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TOWARDS OUR GOAL OF 'VISION ZERO'!

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LEADER SPEAK

S.N. Subrahmanyan,
Chief Executive Officer & Managing Director, Larsen & Toubro

Safety is the result of a well-considered, well-planned and well-executed strategy and sites that have good safety records are the ones that have done well. It requires discipline, purpose and constant focus but, above all, a mind towards safety that is critical to create a safe work culture that in turn leads to the creation of a safe work environment. It calls for a mindset that appreciates the need for safety and recognizes that by following the prescribed EHS conditions, everyone at site can remain safe, injury-free and return to their loved ones at the end of every shift.

One of the many Safety Champions at site whom we have featured in our special ECC News issue on Safety mentioned that a safe environment is one in which all feel nice to work in without fear that directly leads to improved productivity. Our endeavour should be to make every site of L&T Construction a safe one.

Ours is an organization which lays a lot of emphasis on learning from our past mistakes, with special focus on near misses. These are leading indicators which need to be dealt with seriously to prevent potential future occurrence of accidents. It is also important for the site leadership team to create a positive EHS culture which encourages everyone to actively participate in maintaining a safe environment, with strong ownership at every level.

We must not follow safety because the Project Manager says so or the EHS Manager insists. We should follow safety as a matter of standard operating procedure so that even unconsciously we do not indulge in unsafe practices. The ideal site is one in which every person working there is a Safety Manager with the attitude and approach of an EHS manager, completely aware of their responsibilities. A single fatality or injury at site very often leads to a whole family being devastated. We cannot afford a single fatality or injury because lives are too precious to be lost thus.

Almost every aspect of construction has been touched by digitalization that is fast rewriting the rules of the way we do business. The 'connected workman' and the 'connected EHS manager' equipped with IoT, AI, AR & VR and a host of other digital tools are already a reality and our efforts must remain focussed and unwavering to take advantage of the many digital tools and solutions to constantly improve safety at our sites and reach our end goal of 'Vision Zero'.

LEADER SPEAK

D K Sen,
Whole Time Director & Senior Executive Vice President (Infrastructure)

An unsafe incident is just the tip of an ice-berg – a sign of a much larger problem that lurks below the surface. Every accident is a warning that something is wrong with men, method or material and it's time to investigate and act quickly. With every accident there is impairment or even loss of human life and the damage to the dependants of deceased is crippling that leaves them devastated. Apart from this, we lose a good workman.

Every time we analyse the root cause of an accident, we find that improper human behaviour is always the cause and we keep repeating our mistakes without learning from them. This is unpardonable. Time has come that we must take up mass initiatives to eliminate all these recurring accidents.

The positive impact of right human behaviour and a disciplined approach in enforcing sound EHS practices are clearly visible in the international market. For us to compete in these markets, we need to ensure that a uniform practice is enforced both in domestic and international markets. Only then will we be able to ensure our premium position in the domestic market and also establish ourselves as a major international player.

A statistical survey of our safety records reflects that maximum accidents happen due to reversal of vehicles / equipment, failure of cranes, falling from height and electrocution by live high voltage wire. All these are known to us and I expect that through this magazine we will be able to formulate a sound action plan to eliminate these occurrences.

In today's world, every process is getting upgraded to mobile apps. These are easily accessible, highly standardized and transparent since everybody can reach, analyse and judge the information. I urge all to actively participate to make this path breaking initiative hugely successful. I hope this app-based initiative will arouse mass awareness and usage across all levels of our employees.

Safety should no more be a statutory compliance, but a way of life. I would like everyone to drive the cause of safety passionately and I am sure this will significantly change our attitude towards Safety.

THE ROAD TO SAFETY IS LONG AND ARDUOUS BUT NOT SO IF PLANNED

Ensuring safety in road projects

Subhamoy Maitra, RREC - EHS Head, recalls a hit-and-run accident at a road project site that left one of our own officers seriously injured. "Knocked down unconscious and badly bleeding, we immediately activated the emergency plan. He was picked up by two of our colleagues, one of whom was not an EHS person, immediately administered necessary first aid and then rushed to the nearest hospital where he had to undergo multiple surgeries to remove broken pieces from his lungs. We were in constant touch throughout that traumatic period and today," Subhamoy shares emotionally, "I am so happy to see him well and happily reunited with his family and kids."

Staying safe in the middle of 'live' traffic!

This officer was lucky to escape with his life, but the sad fact is that many are not so lucky. 'Live' traffic is one of the menaces that safety managers of road projects must constantly contend with.

The success of any EHS strategy is in being on top of all 'safety-threatening' factors but, in this case, EHS teams have a host of factors to face that are not entirely in their control. "How can we plan for the mistakes of bad or drunken drivers, control dense, snarled traffic, look out for jaywalking pedestrians or careless cyclists," laments B. Rajeev Ramakrishna, EHS In-charge for the Hospet-Devangere-Chitradurga Road Project (HCRP).

For Ramakrishna and Project Manager, R Prabhakaran, traffic woes and other safety trouble spots like workmen tripping, injuries from cranes & machineries, exposure to heat and vibrations, collapse of structures or equipment being used cannot be speed-breakers as they have a crushing deadline of three and half years to complete the 120 km project and, of course, the added responsibility of keeping their safety record clean.

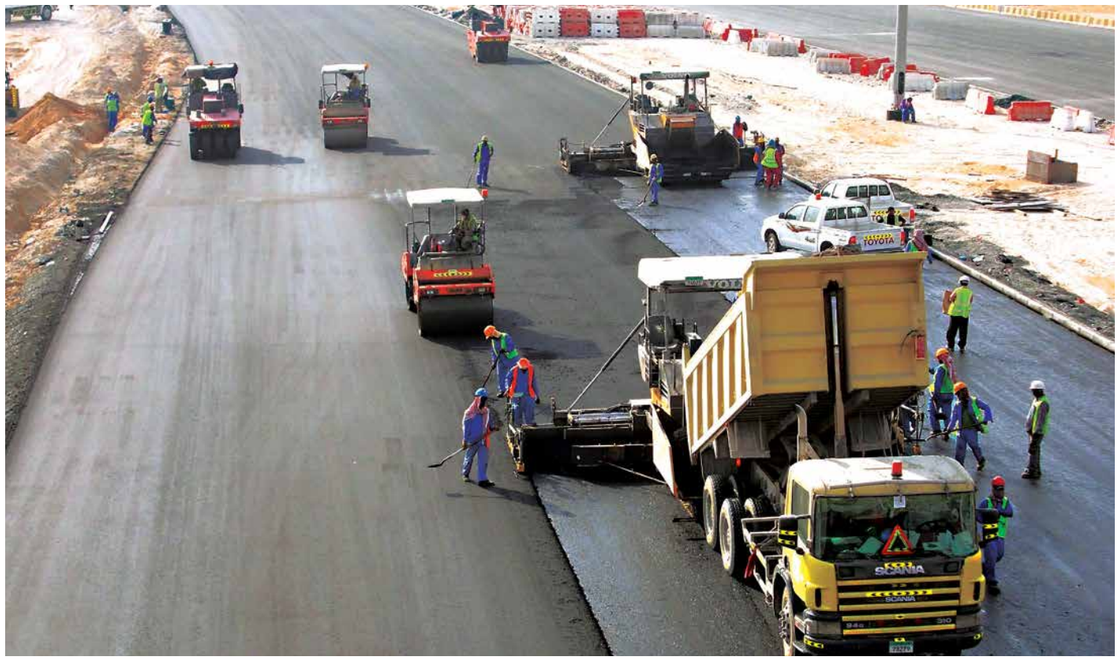
Risk assessment with an action plan evolved at the planning stage is the ideal way to go and Prabhakaran feels that the success of safety at HCRP is attributable to 5 factors: user involvement, senior management support, clear understanding of requirements, proper planning and realistic expectations. He quickly adds, "these elements by themselves will not guarantee success but if handled well, our chances to succeed are better."

