key variations, says Kumar, "The insight revealed that actually 3000 poles were needed against the initial estimate of 1800 thereby increasing the contract value and the requirement scope."

### Plotting 1510 smart zones in 28 days

We had an immediate task to ascertain the scope as the initial RFP did not undergo any change as far as the locations were concerned, indicates Kumar, "LiDAR (Light Detection and Ranging) was a natural choice for such long span surveys as it was faster to implement and cost effective." But that was easier said than done, sighs Laksh, "To begin with, the police department had to be sensitized about the project through a workshop

### Realigning milestones to the camera count

Smart strategy both on and off the field was the need of the hour, indicates Laksh, "The contractual scope was studied in detail after the survey was finalized so that we could hit the road, as it were, to take up different fronts across phase I that had to be commissioned by November 2015." To fast-track the task, we requested for a change in proposal, mentions Kumar, "Instead of commissioning a particular region, the plan was realigned to achieve

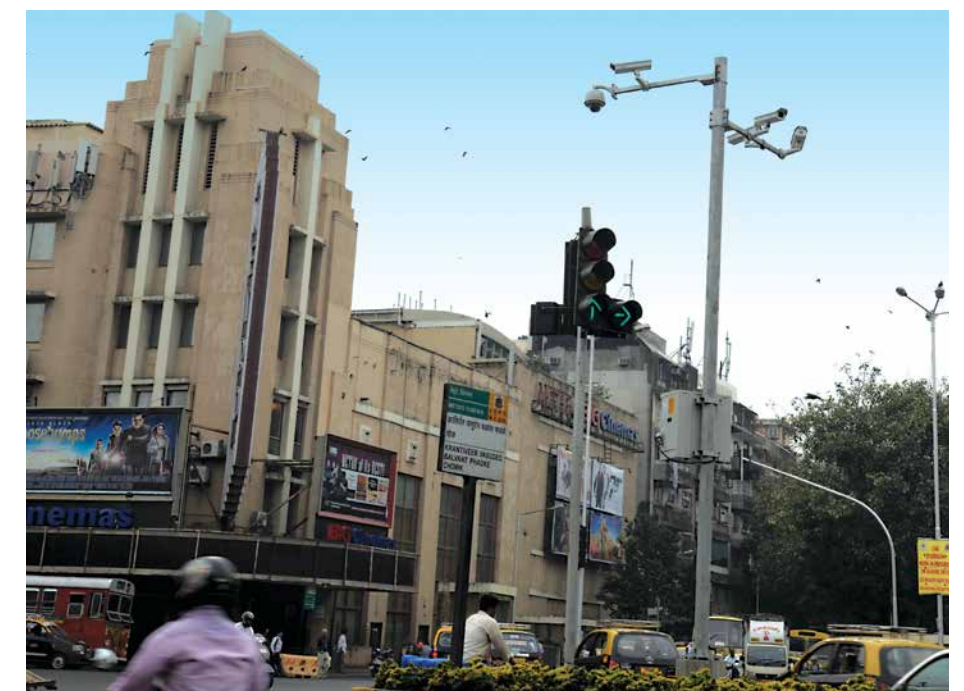
*The dastardly attacks that are now famously referred to as the '26/11' attacks of November 2008, shook the citizens of Mumbai at their very core. The vulnerability of the throbbing commercial capital of the country stood cruelly exposed and the authorities learnt a very crucial lesson albeit at the cost of some 100+ innocent lives.*

*Suddenly, safety and security were viewed in a new light and with mounting pressure from the citizens, the authorities realized the need for some immediate and drastic measures. A top-level committee was formed to evolve a comprehensive strategy to prevent a repeat of the 26/11 attacks. Unfortunately, as with most such initiatives involving several stakeholders, finalization of the plan took a long while.*

*Finally, the first Request For Proposal (RFP) for a secure surveillance infrastructure plan was floated in 2011 that aimed to boost zero public surveillance to be on par with international standards for which 9 major project components were identified to be integrated within the city. The tender was floated 5 times and the contract awarded twice but the plan could not take off due to various strategic reasons. The sixth proposal in 2014 proved decisive with L&T's Smart World & Communication (SW&C) Business bagging the mandate for the construction of India's largest CCTV based surveillance system for Mumbai city within a stringent period of 22 months.*

### A defining project

It was a breakthrough order, exults P.R. Kumar, the Project Director, "The stakes were pretty high both internally and externally as SW&C BU was just about establishing its credentials while, the state government was under pressure to put up a robust surveillance infrastructure that was much talked about." The scope involved design, development, implementation and maintenance of 6000 CCTV cameras over 1510 locations including setting up 3 state-of-the-art Command & Control Centres, 2 Data Centres, a Vehicle Tracking System, Collaborative Monitoring and Mobile Surveillance Systems and to ensure network connectivity across multiple locations of strategic importance in the city.





the milestones based on the camera count that went a long way to help us achieve our targets. This approach had a dual benefit as it enabled strategizing RI/ROW optimization while it also addressed the nearest locations first resulting in considerable savings on time and cost. At the same time, It enabled the Mumbai police to cover all strategic locations at the start of the project to monitor crime and maintain law & order."

### Seeking a smart way forward

With so many stakeholders involved, it was a grueling task to take all of them along with us to achieve our objectives, highlights Kumar. "A large portion of the alignment was across the 24 wards of the Municipal Corporation of Greater Mumbai




**P.R. Kumar**  
Project Director

"A large portion of the alignment was across the 24 wards of the Municipal Corporation of Greater Mumbai (MCGM) which called for individual attention as most of wards had unique functional approaches. With a large part of our work dependent on ROW approvals, we had to take the bull by the horns whenever there was even a window of opening."

(MCGM) which called for individual attention as most of wards had unique functional approaches." It was a complicated process, discloses Laksh, "Approvals from the MCGM came in phases extending beyond the allocated window period to offset which, we took up trenching works beyond the MCGMs' control to cover maximum ground." After several representations to reduce the delay, "we finally began trenching activities in May 2016 while continuously pursuing ways to make further inroads," shares Kumar.

### Accelerating and customizing material procurement

Procurement of materials was mostly in line with the predefined bid requirement with a few items categorized under post bid finalization.