Dense, unruly traffic is an acute problem for Safety In-charge, at the Delhi-Agra Road Project (DARP), Vireshkumar Ramesh Nawale too. "You can imagine the volume of traffic on a National Highway that starts from the national capital, passes through the industrial towns of Faridabad and Ballabhgarh, religious places like Vrindavan and Mathura before reaching Agra, easily the country's biggest tourist destination. The highway was fully operational, and our work zone was just beside it!" Against this challenging backdrop, the team led by Chief Project Manager, Rajesh Kumar Jha have been tasked to widen the existing 4 lane NH-2, that involves 14 flyovers, 14 VUPs, 10 PUPs 1 Viaduct, 359 km of carriageway, 204 km of service roads and 204 km length of drains.

VOICES FROM GROUND ZERO

"How can we plan for the mistakes of bad or drunken drivers, control dense, snarled traffic, look out for jaywalking pedestrians or careless cyclists."

B. Rajeev Ramakrishna
EHS In-charge - Hospet-Devangere-Chitradurga Road Project



Road laying

"Positive motivation backed by a practical and collaborative approach are best to ensure success of work place safety and a safe work environment," declares Jha, referring to his team's wide range of fail proof safety arrangements adopted to manage all work-related hazards. To start with, they developed a general traffic safety arrangement plan involving an advance warning zone as per IRC SP 55, relevant signage, safety cones, temporary traffic diversions and zig-zag road patterns with water barriers to control high-speed drivers. "We have introduced virtual and robotic flagmen that are actually mannequins to signal and control traffic at congested junctions to avoid the risk of placing our own people in such dangerous situations," informs Nawale. In addition, public awareness and defensive driving programmes are regularly organized with the support of the traffic police but as Jha reminds us grimly, "all these are aimed at keeping the risks to as low as reasonably practicable."

A critical steel girder erection

VOICES FROM GROUND ZERO

"Success of safety at HCRP is attributable to 5 factors: user involvement, senior management support, clear understanding of requirements, proper planning and realistic expectations."

R Prabhakaran
Project Manager - Hospet-Devangere-Chitradurga Road Project

Keeping P&M safe

Safety of P&M is just as crucial for site teams and to address this issue, the Chennai EHS Cluster team introduced two initiatives – the VECT (Verify & Ensure Controlling Traffic) and Green Card – shares Subhamoy. "Through VECT, accountability of all activity on a 'live' road is squarely on the front-line execution team from Day 1 and these control measures are changed as per the demands of a particular site as each site is unique." Work at site only begins after the

"Positive motivation backed by a practical and collaborative approach are best to ensure success of work place safety and a safe work environment."

Rajesh Kumar Jha
Chief Project Manager, Delhi-Agra Road Project

carefully chosen VECT managers confirm that it is safe for work to begin. "VECT forms are available at each location and these are rigorously monitored on a weekly and monthly basis," he adds. The Green Card is a system-oriented safety process to keep P&M safe at site that involves a joint inspection by the Project EHS & P&M teams, signed off and thereafter regularly monitored. If deviations are detected, they are immediately addressed and rectified. "Both these initiatives have significantly helped improve our safety performance in the Transportation Infrastructure IC and enhance our brand value too," avers a satisfied Subhamoy.

Higher the height, taller the risk!

The Ghoshpukur-Salsalabari Road Project involved several activities at critical heights such as erection of RCC, PSC and steel girders over live railway lines all of which was beside 'live' traffic. "Instead of a task-based approach that is usually adopted, we went for a system-based method including HIRA, SWM (Safe Work Method) and behaviour-based training to address safety," reveals Project Manager, Niloy Mukherjee. The

"We have introduced virtual and robotic flagmen that are actually mannequins to signal and control traffic at congested junctions to avoid the risk of placing our own people in such dangerous situations."

Vireshkumar Ramesh Nawale
Safety In-charge, Delhi-Agra Road Project

EHS In-charge, Tushar Gangopadhyay chips in that the EHS team involved workmen, local villagers and even the local administration in their safety regimen. "We used events like the Safety Month, Road Safety Week, Environment Day to drive EHS

Lifting of precast elements

Safety orientation for workmen

"Introduction of systems like the formation of an EHS Committee, the implementation of the Reverse the Risk (RtR) system, Permits to Work (PtW) and widespread safety awareness campaigns went a long way in sensitizing workmen to avoid unsafe practices and acts."

Malay Kumar Mahanta
Head EHS TI IC

awareness." Malay Kumar Mahanta - Head EHS TI IC, mentions, "Introduction of systems like the formation of an EHS Committee, the implementation of the Reverse the Risk (RtR) system, Permits to Work (PtW) and widespread safety awareness campaigns went a long way in sensitizing workmen to avoid unsafe practices and acts."

To maintain safety when working at heights, the team erected and used formwork based safe access systems with safety nets. "With workmen having to work at heights of up to 14 m, we evolved a sound lifting plan," shares Tushar. "One key consideration was to certify whether the ground surface was suitable with adequate compacting to place plants, equipment and operating cranes as there is the constant threat of the ground caving." The Erection Engineer was responsible to ensure that all personnel, including those of the sub-contractor, were given EHS training and made aware of different aspects like first aid, fire safety, defensive driving, etc., familiarizing them with the procedures and risks involved in girder erections to eliminate or at least reduce risk.

"Initially, we had to work near an OHE line and our number of near-miss cases was not funny," Niloy shakes his head. To overcome this challenge the team evolved an insightful zoning plan: green where the clearance between OHE line and FRL (Finished Road Level) was more than 5.5 m; blue where the clearance was more than 4 m but 5 m or less; and red if the clearance was less than 4 m, all marked with reflective stickers.

"In essence, identifying risks, analysing and responding to them adequately is the difference between a successful and not-so-successful EHS strategy."

Niloy Mukherjee
Project Manager, Ghoshpukur-Salsalabari Road Project

Smart risk management

"In essence, identifying risks, analysing and responding to them adequately is the difference between a successful and not-so-successful EHS strategy," states Niloy. Towards this end, he and his EHS team have put together a Risk Profile of their project by listing down both routine and non-routine activities based on which they developed their SWM. "After all, it was not only a question of the safety of our own people," smiles Tushar, "it involved the safety of the general public too."

In the final analysis, safety is dependant on our emergency preparedness and team work, according to Nawale that is echoed by all EHS managers. Rigorously following the Golden EHS rules, distributing EHS guidebooks like those given to workmen at DARP, constant training, walk-downs, regular housekeeping are some of the methods that keep lives safe on 'live' roads as L&T continues to build projects that make India proud! ■

LEADER SPEAK

M V Satish,
Whole Time Director & Senior Executive Vice President (Buildings, Minerals & Metals)

We are in an industry where danger is always lurking round the corner and hence safety should be a second nature for every person working at a construction site. Upward, downward and horizontal communication must be quicker, easier and more prompt to not just enhance safety but productivity at sites as well. Communication is usually for a purpose, and unless that purpose is accomplished, the communication is not complete. Hence, kindly ensure that your communication is properly understood and acted upon!

While creating a safe work culture is all about doing the routine things right, our adoption of smart technologies and digitalization has given us an edge that we should not give up. I want all of you to integrate safety requirements in the way you do business in your respective domains. It is not an external fitting but just as important as anything else that we do at site and by following safety processes diligently, we can also ensure productivity and profitability.

A bird's eye view of workmen atop the world's tallest statue

FOR A SAFE VIEW FROM THE TOP

Addressing the danger of fall from heights

As India's Prime Minister was inaugurating the world's tallest statue, a group of people watching the show wondered how it would have felt for workmen to stand at the top of the Statue of Unity (SoU) when constructing the Sardar's head. The perils of standing on a platform and working at heights of over 500 feet buffeted by a strong wind blowing down the Narmada river is something that many of us would baulk to even think about. Whether it is constructing a high rise tower or stringing a transmission line perched high up in the sky, erecting a humungous dome for an atomic plant or working on a bridge hanging over water and another bridge with 'live' traffic, workmen are exposed to the ever-present hazard of Fall from Height (FFH). "As we rise higher, so do the risks for our workforce and hence we need fool-proof safety strategies to prevent any untoward occurrence," emphasizes P Nagarajan, who in his capacity as Head - EHS for B&F IC, is monitoring the implementation status of fall prevention at several high-rise projects. He is speaking with some confidence as B&F projects have won a slew of British Safety Council's 'Sword of Honour' regarded the pinnacle of safety recognition but all businesses across L&T Construction have a good record of preventing FFH.

Understanding the animal

Globally, FFH is among the leading causes, some say 30%, of serious and fatal injuries for construction workers. Research attributes this to the dynamic, complex, temporary and transitory nature of the construction industry. FFH could occur when working on roofing, painting, plumbing, drywall or wall covering, carpentry, electrical tasks,

Accessing heights with a safety climbing screen

"Individual variables like their (workmen) demography, attitude, knowledge levels, behaviour patterns, physical characteristics and health are key reasons for FFH."

M Kamarajan
Advisor - EHS, B&F IC

sense that obese or elderly people should not be allowed to work at heights, even with protective gear, but attitude and behaviour are softer, intangible aspects that are more difficult to address. Santhosh Bhaskar, EHS – Head, Project SoU, had the ordeal of taming workmen with no background in safety procedures to understand and accept his mandatory safety briefings before being allowed to climb the statue. "Often such labour chooses to ignore these training sessions spelling danger for all," says Nagarajan, "but more serious is the attitude of some that "it cannot happen to me" that is really a recipe for disaster." There is a strong co-relation between FFH and 'behaviour' that could either installing sheets and the like. While studies reveal that FFH occurs most due to fall from scaffolds, it could also result from fall from ladders, roofs, statues, bridges, transmission towers, elevated platforms, through walkways, openings or fall from another level.

"Hazardous activities expose workmen to FFH," remarks M Kamarajan (MK), Advisor – EHS, B&F IC, "but individual variables like demography, attitude, knowledge levels, behaviour patterns, physical characteristics and health are key reasons for FFH." It is common

Climbing heights, hooked to life lines

be due to carelessness, misjudgement or overconfidence or even triggered by overwork, sleep deprivation and/or work depression. "It is a hydra-headed issue," concedes MK, "therefore ensuring use of the right PPE like full body harnesses, safety belts, personal fall arrest systems and safety nets, is really a basic but important first step."

While remaining safe is to a large extent the individual's responsibility, dangerous site conditions like unprotected walkways, incomplete guardrails, slippery or sloped surfaces, improper placement of scaffolds and ladders and insufficient lighting could cause incidents. "It is very important to monitor the amount of time workmen spend at height," cautions Gopi Krishnan, EHS In-charge, Project ICC Towers, "and ensure that they return before they get too tired or disoriented."

Creating a safe environment

B&F's Crescent Bay project recently clocked 25 million safe man hours, the ICC Towers 15 million and ITC Pragati Towers 13 million safe man hours all of which were high-rise towers in Mumbai with some soaring to 60+ floors. "Apart from working at such heights, since our site is close to and facing the Arabian Sea, the wind is sometimes so strong that it threatens to just blow you away," shares Gopi Krishnan. To combat both the threats of height and wind, the EHS team erected Safety Screens that created a sense for the workmen as if they were working at ground level. "It is a hydraulic climbing safety screen stretching across 3 levels that prevents the workmen to see the height at which they are working, keeps them safe from the buffeting winds and, most importantly, prevents them from falls."

"Safety screen is a hydraulic climbing system stretching across 3 levels that prevents the workmen to see the height at which they are working, keeps them safe from the buffeting winds and, most importantly, prevents them from falls."

Gopi Krishnan
Manager - EHS, ICC Towers

Creating a safe work environment at height

At SoU, RSPs (Rope Suspended Platforms) were used for the bronze welding activity when the team found it next to impossible to rescue workmen from the vertical fall arrestor due to the outward slope of the statue's external surface. Still inaccessible even by cranes, Bhaskar and team evolved a very simple solution of installing two RSPs close to each other at the same level of work to carry out the work that resulted in huge savings both in terms of money and lives. Where scaffolding was a non-starter to reach the weld joints of the fingers of the statue, they resorted to a sway rope of 18 mm dia to drive the RSP up to the required height of 83 m.

Bhasker goes on to explain that the available void area was cleverly used to create an overhead safe working platform extending the full 6 m with catch nets that had to be subsequently taken off considering the welding activities involved on the stubs. Thanks to this platform, all 2nd level activities including heavy lifting, were safely carried out. "After the stub locations were identified, the pre-installed working and intermediate platforms were equipped with aluminium ladders and grab-rope assemblies. We had an additional platform with a lifting cage ready to be pressed into service in case of any emergency." The lifting of the bronze panels was also risky, "for which we introduced additional chain pulley blocks to offset the cascading effect."

In PT&D, the safe environment was created by a sag bridge at one of the 168 tower locations across the 500 kV Yong Peng East Substation to Point A Transmission Line, Johor, Malaysia, on which safely perched 60 m above ground, a gang of 6 workmen went about their sagging works. "We introduced the sag bridge concept for the first time in West Malaysia in this project," informs the EHS In-charge. "It is placed parallel with the rough sag of the conductor as a platform for fitters to carry out the final works while completely eliminating the hazards of working at height." The advantage of this system is that it can be customized as per the tower specifications as was the case in this project. "A 20 m sag bridge was used to accommodate 5 m platforms in 4 parts with all tools required for final sagging placed on the bridge." Communication is always vital in such tasks, he avers, "For reaching workmen positioned even higher, a special frequency walkie talkie was used to convey instructions while three types of signal systems were used to network with the crew: whistling is when the range of the tower is around 60 m high while instructions to commence or stop work are communicated by flagging from the ground level."

A safe platform on sag bridges for transmission tower erections

VOICES FROM GROUND ZERO

"Every day, we lived with the threat of people falling off the edges, falling to the ground through openings, tripping into excavation pits or loose material falling on people working below; but being aware of these dangers is really half the battle won!"

Santhosh Bhaskar
EHS In-charge, SOU Project

For teams from TI and Heavy Civil IC, building elevated corridors, bridges and barrages, the risk of FFH is a constant threat. The team from the recently completed Mandovi Bridge in Goa recall the perils of working over water and other full-functional, adjacent bridges with 'live' traffic streaming below them. Working atop each of the piers of the Medigadda Barrage was a test of the safety measures taken at site and the fact that the EHS In-charge, N Ramesh Kumar and team were able to clock 13.9 million plus safe man hours speak volumes of their success.