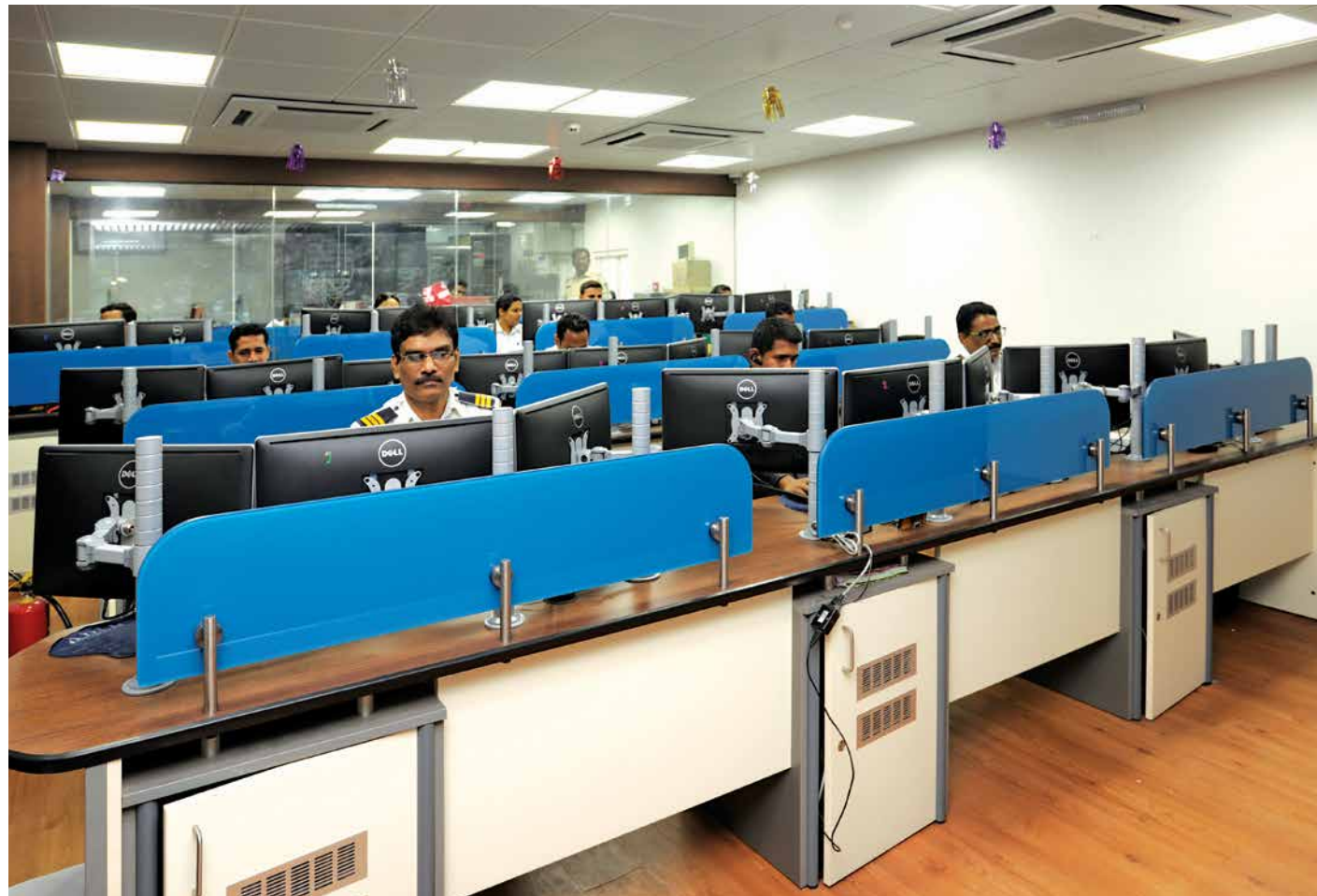
To further integrate, we worked on the post engineering of materials, says Laksh while Kumar adds that all along it was important to perfectly integrate the individual components with one another in such an open architecture environment. "Then, the delivery of products were aligned with the production schedule to meet the 'Just-In-Time' requirements." Most of the imported smart infrastructure were thoroughly tested at the state-of-the-art lab established at site. "This not only helped in weeding out any defective products but also provided an excellent opportunity for hands-on training for our engineers" mentions Laksh.

Two strategic stores facilitated material management in line with the regions based on the police jurisdiction. A system of item wise stacking with tags was ensured while IT equipment were stocked in enclosed areas and workmen were adequately trained to deftly handle material. A daily stock in hand report kept the field teams informed and avoided gaps while executing.

### Third eye technology

The cameras specific for city and coastline surveillance were sourced from two US based companies - Infinova and Flir. The PTZ cameras can Pan, Tilt and Zoom, with 2 mega pixel capacity, high-definition, high frame rate and high SNR real-time images acquisition system. The PTZ domes can view and control H.264 high profile M-JPEG dual stream encoded HD video and support three video streams. The maximum resolution is 1920x1080@30fps or 1280x720@30fps. It is equipped with a user-friendly graphic interface too for easy control, has convenient settings and can perform operations at the click of a mouse.

Specialized thermal cameras take care of coastline monitoring with high performance sensor imaging detailing for optimal threat detection and peak analytics performance even in challenging imaging environments.





## Young brigade to the fore

For Kumar, leading a team whose average age was under 29 meant that he could bank on agility to press the accelerator. “We were perhaps the youngest unit in L&T to take up such a large scale and composite project.” A very effective unit according to Laksh, “We had the skillsets and expertise to take on a range of tasks

with professionals from a cross-section of disciplines on board.” Take for instance the civil scope, chips in Kumar, “Qualified quality engineers with a civil background enabled us to ride over the crisis of installing numerous precast poles in different soil conditions.” Involvement of team members was sustained all through with periodic revision of roles based on the emerging needs thus keeping the morale high, beams Laksh. “The



**Lakshdev Gupta**  
Planning Manager

“There were instances when we completed a month’s work in just 3 days largely possible due to process innovation. For the records, we achieved a peak productivity of over 150 pole installations in a single day and 100+ nos. of network and power trenching which roughly translates to two months of work.”

ANPR pole design is one such task developed in-house by our youngsters that can be used as an ‘L’ or ‘T’ format making the pole highly flexible.”

## Converting constraints into opportunities

All along, an unlikely stimuli was our trigger point, exclaims Kumar, “It was a weird equation but with a large part of our work dependent on ROW approvals, we had to take the bull by the horns whenever there was even a window of opening.” During the peak period, close to 30 subcontractors and more than 1500 workmen were engaged across fronts, recalls Laksh, “There were instances when we completed a month’s work in just 3 days largely possible due to process innovation.” Most of the on-field structural scope was achieved by assembling and testing the components at the stores for seamless integration. Additionally, a separate team took up the cable dressing tasks. We delivered repeatedly whenever the asking rate was higher, exclaims

Laksh, “For the records, we achieved a peak productivity of over 150 pole installations in a single day and 100+ nos. of network and power trenching which roughly translates to two months of work. For South Mumbai, we closed in on the milestones by completing 234 poles out of the total 475 in just 7 days which was twice the requirement of the entire Gujarat CSTIMS project.”

## Designing with a plus factor

Pointing to one of the poles at a strategic junction, Kumar reveals, “It may look simple but there is a lot of engineering that has gone into the development of these structures.” Originally the design was developed based on London’s infrastructure but was customized to Indian conditions with a range of significant value additions that included unipolar orientation, accommodation of cantilever in steps of 500 mm with the provision for holding multiple cameras.” On the whole, it is a scalable setup, mentions Laksh, “one pole can hold multiple fixed and PTZ cameras with the cantilever designed to swivel 180 degree horizontally and 55 degree up and down without disturbing the wiring.”