Capping a dome

Perhaps one of the best examples of working successfully at height was the first-of-its-kind effort to lift a 355t inner containment (IC) circular steel structure to a height of 44+m at the Kakrapar Atomic Power plant that obviated the need for workmen to be lifted many times to the top to fix individual panels, shares Sudharsan R, the then EHS Incharge. "We deployed an efficient 1350 T crane after ascertaining that its working load was 424 t, way above the intended lifting weight." A special 18-holed spider, fabricated at site, was attached to the lifting hook of the crane and hooked to a spatial ring type truss, also fabricated in-situ. "We tested this set-up meticulously using concrete

Rope suspended platforms at Project SoU

Workmen fixing the individual panels of the prefabricated ring liner at Kakrapar Atomic Power Project

blocks," explains Sudharsan, "and ensured the spatial truss was correctly aligned because the entire weight of the ring liner was distributed at 80 points from which they were hung using slings, load cells with online monitoring and adjustable shackles." Everyone involved in the exercise, signalmen, riggers, crane operators and welders, were trained thoroughly and then given different coloured (dress codes) to easily identify their respective trades on D-Day. "As the first sequence, the hovering spatial ring was connected to the ring liner with slings and shackles and then," Sudharsan pauses for effect, "on the proceed signal, the crane operator lifted the load to a minimum height, held it to ascertain stability before hoisting it to the prescribed height. Then it was lowered, positioned and then bolted securely by riggers on top of the structure." Sudharsan adds how the wind was a crucial factor and the plan was to call off the lift if wind velocity exceeded 8 m/s or 29 km/hr.

Making safe heavy lifts

Heavy lift erections are always critical tasks that call for a detailed staging plan depending on the weight and location

"With so many stake holders involved, all aspects of the lift had to be cross-checked multiple times in line with the rigging system guidelines and communicated precisely."

Kausik Dutta
Head CMPC

of the lift. As per safe guidelines, such tasks are carried out either during lean hours, preferably late at night or in the early morning hours. While lifting precast and steel structures are common sights across infrastructure projects, the more complicated are the mammoth equipment across metallurgical and material handing projects requiring different safe approaches. There are comprehensive EHS schemes with a range of SOPs for various activities and digitalisation is making the process more secure.

At the JSW Dolvi project, MMH SBG achieved its heaviest lift of a 415 t (438 t considering the weight of both the rigging and hook block) converter using a 600 t Demag CC 2800-1 crane. Kausik Dutta, Head Construction Methods Planning Cell, shares that "With so many stake holders involved, all aspects of the lift had to be cross-checked multiple times in line with the rigging system guidelines and communicated precisely." Another critical lift at the Dolvi site was the 300 t lower structure erection of Blast Furnace#2 and to minimize the risk of working at heights involving in-plane and out-of-plane inclinations, a detailed analysis backed with stability calculations was arrived at through a stage wise scheme that included horizontal lifting, upending to facilitate safe final erection.

Putting together a 52 t steel truss with a 35 m cantilever span across a 25,000-volt powerline passing beneath the span at Lucknow Metro Phase II is now considered a L&T safe benchmark for such daunting tasks. The entire construction method was driven through incremental push launching technique with five intermediate trestles using strand jacks, nosing trusses and counterweights. As the Railways had imposed a speed limit for the truss operations, the progress of the automatic launcher was slow, though steadily gaining around 500 mm in one go with the entire activity completed in 5 days.

Some blips

"Even with the best of intent and efforts, we still have a number of near misses," acknowledges Nagarajan, "but rather than hiding them under the carpet, we record them diligently doing a thorough analysis to find out how it happened, what went wrong, what were the process faults and how can we prevent a repeat of that incident in future. We, at B&F, consider near-misses as great learning opportunities," he declares.

"Every day, we lived with the threat of people falling off the edges, falling to the ground through openings, tripping into excavation pits or loose material falling on people working below; but being aware of these dangers is really half the battle won!" exclaims Bhasker who had his fair share of near misses and narrates one. "On 20th March 2018, during the erection of the structural frame at the 165 m level, a shim plate that was being used to increase the thickness of the beam broke away and fell as the erector was trying to remove the plates for further erection from the splice plate." He stares at me as if re-living the incident. "Fortunately, since it fell into the designated exclusion zone at the 83 m level, no one was injured. We took immediate corrective action and such an incident never recurred."

Ways to stay safe

A few other important boxes that EHS managers need to tick to prevent FFH:

- Professionals to set up scaffolds and ladders
- Safety monitoring systems like RFIDs in helmets that track the health of workmen
- Controlled access and 'no-go zones'
- Railings, guard rails, surface protection like safety nets
- Work in groups or at least in pairs

Are you healthy enough to work at height?

Full body harnesses and a check of all safety equipment before use are mandatory. "Perched on a platform, 500 feet above the ground is a bad place to find out that you suffer from vertigo," says Bhaskar who even delivers humour with a deadpan expression. A workman's fitness, vital signs like blood pressure, heart beats, pulse rates, fear of heights, claustrophobia, alertness and behaviour traits are all checked before he can climb. "In fact, we have introduced a biometric system in some of our sites," says R Rajkumar, Digital Office, B&F, "so only authorized personnel can go up."

How safety-conscious is the sub-contractor?

The sub-contractor is a very crucial cog in the wheel and his attitude to a large extent influences the attitude of his workforce towards safety. Often, EHS managers need to 'manage' errant sub-contractors which is undoubtedly tougher than influencing their workmen. "Yes," nods Nagarajan, "the workmen of sub-contractors also need to be checked and their equipment certified and yes, all this is time consuming and often project managers are fretting about loss of productive time, but our response is that more time will be lost in case of an incident if the safety procedures are not followed to the 'T'."

"Finally, it is only training and more training that can save our day," concludes MK. ■