## Surging ahead with a timely thrust

Playing the waiting act was testing, acknowledges Kumar, “We needed a lot of perseverance to get the pending clearances which were finally approved by none other than the Chief Minister empowering us to accelerate in the last leg. A 16 month backlog was turned around in just 4 months on the guarantee of raising a FIR against any stake holder who held up works with an assurance of no penalization for any on-field issues.” It was like a green corridor, chuckles Laksh, “You have to see it to believe it as we went full throttle to achieve the commitment given to the Chief Minister and the people of Mumbai!”



## Reaching out to the unreachable areas

There were certain inaccessible areas that are unique to Mumbai especially from the environmental and sensitivity point of view like the Aarey Milk colony which technically was a no construction zone. “We had to file a case with the Green Tribunal court for approval which was granted after 7 months of rigorous follow up,” shares Laksh.

Kumar is all praise for his team for installing “116 live cameras without any damage to environment!” Similarly, the Mumbai Port was another restricted area which was accessed after taking into confidence the senior executives that facilitated the installation of surveillance equipment in that area for the first time in a decade.

## Digitalization gives the edge

A slew of digital initiatives gave the project a decisive edge. Intelligent

Power Distribution Units were installed to track power connectivity in the installed IT infrastructure and poles were mapped on data sheets for analysis. Geo-Spatial devices helped in the survey, in-house software for real-time monitoring and RF Radios for wireless transmission. Additionally, there were various forms of access requests and establishment of remote services to ensure data protection and secure communication in compliance to ISO 27001.

## Engineering at the heart of the matter

Today, Mumbai boasts of not one but three state-of-the art command and control centers. “Putting these together was no mean task as the administrative structure of the police department had to be aligned with viewing stations,” says Kumar. It called for creating a wireframe infrastructure that connected 100 police stations and other high level offices across the city to the viewing stations.”

The 3 state-of-the-art command and control centers being operated by the Mumbai police are the most advanced city surveillance systems in the country. Each center is distinct in its architecture with the main center, the largest such facility across the country, established inside the commissioner's office at the 5<sup>th</sup> floor spread over 1500 sq.ft. It has 3 giant video walls of '8x2' configuration with 67 screens and is also the interface for video surveillance and other critical security applications such as Picture Intelligence Unit, VAHAN, CCTNS, Interfaced with Dial 100, call takers and dispatchers i.e. Directing Emergency Response Teams (Police) to the affected place.

"Integrating the infrastructure inside the commissioner's office was a critical task that had to be carried out with utmost safety and quality," mentions Kumar, "Right from sourcing an experienced vendor to thorough checking of the specifications was meticulously done." We also ensured that the process was fool proof, affirms Laksh, "A full time L&T engineer with 15 plus years of experience was exclusively deputed to oversee these tasks which were accomplished in 28 days."

From the traffic regulation perspective, another key center has been established at Worli from where challans are generated for all traffic offences. "It has been a huge success generating over Rs. 40 crore of revenue and improving discipline among road users" laughs Kumar. For back-up, a disaster recovery command center has been established at Kalina and in case of any likely breakdown, the architecture has been designed so as to accommodate the entire operations of the main command and control center. At any point of time, the proportion of the display matrix can be customized to include more windows and the live video feed is stored for 30 days. Two data centers, one in Mumbai and another in Navi Mumbai cater to high-tech requirements.

## Banking on intelligent applications

A fully integrated security surveillance application – Verint, provides easy-to-use and highly flexible management tools for controlling the most demanding multisite video surveillance operations at the control centers. It helps operators

detect, verify, resolve and investigate security events quickly and effectively through customized dashboards in a Situation Management Center Application that includes a complete Virtual Video Matrix (VMX) that accelerates event management, using the power of the network to deliver videos wherever and whenever needed.

For network and performance monitoring, a customized software application – Enterprise Management System - has been installed to quickly and easily detect, diagnose, and resolve performance issues before outages occur. This easy-to-use, agentless software delivers real-time views for visual tracking and network performance monitoring at a glance. Further, network expansion is also supported by using tools such as dynamic network topology maps and automated network discovery.

Various other applications like Automatic Number Plate Recognition, Video Analytics, Vehicle Tracking System and Facial Recognition have been deployed in this robust system to effectively monitor and control the overall operability of the system.



## Other empowering integrations

Some of the other significant applications integrated include Vehicle Tracking System, DIAL 100 system that enables sharing of information to the Mobile Data Terminal for further dissemination. "So far more than 3500 footages were delivered for solving various incidents with the Picture Intelligence Unit having a provision of generating on an average more than 3000 manual alerts, 9000 video analytics alerts, 400 ANPR stolen vehicle alerts, 0.12 million calls for services out of which 5 % were distress calls." shares Kumar.

## Delivering a safe promise

In line with the safe city objectives, the project achieved the phased out milestones with the Chief Minister inaugurating the overall scheme for the public on 2<sup>nd</sup> October 2016. "We could complete the project well ahead of time thereby availing the users to enjoy

the benefits of the system," mentions Kumar. The gains are many as the system gives a clear 360 degree insight to solve many cases including a high profile kidnaping that was resolved within 24 hours. During major happenings, such as the Maratha Morcha, Ganesh Viserjan, natural disasters and VIP movements, it has acted as a force multiplier facilitating seamless coordination. With the Go-live achieved on 5<sup>th</sup> September 2017, Mumbai now rests assured of a comprehensive surveillance system in place.

## In line with the Service Level Agreement

For team L&T, with more than 2 million safe hours on the board, the onus is to oversee the operations and maintenance for a 5 year period adhering to one of the most stringent Service Level Agreements (SLA). Being a first-of-its-kind SLA, a lot depended on us to integrate the requirements indicates Kumar, "With no 'Common Off the Shelf' insights available it was necessary to quickly come up with a unique and robust software to support the SLA." It was a 'Make in India'

project, shares Kumar, "We developed a customized SLA Management Software to take care of the various parameters in a largely uncontrolled environment." The gains are comprehensive as specific forms have been created for proactive monitoring and submission of evidences thereby facilitating 360 degree crime analysis. So far we have upped the scale significantly, exclaims Kumar, "Beginning with a score of 67.5% in Q1, the SLA performance has been top notch achieving 94.5% in Q2 and 97% in Q3, with a perfect score of 100% in 56 parameters out of the 57 SLAs."

The results are there for all to see acknowledges Kumar with a broad smile, "Various inputs from the surveillance system are now being collated by the state government towards making a comprehensive insight on crime analysis which will be presented at India's first conference on crime analysis." Certainly this marks a significant moment for the city administrators and for L&T, it's all about making cities safer as a Master Systems Integrator.

## Mumbai City Surveillance Project : India's Largest Surveillance System

CCTV & Number Plate Cameras :  
**6000 Cameras (1510 locations)**

Data Centers :  
**2 Data Centers (Active - Active)**

Command/Viewing Centers :  
**3 - Command & Control Centers**

Vehicle Tracking System :  
**Vehicle Tracking for 1000 Vehicles**

Collaborative Monitoring :  
**Receiving video feeds from 100 establishments**



Just 30 months to channelize  
water life lines in the land of dunes!