Safe barricading for an elevated metro rail corridor

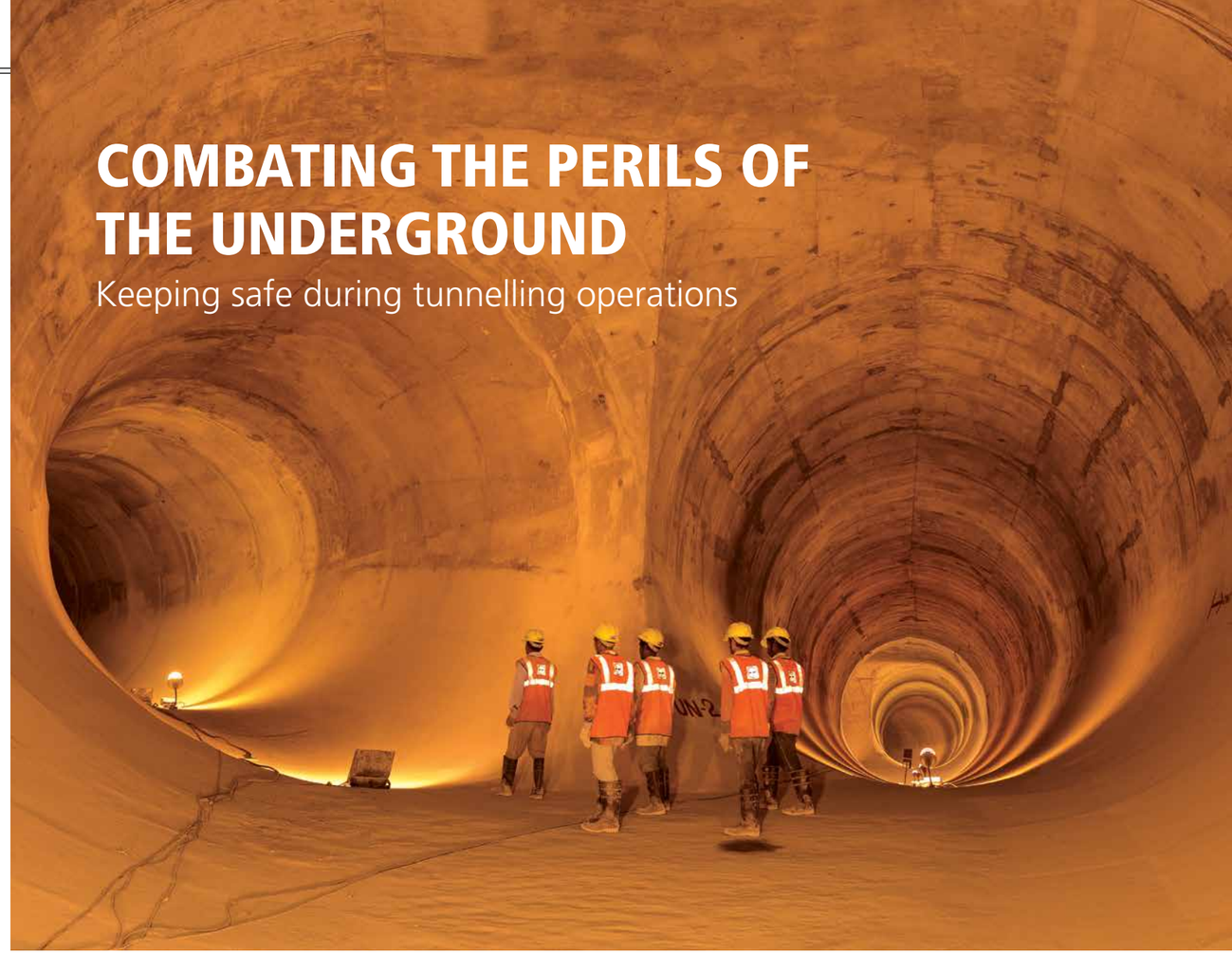
LEADER SPEAK

S V Desai,
Senior Vice President & Head (Heavy Civil Infrastructure)

In the construction industry, ensuring production and keeping lives and assets safe are two faces of a coin. These factors have been the pillars on which the entire organization is established and reasons for our glory. Embedding this philosophy within ourselves, we not only learn from our own experiences but also continuously look at our peers to improve our practices and adapt ourselves to changing business scenarios. It is the need of the time to think out of the box to keep our workforce safe and sound, protect and conserve nature and bring smiles to all the stakeholders. The accolades earned speak for the standards that we uphold; the smile brought within the family when an employee returns home safely is our real reward.

COMBATING THE PERILS OF THE UNDERGROUND

Keeping safe during tunnelling operations



Safe access chambers to the Punatsangchhu HEP

Starved of space, infrastructure development in recent years is increasingly going underground, as it were. The establishment of L&T's Tunnelling Excellence Academy in Kanchipuram by the Heavy Civil Infra IC is an important initiative to create and build in-house efficiencies in tunnelling. Several metro projects that L&T is currently executing at Doha, Riyadh, Mumbai and Ahmedabad, to name a few, involve substantial work underground.

Tunnelling is involved in three spheres of infrastructure development: for underground sections of metro projects, tunnelling is normally at a depth of 20-30 m to lay tracks and construct underground stations while in hydel power projects, tunnelling depths can go even up to 1,500 m. In public utility laying projects, sewerage lines normally lie at depths of about 15 m, while others like water lines, telephone lines, power lines or even trenches for laying roads and highways, micro-tunnelling is normally at a depth of 3-5 M.

""Often, maps are absent, utility lines are rarely well mapped or is there available data on the strength of foundations of structures so in some cases it is a bit like groping in the dark," Stephen Phillip

VOICES FROM GROUND ZERO

"Often, maps are absent, utility lines are rarely well mapped or is there available data on the strength of foundations of structures so in some cases it is a bit like groping in the dark, but modern day geotechnical studies are certainly making our lives a whole lot easier."

Stephen Phillip Storey
EHS Head - HCI IC

Storey, EHS Head, Heavy Civil IC shares some travails about tunnelling, "but modern day geotechnical studies are certainly making our lives a whole lot easier."

As work proceeds in top gear at the Mumbai Metro, a huge issue that Michael William Sanderson, EHS – In-charge, Mumbai Metro – UGC 01 must be ever mindful off is the inadvertent weakening of existing structures or buildings adjacent to the alignment. Adjusting his helmet, Michael glances at some old, heritage-looking buildings of South Mumbai and remarks, "We are monitoring the behaviour of some of these buildings to ensure that there is no movement or weakening of their foundations due to our tunnelling and TBM activity."

Ahmedabad is India's first Heritage City of India as declared by UNESCO and therefore the onus on Yadavalli Vn Sarma, Project Manager, Ahmedabad Metro is even greater. "We have had to align our tunnel to keep the mandatory distance of 100 metres from heritage structures like the world-famous Relief Road Heritage Commercial Area which has resulted in many curves in our tunnel that has made both tunnel construction and loco operation inside the tunnels quite challenging." During tunnelling, the team is constantly faced with old, long unused wells inside residential buildings that no one has any clue about.

Dust, heat, fire, TBM, confined spaces – a deadly combination

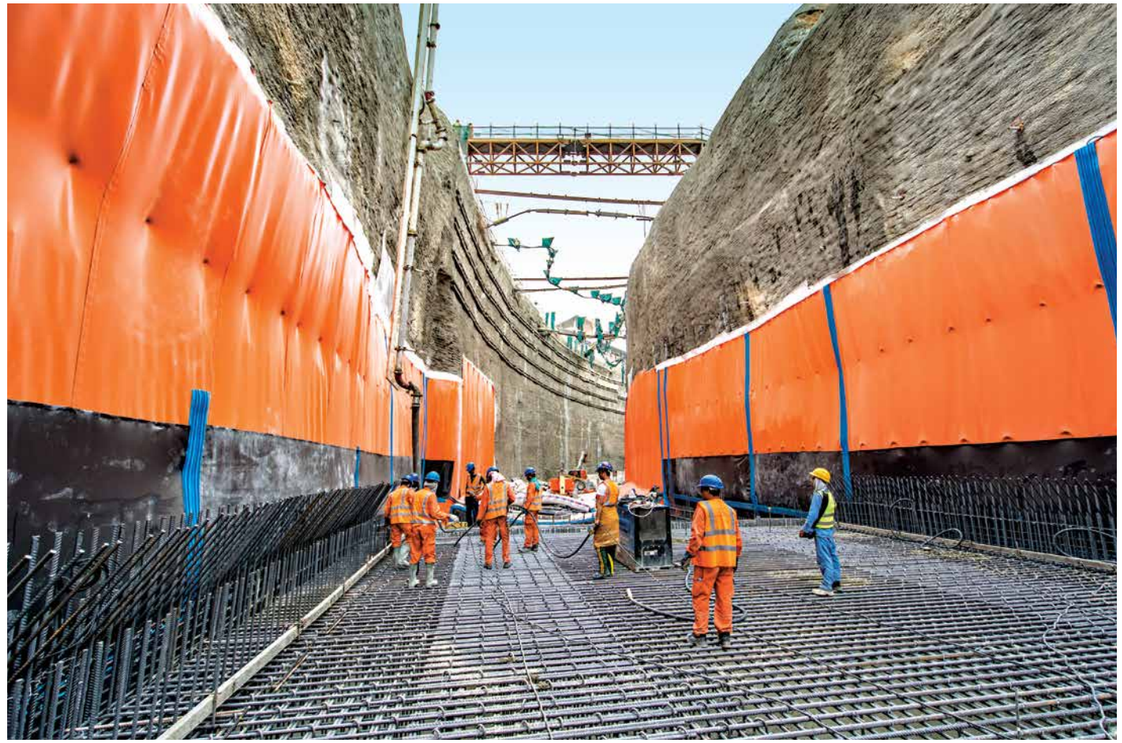
Digging, blasting, grout mixing, short concreting can all create copious amounts of dust which, if inhaled, can lead to ailments while repeated trimming, corking and working in poorly ventilated spaces can cause thermal discomfort due to the high temperatures and heat stress. "Noise, vibration, toxic fumes and gases are problems that we have to face," says, Yadavalli, "In some cases, on this stretch, the sandy soil is so unstable that we have to be always ready to face the threat of the soil collapsing."