Nagaur-Bikaner Water Supply Scheme

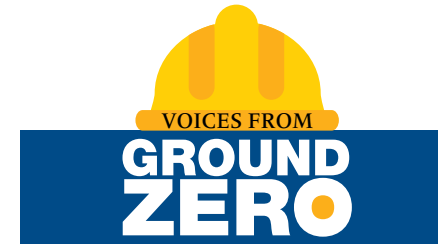


With so much talk about the inter-linking of rivers, the Indira Gandhi Canal represents the shape of things to come. One of the largest water distribution networks in the country, it sources water from the Himalayan Rivers of Sutlej, Beas and Ravi and channels it to the states of Punjab, Haryana and Rajasthan. Already lives have been transformed; barren wastelands converted to cultivable lands and gradually water is flowing to irrigate the dry and parched interior regions of India's hottest and driest state – Rajasthan. The Nagaur and Bikaner water supply project, initiated by the Public Health Engineering Department of Rajasthan and awarded to WET IC, is a part of this grand programme that aims to bring drinking water to 9 towns and 1,097 villages bordering the Thar Desert. To bring succor to people who struggle with ground water that is extremely saline and highly fluoride toxic.

## Laying the ground

Having delivered similar significant water infrastructure schemes in the arid regions of Rajasthan before, Project Director Shaik Yesdani Ahmed found himself on familiar territory. "This, however, was a bigger project with a tighter deadline of just 30 months," he clarifies. The scope involved the construction of a 5310 ML capacity reservoir that would be the storage hub, a 250 MLD water treatment plant, 11 intermediate clear water reservoirs and pump houses. "With the scope covering close to 256 km of MS and 207 km of DI pipes, it was critical to finalize a route that was less congested, bypassed villages and permanent structures."

Their first road block was the survey as Planning Manager, Harshal informs, "Since we couldn't go ahead with the already proposed survey, we conducted



**Shaik Yesdani Ahmed**  
Project Director

"Putting together the water transmission main across 256 km was tricky as well involving a significant amount of MS pipes. Wisely we went for a vendor who put up a plant and it worked very well for it gave us an edge in costing, production and delivery with close to 1,20,000 t of pipes in the scope."

a Differential Global Positioning Survey that helped us zone the plots and finalize the alignment in really quick time."

There were three key packages and the team decided to split them into separate work fronts, led by three Project Managers: Dinesh Kumar (TM 01), Daujee Mudgal (TM02) and A. Elango (TM 03) with separate teams and resources and hit them all together. "We established strategic junctions to meet the internal milestones," mentions Shaik, who set up major zones at Nokhadiaya, Deshnok, Johdiyasi and Jayal to facilitate prompt supply of materials to the various work fronts along the alignment.

## Simplifying the process

Putting together the water transmission main across 256 km was tricky as well involving a significant amount of MS pipes for which Shaik had two options: to either outsource the conduits or source a vendor who could customize the production by setting up a plant for meeting the requirement. "Wisely we went for a vendor who put up a plant and it



250 MLD Water Treatment Plant at Nokhadiaya



Pumping Station at Jayal Headwork



Pumping Station at Deshnok Headwork

worked very well," smiles Shaik, "for it gave us an edge in costing, production and delivery with close to 1,20,000 t of pipes in the scope." The deployment of pipes was according to the availability of work fronts while those that faced ROW issues were taken up in phases. The other essentials such as DI pipes were externally sourced considering the feasibility advantage.

## Watch your step

With the alignment running through public domains, the team had to be wary when laying the conduits, constructing the raw water reservoir, water treatment plant, pump house and other associated structures. As soon as the client approved the drawings, Shaik and his team took off. More than 350 subcontractors were engaged at each work front to ensure progress as per

schedule. Since they were dealing with a predominantly desert-like terrain, they had to contend with steep ascents and loose, infirm underfoot conditions when constructing the structures. Forewarned is being forearmed and their previous experience in the region came in handy for they ensured safe work fronts with approach ramps that secured the movement of materials and facilitated the process through appropriate staging as and when required. Every task has its own challenges even if it is an encore. "Each time the task seemed tougher," Shaik shakes his head, "but we were successful thanks to our expertise in executing such projects before."

The transition was in phases, adds Harshal, "Land acquisition was largely handled by the client though being on the ground, we had to interface with

the locals which called for some deft handling because it involved the local administrators as the alignment was going across cultivable land."

The strategic railway crossings required an entirely different approach. "Four railway crossings had to be aligned as per the time frame stipulated by the Railway Authority of India which was very stringent," explains Shaik. "It was more of a window-like opening during which we had to quickly preplan the sequence and execute the crossover."

## As unpredictable as the weather

"A blisteringly hot day could very often eventually turn out to be a stormy evening and there were many such occasions," remarks Shaik, "but we braved the hostile weather very well,



*Inlet and Clariflocculator Unit*

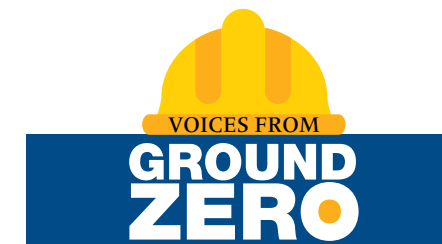


*5310 ML Raw Water Reservoir*

of course, with due caution and safety because of which we came to be known as the 'Desert Warriors of L&T' among the locals," he laughs. Nothing was ever taken lightly: during summer, the workmen were advised to take a break between 12 pm and 3 pm while energy supplements such as glucose water and towels were made available across work locations. "Winters were an altogether different proposition with temperatures dipping below zero degrees," shivers Shaik, "but we ensured that warm accessories such as blankets and other facilities were provided at the workmen colony."