VOICES FROM GROUND ZERO

"We have had to align our tunnel to keep the mandatory distance of 100 metres from heritage structures like the world-famous Relief Road Heritage Commercial Area which has resulted in many curves in our tunnel that has made both tunnel construction and loco operation inside the tunnels quite challenging."

Yadavalli Vn Sarma
Project Manager - Ahmedabad Metro

TBM (Tunnel Boring Machine) in action at Riyadh



Cut and cover work in progress for underground station building

Workmen can easily be trapped or injured in dark tunnels or hit by loco movement while fire is another ever present danger that could be triggered by either faulty electrical installations, grouping of cables, electric motors, lighting, cables, switchgear, transformers, overheating of power units or even a short circuit in the TBM.

The TBM presents challenges as big as its size and complexity of operations. "Repairing and cleaning the TBM cutter-head or changing the cutter discs are dangerous exercises because it is very easy to slip, fall and get injured in the process," remarks Michael, whose last words are drowned out by the din as TBM operations re-start.

Remaining safe underground

Although the risks are many and varied, Stephen feels that proper designing, planning and caution are imperatives to keeping manpower safe underground. "The design is critical following which a competent tunnelling supervisor or engineer should prepare a method statement for the excavation of the underground services incorporating all the requirements along with a detailed sequence operation. The method of shoring must be part of the design and temporary or makeshift shoring is a definite no no!" An emergency rescue plan should be in place that is shared with the workforce and adequate number of well-marked, well-lit escape routes, fire-fighting equipment, such as extinguishers & fire reel hoses with suppression systems designed into the TBM, to quickly fight fire and prevent it from spreading and creating smoke. Regular fire drills are a must during which the emergency arrangements can be tested to ensure that they are robust and working to exit the tunnel workspace.

Base slab work in progress

Safe to start: Work in any tunnel should only start after a thorough inspection of the site and certification that all equipment is fit for use. This is an imperative especially during adverse weather conditions.

Plan for water: De-watering systems should be planned based on ground water table levels and soil strata; where the water pressure is high, a total dewatering method is the answer. For Michael, the Mumbai monsoons are posing some stern questions. "We have already had several spells of heavy rain and flooding, but our plans and systems have stood up to the test," he says with a tight grin. "We require a provision for continuous dewatering pumps with standby pumps and be ever prepared for night operations," warns Rajesh K Bhandary, EHS In-charge, Mumbai Metro - UGC 07.

VOICES FROM GROUND ZERO

"We require a provision for continuous dewatering pumps with standby pumps and be ever prepared for night operations."

Rajesh K Bhandary
EHS In-charge, Mumbai Metro - UGC 07

The Doha Metro team relates a harrowing experience when a bore hole installed for dewatering accidentally connected with an aquifer due to soil movement releasing water at enormous speeds that inundated the entire station box to about 3 m. All the excavation equipment was lifted in the nick of time to the surface avoiding material damage. Precision drilling into the source and extensive cement grouting for three days brought the situation under control but the station depth had to be consequently reduced by 3 m that in turn affected the vertical alignment between connecting tunnels at both ends of the station forcing necessary alterations.

Controlling noise and vibration levels: While acoustic enclosures are provided in some equipment to control noise levels, frequently used plant, tools and equipment across projects sites are assessed for noise and then either corrective action is taken and/or warning signage posted. It is advisable for workmen exposed to continuous noise in excess of 85dB to wear hearing protection of at least SNR (sound noise reduction) +30, or more if national regulations or client requirements stipulate. Workers at risk of 'vibration white finger' for using jack hammers for long periods should ideally reduce such use and frequently medically checked. Apart from task rotation, normally low-vibration tools are specified during the procurement phase.

Dressed to stay safe: In tunnels, overall protective clothing include

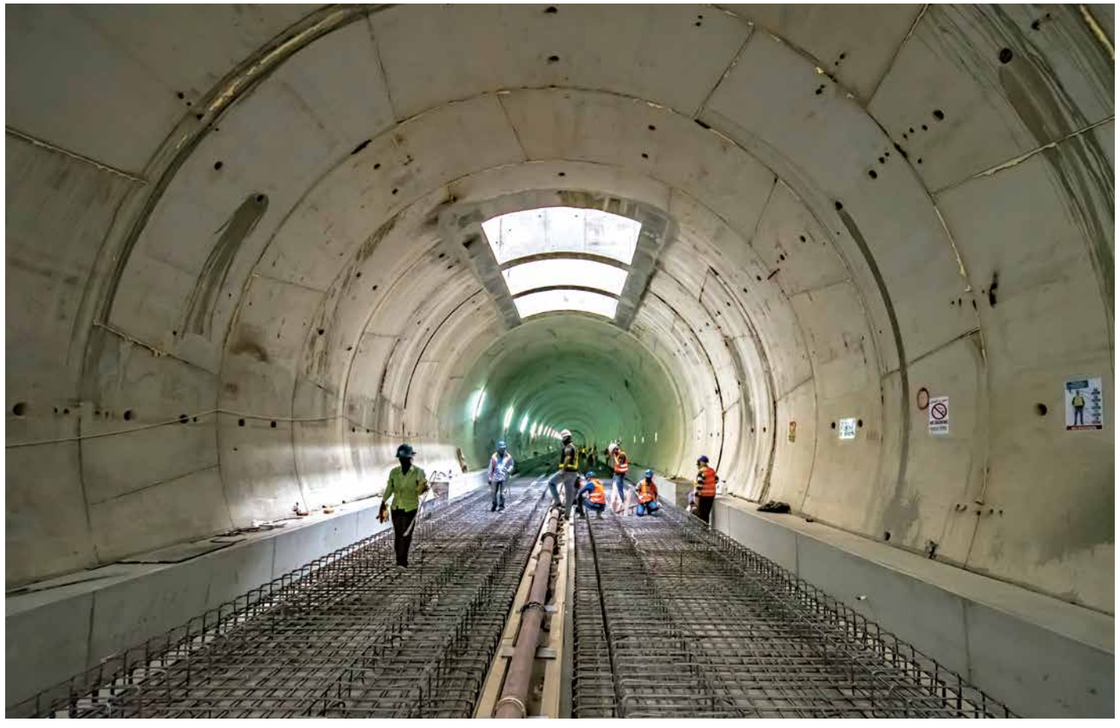
VOICES FROM GROUND ZERO

"The moment we encounter any sign of water, we have to stop, because there is no way to ascertain how big is the water accumulation. The only way forward is to dig a way around it."