## Many gains from value engineering

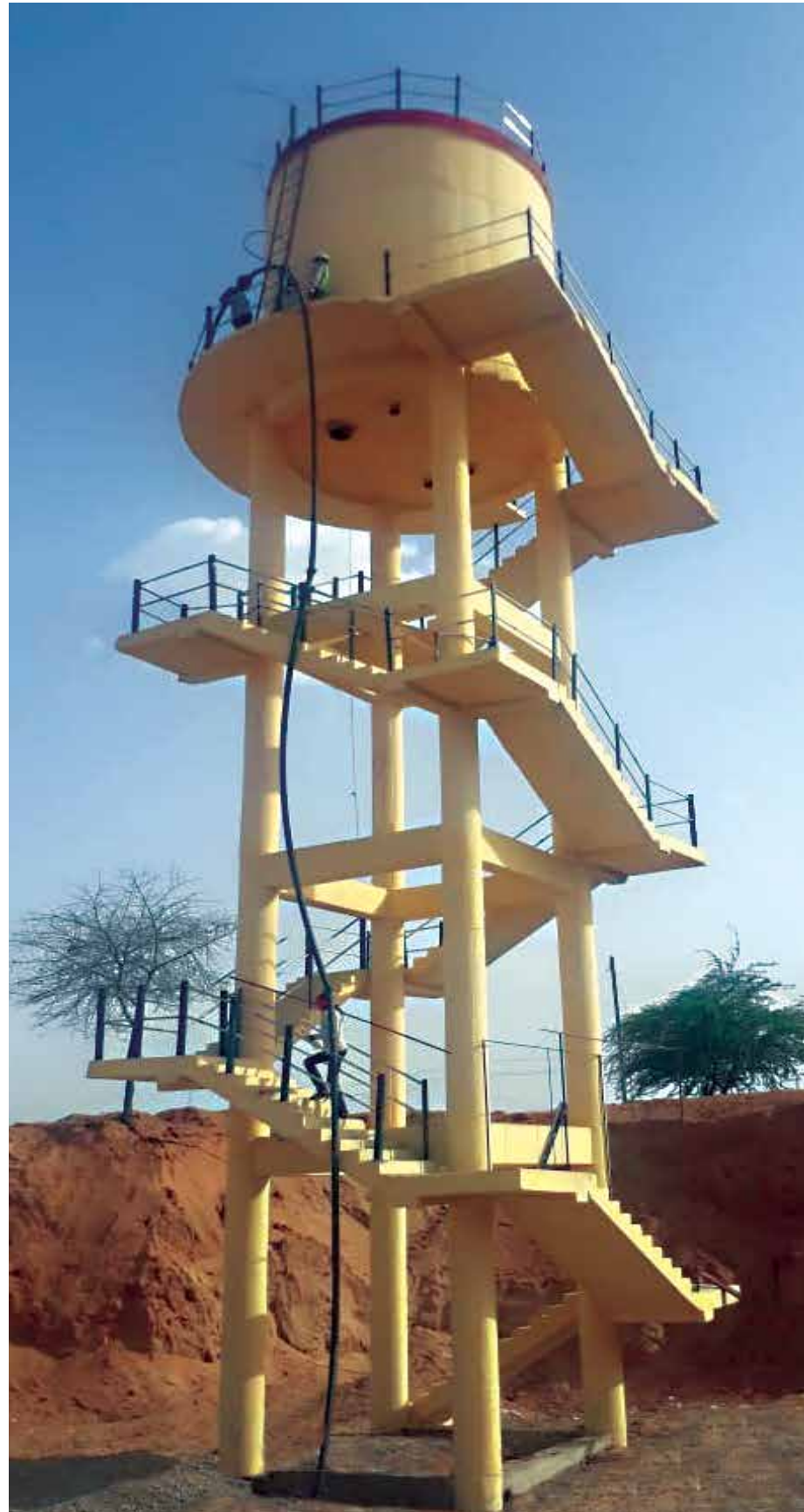
At the end of the day, it is all about improvisation on the ground that spells success and the project team



**Harshal**  
Planning Manager

"We streamlined the essential tasks with value engineering to speed up the works. To begin with, MS special were fabricated at the yard and later integrated with the flanges at the head works."

improvised a fair bit and successfully too. "We streamlined the essential tasks with value engineering to speed up the works," shares Harshal. "To begin with, MS special were fabricated at the yard and later integrated with the flanges at the head works." Another novel approach was the deployment of mobile tower cranes for the first time to facilitate concreting of major structures and concrete pumps for mass concreting works. Apart from setting up a batching plant at site, a curing compound was used for the pipe joints across a 250 km span where water were not available. Individual agencies were called to execute the different works that avoided monopoly and over dependence on specific subcontractors.



Surge Tank

## Being in control with digitalization

Life is changing for the better for Project Directors like Shaik thanks to the huge benefits of digitalization. "Not only was I able to monitor vast spans across the project but reviewing daily progress with 'Pragati' was so much easier." The P&M asset monitoring system ensured maximization of resources for the necessary impetus to speed up the works. The team did not have to fear of sudden breakdowns either as data analytics give them sufficient early warning to preplan and mitigate any likely breakdowns. Apart from ushering in greater transparency, the 360 degree daily insight is a wonderful boon for Shaik and his ilk.

## Building a modular purification system

"The plant has a unique modular design and has been built with future requirements in mind," points out Shaik, alluding to the fact that apart from just building the water network, there was a lot more engineering that went into the making of one of the most state-of-the-art water treatment plants in the country. It has 6 modules of 50 MLD capacity each for a total output of 300 MLD, "and the great thing is that it can be integrated and scaled up at any time in future whenever requirements increase." Other support equipment/infrastructure includes 6 vertical turbine pumps, an inlet chamber, 6 48 m clariflocculators, internal and external flocculation tanks, sedimentation tanks, 20 rapid gravity sand filters, a chlorine contact tank, a chemical house, a control room, an administrative building, a 27.5 ML clear water reservoir and a clear water pumping station.

## Automating the scheme

L&T executed the complete automation of the pumping system with PLC



Master Control Center



Hon'ble CM of Rajasthan, Ms. Vasundhara Raje, inaugurating the scheme

SCADA, which monitors and controls the flow in the plant. Each pump house is equipped with a local SCADA, that is connected to the Master Control Station for single point management with a provision to access a range of reports on temperatures, pressure levels and discharges. The pumping station is equipped with vertical turbine pumps and can be operated in auto or manual modes through the Remote Terminal Unit from the Master Control Station. The treated water discharged from the plant is again put through a treatment process at the various offtake points.

## Reaping the benefits

For Shaik and his team, it is time to sit back and enjoy the uplifting feeling of having been part of a national mission to bring the gift of life to thousands of people. "Having executed the project safely with over 8 million incident free-man hours gives us added pride and satisfaction," says an obviously happy Shaik. "It is to be noted that the blocks in Makarana were getting water supply once in 15 days and the people in Degana, Didwana & Ladhnu were receiving water once in 4, 8 & 7 days respectively, prior to the commissioning of the scheme." For the 4 lakh plus people across the camel hump landscapes of Nagaur and Bikaner, a distant dream is now a daily reality with the scheme on stream after the successful inauguration by the Hon'ble Chief Minister in May 2018. Having done all the good work, the onus is now to keep the system running efficiently for the next 10 years, a promise that L&T's Desert Warriors are keen to deliver!



Driving the city of pearls  
into the future

Hyderabad Metro Rail Project



On November 28<sup>th</sup>, 2017, the Hon'ble Prime Minister Narendra Modi inaugurated a 30-km section of the Hyderabad Metro Rail, setting on tracks one of the largest metro projects in the country. Not only did it bring to fruition the sterling efforts of several L&T stalwarts, but it also realized the dreams of millions of Hyderabadis for a world-class metro rail system. Apart from transforming their lives, the L&T Hyderabad Metro Rail, is another chapter to the wonderful relationship between the city of Hyderabad and L&T that already features Cyber Towers, HiTech City, HITEX Exhibition Centre and the Hyderabad Airport.

## Where it all began ...

Though the initial bidding for the project was completed in July 2008, the earlier contractor was unable to fulfil the expectations of the stakeholders by failing to achieve financial closure in the stipulated period therefore the Government of Andhra Pradesh invited for fresh bids in July 2009. "We actually got a second bite of the cherry when the rebidding process began in July 2010," recalls Project Director M P Naidu (MPN). Metro biddings are typically intensive owing to their magnitude and the HMR project was a monstrous in size! To add to that,

The Hyderabad Metro project has given the theme of 'Speed & Scale' new definition!