R Anbalagan
Vice President & Head - Hydel, Tunnels, Nuclear & Special Bridges

safety helmets, safety boots, hi-visibility vests, gloves, hearing protection devices & face masks are a must along with appropriate respiratory protection.

To breathe easy: Air quality in tunnels is periodically tested with a multi gas monitor to ensure acceptable levels of oxygen, lower flammable limits, carbon monoxide, hydrogen sulphide and methane. Alarms trigger emergency procedures for all personnel who are trained to exit the tunnel quickly and safely using an Emergency Escape Breathing Device, a lifesaving appliance to escape from hazardous conditions such as fire, smoke, poisonous gases, etc. It is critical to maintain tunnel ventilation by ensuring movement of fresh air in and out of the tunnels and all carbon burning fuel plant & equipment such as generators, excavators and parked



Building safe portals of connectivity

vehicles etc. are never placed adjacent to deep excavations as exhaust fumes are likely to settle in the excavation zone.

Keeping P&M safe: It is imperative to follow an EHS Code of Practice for the safe movement of vehicles at project sites along dedicated and well-maintained routes separate for people and vehicles. Transportation of P&M, maintenance, repairs, inspections are conducted only by competent and trained persons and there are dedicated banksmen for loco movements who are in constant radio contact with the loco driver. As far as possible, entry of vehicles into a tunnel should be avoided; ideally concrete, for example, should be pumped into the tunnel using concrete pump lines and compressor pumps. "Tunnels are usually one way IN and same way OUT which make things very challenging," shares G Divakar, Senior Manager EHS, Heavy Civil Infrastructure, "requiring deep thinking and frequent assessment of our 'emergency preparedness'. We have harnessed digital technology at the Tunnel Access Controller and Emergency Control Room to keep count in real time the number of people inside each tunnel."

Burrowing into the side of a mountain

The challenges of digging into a mountain are of a different magnitude all together. "We face challenging geologies in most of our projects in the Himalayan region," shares R Anbalagan (RA), Vice President & Head – Hydel, Tunnels, Nuclear & Special Bridges. "The Himalayas are known as the New Fold mountains that are less mature and stable when compared to other older mountain ranges like the Alps and both our major hydel projects – Punatsangshu in Bhutan and Singoli Bhatwara in Himachal Pradesh - face similar issues."

Keeping things dry: Water is perhaps the biggest threat and project teams must be constantly on the alert for any sign of seepage when tunnelling. "The moment we encounter any sign of water, we have to stop," cautions RA, "because there is no way to ascertain how big is the water accumulation. The only way forward is to dig a way around it." Teams are always ready to carry out de-watering whenever required that entails the establishment of a clear de-watering system that is clearly communicated to the workmen, drivers, employees and even the client, special training for the workmen, adequate illumination in the tunnel and all arrangements for emergency rescue.

A secure underground work zone with ventilation vents and appropriate lighting

Gearing up for a safe day at work

VOICES FROM GROUND ZERO

"When handling, explosives should not be dragged, dropped, kept away from metal tools to avoid sparks and should not be handled during a thunderstorm."

Arindam Maity
EHS Manager - Punatsangshu Hydel Project

Handling explosives: Blasting is an unavoidable exercise in tunnelling and along with it comes the dangerous task of handling, transporting, storing, charging and using explosives which gives Arindam Maity, EHS Manager, Punatsangshu Hydel Project, sleepless nights. "Explosives have to be transported carefully in enclosed, leakproof vehicles, with double locking, properly insulated electrical wiring and driven by a licensed driver," he says. "When handling, explosives should not be dragged, dropped, kept away from metal tools to avoid sparks and should not be handled during a thunderstorm." The charging and blasting are carried out meticulously with proper permits and evacuation plans. "In the case of misfires, the place needs to be immediately barricaded, flushed with water and monitored till the situation is under control," he adds.

Geological weaknesses: These regions are prone to natural disasters like heavy rains, earthquakes, landslides that can trigger tunnel collapses or mass sliding like experienced by the Punatsangshu team who found their concrete trusses twisted out of shape one morning. While it is impossible to plan for disasters, it pays to be well prepared which is what Arindam ensures. "We follow a tally board system, carry out emergency mock drills regularly, conduct regular surveys to check for any displacement, have inductions for all who enter the tunnel, intercoms for instant communication and well-illuminated emergency exits."

"Yes, the dangers are many, varied and sometimes, quite unexpected," nods Stephen, "but it is possible to overcome all these with proper planning, preparedness and a positive mindset," he concludes. ■

LEADER SPEAK

R Srinivasan,
Executive Vice President & Head (Smart World & Communications)

Digitalisation is an important tool to achieve our goal of zero incident and safe environment. Amongst the main advantages, three things stand out: i) With our constantly expanding workforce and resources, it is extremely important to bring the new entrants and trainees to the level of safety being practiced at the company level and meet L&T benchmarks and digitalization that provide the answer through standardisation of processes. ii) Any near miss or potential hazard cases at any site and learnings thereof must be transmitted to all the sites instantly so that the entire operation is in sync. & iii) With live monitoring, emergency responses and expert advice as and when required, quick turnaround is possible. Digital tools like VR, AR and AI are already providing us with additional ammunition for us to achieve our goal of zero incident.

Girder erection across a busy junction

BUILDING INFRASTRUCTURE IN THE HEARTS OF CITIES

Understanding the hazards of constructing in congested cities

P R Kumar, Cluster Head, Smart World & Communications (SW&C) business unit has a lot to share about his project team's difficulties to execute India's largest surveillance network in Mumbai city. "There were challenges for us both above the ground and below," recalls Kumar, with his usual vigour. "Over ground, we had to avoid high-density traffic areas but then the whole of Mumbai is one big high-density traffic area," he laughs. "Space constraints in pedestrian areas was another headache and then there were power lines, dish cables, even clothes lines. Once we started to dig, we had to be extra careful not to damage any of the utilities lines running underground but that was only after we had received the necessary clearances and approvals from the Municipality and other local authorities."

Almost all IC and BU teams building urban infrastructure within the narrow confines of congested cities face similar challenges as Kumar be it constructing a high-rise residential tower or a sewerage network; a metro rail system or a deep basement car park. The two phases of the Lucknow Metro, for example, constructed by teams from the Heavy Civil Infrastructure IC and Railway SBG of Transportation Infrastructure IC are arguably the fastest built metro systems in India! One can well imagine their stress to build so fast, yet maintaining high standards of quality and safety and this article is about how Project and EHS Heads achieve this tall order.

Workmen fixing a surveillance camera

A diver accessing a storage tank

Look before you leap

Before they begin excavations, construction teams must first ascertain what lies beneath. Very few cities have well chartered and documented evidence of public utilities and therefore as K S Sudheesh Kumar, Head – EHS, WET IC shares, "It is a discovery process and many a time the discoveries are not very pleasant. It is almost a jungle down there and no one has any clue what they are, how old or in what condition they are but if anything goes wrong, which it is bound to, we have to face everyone's wrath."

There are water lines, power lines, gas lines, telephone lines, sewerage lines, all jumbled up without any colour coding or markings whatsoever. "Therefore, first we need to make sense of this jumble, identify the nature of the lines, mark and map them and then carefully handle them so that there are no disruptions. In fact, after most L&T projects, one big gain for the concerned municipality is that all their underground public utilities will be clearly chartered but we don't get paid for this extra service," adds Sudheesh with a sad smile.