The world's largest project on a PPP (Public-Private Partnership) mode in the metro sector

India's largest single urban transportation development project

One of the longest stretches of metro in India - 72 kms

At 30 km, it is the longest section to go operational at one stroke

The fastest in achieving financial closure within 180 days from signing the concessionaire agreement

Two of the largest precast yards in Asia

there were barely 6 months from pre-qualification to financial bid submission stages.

A core team under the leadership of K Venkatesh, the CE & MD of L&TIDPL and guidance of the Late A Soundararajan put together a comprehensive financial model and after a stringent two-stage bidding process, L&T emerged successful. The LOA (Letter of Award) was issued on 6<sup>th</sup> August, 2010 and L&T's odyssey to develop a metro system par excellence commenced.

"It was critical to achieve financial closure within the stipulated window of 120 days of signing the concession agreement because that was where the earlier developer had failed," shares



**GROUND ZERO**



**P Ravishankar**  
Head - Project Planning,  
Control & Contracts

"At Rs. 11,500 Crores (then), this project was perhaps the biggest of its kind in the infrastructure space barring some power plants."

## Get, set, go ...

"At Rs. 11,500 Crores (then), this project was perhaps the biggest of its kind in the infrastructure space barring some power plants," declares P Ravishankar, Head - Project Planning, Control & Contracts. "We planned 3 corridors split into 6 stages with a horizon of 5 years to complete the 72-km alignment and we wanted to complete all the designing and engineering before commencing construction to give us more time for negotiations."

"With end-to-end delivery responsibility, we were expected to deliver from concept to commissioning: construction, operation and maintenance," shares Chief Operating Officer, Anil Kumar Saini in his neat, clipped tone.



**GROUND ZERO**



**Anil Kumar Saini**  
Chief Operating Officer

"With end-to-end delivery responsibility, we were expected to deliver from concept to commissioning: construction, operation and maintenance."



**GROUND ZERO**



**J Ravikumar**  
Chief Financial Officer

"It was critical to achieve financial closure within the stipulated window of 120 days of signing the concession agreement because that was where the earlier developer had failed."

Chief Financial Officer, J Ravikumar, looking out onto the bright, sunlit terrace outside his plush cabin at the Uppal HQ. "We could only deal with PSU banks and that increased the pressure but we pulled it off!" He sounds exultant even so many years later. The Concession Agreement was signed on 4<sup>th</sup> September 2010 and the financial closure was ready bang on time by 1<sup>st</sup> March 2011. However, due to a delay in procuring the requisite land from the government, the appointed date was 5<sup>th</sup> July 2012 and the Bhoomi Puja was conducted for the project on 26<sup>th</sup> April, 2012.



Integration was perhaps one of his biggest and early challenges. “We were responsible for everything right from designing to site execution and everything in between and what helped us was the Early Engagement process that we adopted. We had to deal with a large number of vendors and suppliers, so we brought them on board as early in the piece as possible and thus made them part-owners of the project!”

## Thinking innovation to create a masterpiece

For MPN and the project team, the role was different as L&T were developers of the project with the construction entrusted to L&T Construction. Though a more demanding role, the project presented them an ideal platform to show case their technological and engineering capabilities. “Every aspect was sieved through two filters: ‘best-in-class’ and ‘fit for purpose’ says MPN,



**M P Naidu (MPN)**  
Project Director

“Every aspect was sieved through two filters: ‘best-in-class’ and ‘fit for purpose’ says MPN, “but the big difference in our approach was that, as a team, we believed that we were going to create the best possible metro. Innovation was our operative word.”

“but the big difference in our approach was that, as a team, we believed that we were going to create ‘the best possible metro’ that drove the team

and our contractors to even greater heights. Innovation was our operative word,” he smiles.

The RAMS (Reliability, Availability, Maintainability, Safety) principle was followed because as MPN reminds us, “Though we were building the metro for the people, we have to give it back to the government at some point.” Everything therefore had to be just right. They strove to drive down operation cost, which in turn would result in lower cost of maintenance and a measure of the success is reflected in the fact that while the Delhi Metro requires 63 people per km for maintenance, the Hyderabad Metro needs just 25 per km!

## A survey to reckon with

The initial survey to map out the alignment was crucial as the construction method and the government’s land acquisition plan rested on its accuracy. “Of course, the government wanted to

acquire as little land as possible and looked to us to help them. In fact, our survey was so good that when we started to connect the sections, our closing error was not more than 10 mm,” beams MPN. The engineering challenge the survey threw up was that they would have to consider a number of ‘non-standard viaducts’ across the 72 km alignment. “We decided on 85 m span column space that was unsupported,” and there are 8 ROBs, each with a signature design of its own dictated by the strict requirements of the Railways.

## Following examples; setting them too

With the alignment planned to cut through the very heart of congested Hyderabad, two paramount considerations for the team were: how to help the government to acquire as little land as possible and how to create as little inconvenience for the local citizens as possible. The first requirement was to evolve a smart method to make the viaducts leaner and meaner. “It was SNS who came up with the idea,” says MPN with a laugh. “We were evaluating different possibilities and he came up with idea of adopting a ‘Spine & Wing’ approach. We had successfully implemented it for the Mumbai flyover and we were confident it would work here too. Straight away, two columns were removed, only one column was required that needed less space, less material, less time!”

A novel foundation scheme was adopted under the guidance of Prof. Raju of IIT Delhi. Hyderabad has a rocky terrain and the technical criteria calls for excavation of a minimum depth. Lean concrete was filled in the excavation to rain the founding levels, which in turn reduced the pier heights, the corresponding sizes of footing, etc. This method was later adopted for the Riyadh Metro.

With the overall design featuring just a column and viaduct, the team precast the elements in the yard, moved and erected them at site in the middle of



*A picturesque view of metro station*

the night all within a 6-hour window without the citizens knowing what was happening. “One day we would see some rubble and debris but the very next day the debris would have gone, and you could see a column erected with a cap,” says a local whom

I met and spoke to at a newspaper depot. It was not that simple because as MPN says, “We had at times some 20 launching girders working together,” referring to the magnitude and the speed of construction that the Heavy Civil Infrastructure IC was handling.



Another dictate from SNS was not to have any of the kilometres of wires and cables hanging around. The team found a way to conceal them that enhanced the aesthetics of the structure. The water sumps are all located under the median in the middle of the road and another innovation the team came up with was to use a curing compound rather than water. It saved gallons upon gallons of water as also all the logistics issues and the muck that is created in the middle of the road during such works.



**S Arunakumar (SAK)**  
TFL Head - HMRP

## Stations designed with a difference

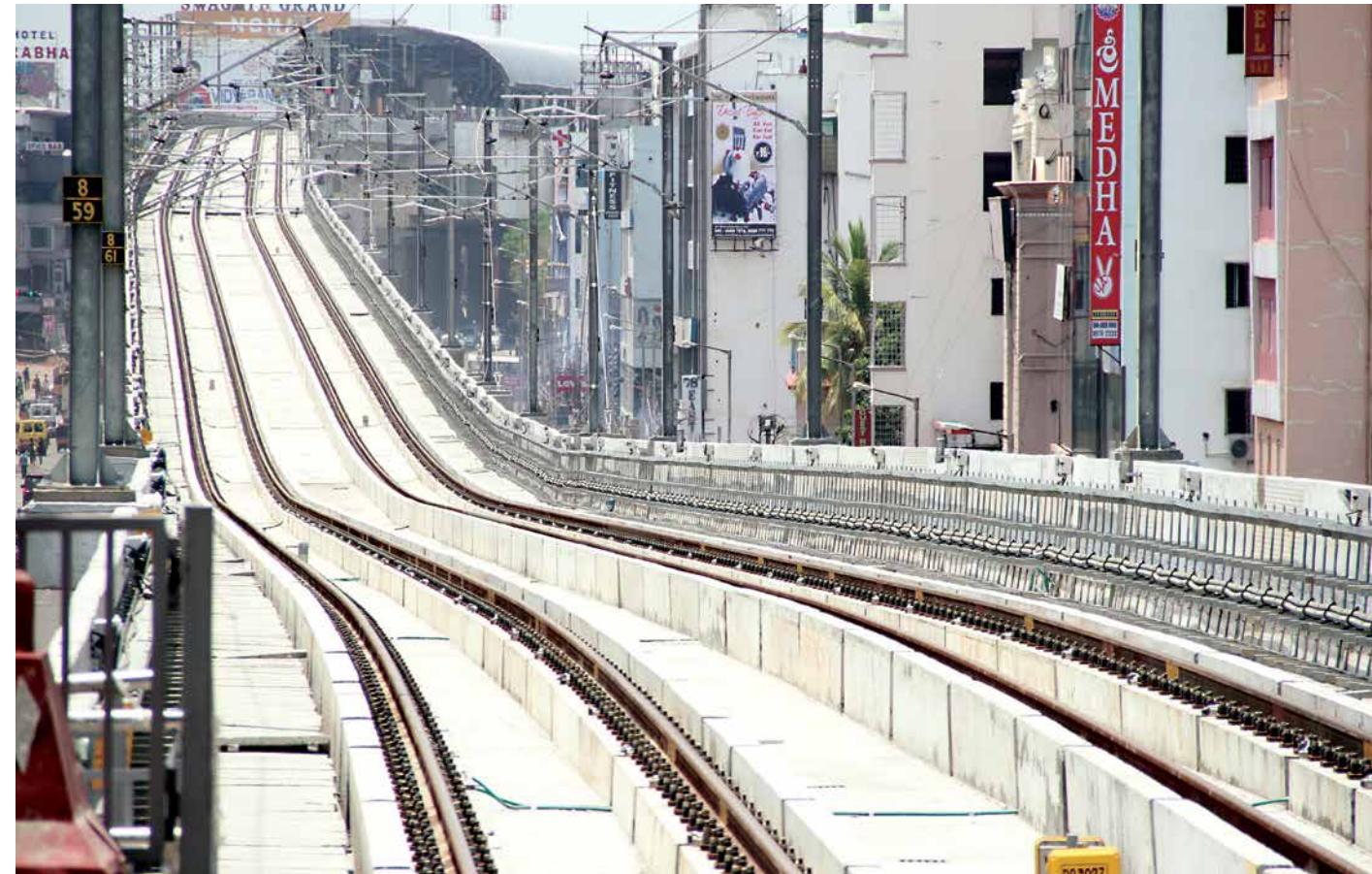
The Hyderabad Metro stations are the first of their kind in the world, balanced cantilevered and resting solely on central piers using the Spine & Wing concept. "We almost bit off more than we could chew," chuckles S Arunakumar (SAK), TFL Head - HMRP, representing the B&F IC's involvement in the project. "We

"We planned for the construction of all the 65 stations together and at the peak activity phase, as many as 45 stations were being simultaneously executed in the dense traffic corridors of Hyderabad!"

planned for the construction of all the 65 stations together and at the peak activity phase, as many as 45 stations were being simultaneously executed in the

dense traffic corridors of Hyderabad!" The average precast erection time for each station was 90 days while a typical station took 15 months to construct. "The Ameerpet Interchange station which is one of the biggest with built up area of 2.5L Sqft was executed in 15 months!" shares SAK proudly.

Constructed in around one-fourth of a lakh of built-up area on the road median, these 65 stations involved 12,500 precast elements put together in a space of 24 months and sourced from two precast yards located in geometrically opposite corners of the city equipped with fully hydraulically operated moulds. SAK then reels out a slew of numbers that highlights the largeness of the task. More than half a million cum of concrete, 50000 MT of TOR steel & 15000 MT of structural steel, 5000 MT of pre-stressing strands, the list is long and impressive. "All this took approximately 100 million-man-hours to execute," he adds quite simply.

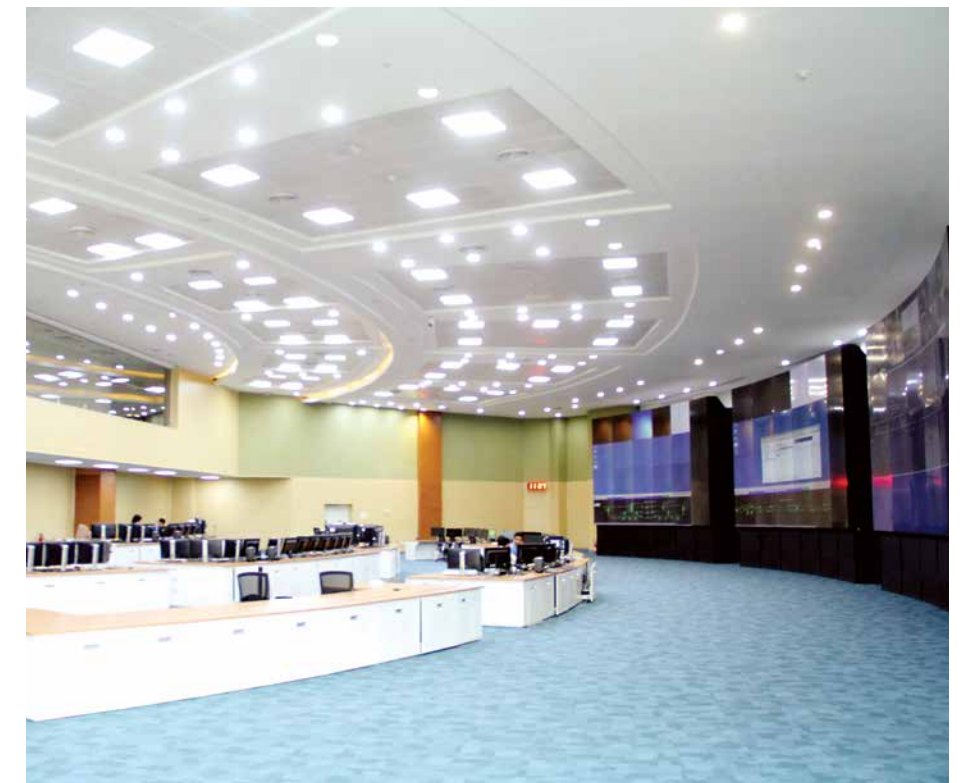


Intelligently designed, the stations have humps at approach points to slow down the rake and at exit points too for it to speed up when leaving the station.

All the stations have won the Green Building Platinum Rating for the design, use of flyash (90%), adoption of precast engineering, less use of water, energy and power conservation.

## Tracks with a bent towards greater passenger comfort

The metro negotiates sharp curves of 128 meters that calls for specially designed tracks. After several oscillation and other studies, analysing methods followed by other metro systems overseas and ascertaining the P/Q Index, the team moved away from the 1 in 20 rail configuration to the 1 in 40 for better stability and thereby greater passenger comfort. "With such sharp curves



Operations Control Centre

involved, we decided that by tilting the rails slightly we could achieve better stability," informs MPN. The wheels of the rake are connected by an axle and have to rotate in tandem although the outer radius is more than the inner one which is why the tilt to the track. "Since it was the first time this method was being used in a metro, we had to take due RDSO approvals to implement it," says MPN.

## A 'powerful' intervention

Powering the metro was another challenge that was faced by the Power Transmission & Distribution IC. Their scope of work was extensive: involving receiving substations, depots with auxiliary substations, operation control centres, genset and UPS systems. "Our design ensures 99.9% availability of power supply," declares A Alphonse, Construction Manager (Electrical), confidently, "and standardization of designs across the project saved both time and cost."

In line with innovation being their operative word, he refers to their innovative use of the less available space by "introducing first-of-their-kind 33kV & 25kV Gas Insulated Indoor Switchgear in both the receiving and auxiliary substations." The 33 kV cable were laid on the viaduct with drums located at the median, without having to lift them onto the viaduct that avoided the use of additional P&M and again saved cost and time. "Of course, the LED lighting implemented across the project makes this a truly green project," he smiles.

Power constitutes 30% of operating cost and it is no rocket science that if cost of power is reduced so will operating costs. The introduction of solar panels has reduced the cost of power by 30%, which is a huge bonus. Even, the rolling stock was selected on the basis of power consumption.

## Built-in reliability

There are built-in redundancies and 'MAXIMO', an online asset management system that triggers alarms, address

maintenance issues. "MAXIMO is basically an electronic fault-finding system that enables need-based maintenance of various systems, etc.," elaborates MPN. "We dispensed with the normal railway regime and instituted this method that, most importantly, brought down maintenance costs."

The smart set-up uses sensors for the various systems like firefighting, lifts, cameras that 'talk' to the station controller who, sitting in his cabin, can monitor the functioning of the entire metro. At the first sign of trouble, the controller can take immediate action by de-activating the errant system, switch systems and then instruct the maintenance crew to address the fault – need-based maintenance has significantly reduced operating costs. The Advanced Communication-based train control system is also in use for the first time in India.

## Only the best

MPN recalls his days at the DIAL project. "One of the things that we learnt at DIAL



One of the largest precast yard in Asia



**G Ravi**  
Head - TOD

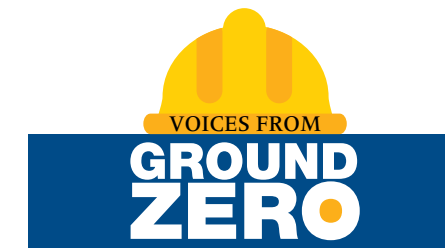
"To start with, we are almost ready with 2 very large malls covering cumulatively about 6 lakh sqft and we are looking at rentals to the tune of Rs. 5 Crores per month."

was that getting the best partners went a long way in a successful project and we followed that principle here too." Only the 'best in class' system partners were chosen whether it was with respect to designing, the rolling stock, signalling, civil construction, et al.

## TOD to the forefront

With the metro largely in place, the focus has shifted to Transit Oriented Development (TOD) that is an integral part of the project to establish its financial viability and bankability. With 18.5 million sq. feet of land at his disposal, G Ravi, Head – TOD, is faced with the stern challenge to convert this land into commercially attractive properties. "The metro and the TOD assets form the Project Assets of the concession for an initial period of 35 years," informs Ravi.

Metro systems usher in economic activity along its route, which is what Ravi is banking on. "To start with, we are almost ready with 2 very large malls covering cumulatively about 6 lakh sq.ft and we are looking at rentals to the tune of Rs. 5 Crores per month." He and his team have already brought some of the big brands on board and soon should get the big bucks to roll in too.



**K V B Reddy**  
MD & CEO

"We should be able to operationalize two entire corridors by this year-end and thereafter it would be a question of connecting the unfinished dots."

## The end is in sight

On MD & CEO, K V B Reddy's shoulders lie the mantle of not only bringing the big bucks in but also leading the Hyderabad Metro project round the corner onto the home stretch. "We should be able to operationalize two entire corridors by this year-end and

thereafter it would be a question of connecting the unfinished dots," he says, looking serious but determined. "There are hurdles in terms of fund flow, approvals, land acquisitions but at the end of the day once we are done, the city of Hyderabad will have one more reason to be enormously proud of!"

Although, a majority of the metro system is ready to go operational, the remaining incomplete sections are giving MPN and team headaches, "filling the gaps is a painful exercise." There is talk of de-scoping due to certain unsurmountable problems that the government is facing and other chatter about stretching the alignment to link the Hyderabad airport. On the ground, however, the metro is on track, running smoothly with very few hiccups. The Hyderabadis have taken to their prized possession with as much relish as they tuck into their biryani and with footfalls steadily increasing, the motto of 'My City, My Metro, My Pride' is finding widespread expression day in and day out.

# L&T wins FICCI Corporate Social Responsibility Award



L&T has been conferred the FICCI CSR Award 2016-17 for its innovative work in integrated community development for rural communities, as part of its CSR initiatives. The award was presented at the prestigious Federation of Indian Chambers of Commerce and Industry (FICCI) CSR Summit & Awards 2017, on November 30, 2017, at New Delhi. Mr. P.P. Chaudhary, Minister of State for Corporate Affairs, Law & Justice, presented the award.

The award was conferred in the category of Health, Water and Sanitation for Private Sector Companies. Watershed initiatives undertaken through L&T's flagship Integrated Community Development Programme are implemented across five locations

in three states. Communities in these locations have seen a significant increase in their water availability, crop productivity and community participation in decision-making over the project period.

L&T was adjudged winner post three rounds of review, including site assessment, followed by interaction with a distinguished jury chaired by Mr. U.K. Sinha, former Chairman of SEBI.

This award is yet another affirmation of L&T's CSR commitment towards 'Building India's Social Infrastructure' and reaching out to the most underserved segments, through its innovative community development initiatives.