VOICES FROM GROUND ZERO

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K S Sudheesh Kumar
Head – EHS, WET IC

Rebar works

Gas lines are a huge concern when executing in cities like Bengaluru. Sudheesh recalls an incident at the WSF to Bommanahalli Project, when excavating on the main road after taking permissions from GAIL, in the presence of GAIL engineers. "Unfortunately, a gas line was damaged. We isolated the area in no time for an hour to attend to the leak, considering public safety in a heavy traffic area." All such excavation works in such areas must be carried out in the presence of authorised personnel with Emergency Preparedness Plans and other arrangements. Assistant EHS Manager, Abhijit Rout adds that digging into an old network without updated drawings and plans is only asking for trouble.

The situation is not very different overseas as EHS Manager, R Palanikumar at the Mauritius Metro site deals with an old network and non-updated drawings and plans. "It is time consuming," he laments, "and often we have to repair

Workmen busy laying pipes under the watchful eyes of supervisors in a well barricaded zone

> **"It is time consuming and often we have to repair some of the damaged pipes that are over half a century old. The public do not understand our difficulties therefore managing their grievances is yet another issue."**
>
> **R Palanikumar**
> *EHS Manager - Mauritius Metro*

some of the damaged pipes that are over half a century old. The public do not understand our difficulties therefore managing their grievances is yet another issue."

At times, there are several end-users involved that project teams are forced to approach for the necessary approvals. Kumar perks up, "We faced this situation both in Ahmedabad and Mumbai. The reality is that we have a non-negotiable delivery deadline which these authorities will never appreciate; at the same time, we cannot 'push' too hard either because then things could backfire, so it is quite a tightrope walk!"

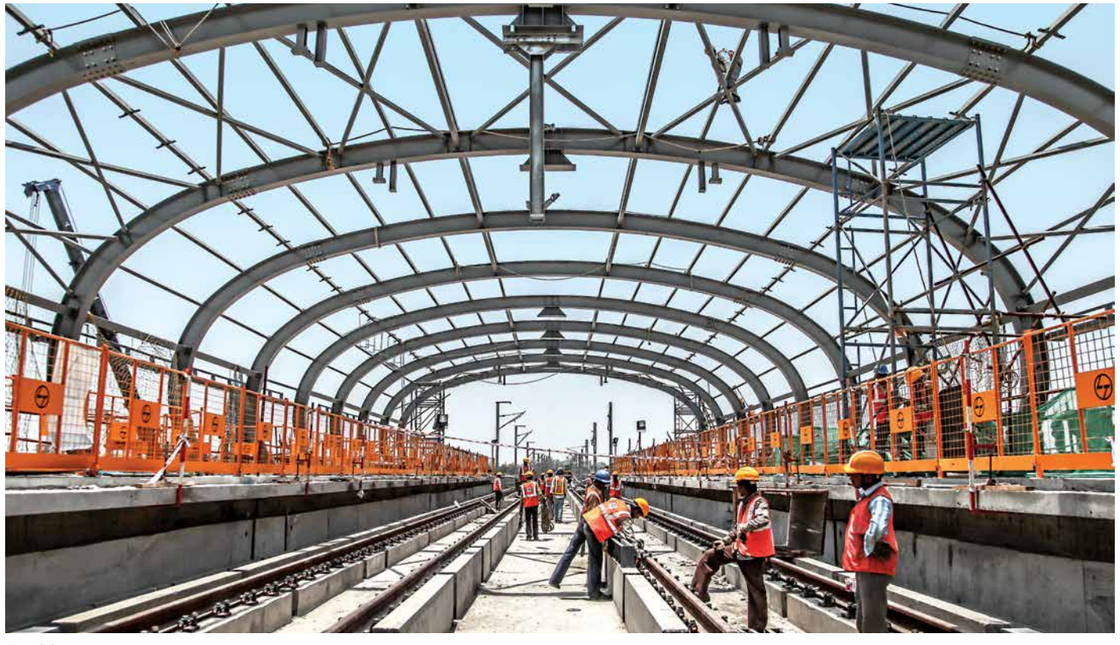
The depth and extent of excavations are dictated by the condition of the soil. K P Ravinath, Head – EHS, L&T GeoSTructure offers valuable insights. "Crews are often briefed not to go below the level of existing foundations and if deeply embedded structures are encountered, work should proceed only after thorough review and provision of supports." Debris removal and backfilling are related functions which if not taken up and completed quickly and efficiently, can, as Kumar jokes, "literally cause a stink!" More than a stink, it can lead to unsavoury situations that a WET team had to encounter at a project in Moradabad, UP where the incomplete backfilling work by the concerned authorities led to a fatality due to flooding of open pits that were also not safe barricaded. Executing open cut excavation is normally carried out by SBH shoring box (German technology for shielding & shoring) and other approved shoring systems from EDRC in congested or narrow areas with all safety requirements.

It is an ordeal for our WET IC teams to excavate, tunnel or carry out trenchless cuttings to lay pipes in the middle of crowded marketplaces or on roads with heavy traffic. "The hazards and risks need expert assessment and control measures implemented through a hierarchy of controls," cautions Sudheesh. At the same time, they must consider options of alternate routing, coordination, permissions, timing of activities, compliance to statutory requirements, restriction of the public, diversions or alternate traffic routes and traffic management. "We even consider updated technologies like Diamond Rock Cutting."

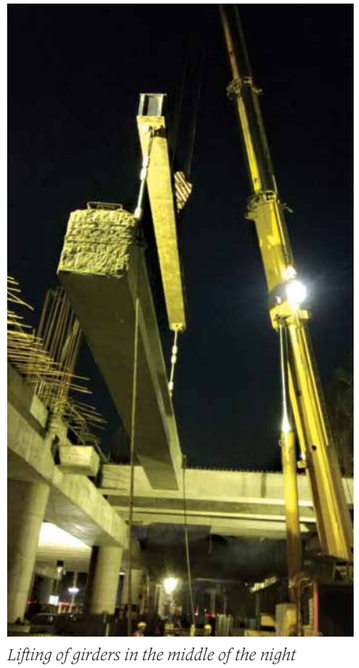
Consider all these factors when constructing in a teeming city like Kolkata and one can understand Cluster Head, Waste Water, KKCO (WET IC) Business Unit, M M Jaiswal's task of executing a sewerage pipe line network in Barrackpore city. "This is one of the most crowded places with multiple local railway station gates adding to the mess. We had to safely construct a lifting structure and a STP with pipe networking both above and below the ground. We managed," grins a relieved Jaiswal.

Public interface is unavoidable but needs to be handled with kid gloves as incidents involving the public can get nasty, warns Sudeesh. "There are potential risks of public agitations, mobs, media and sometimes national attention, stakeholders' dilemma, company reputation, brand image and other issues."

Putting safety first for a steel girder erection across a busy traffic junction



Track laying



Lifting of girders in the middle of the night

Apart from controlling external factors like traffic and public, project teams must be equally vigilant of internal factors within a site - the huge quantum of men and material entering or exiting a site that require close monitoring. Normally, safe access and exit points are clearly identified and demarcated and as Brij Mohan Sharma, Chief Project Manager, Lucknow Metro, TI IC, adds, "Prior to start of any work, the EHS & execution teams conduct safety walk downs to ensure safe access and egress."

Flooding is another issue that several cities experience during the monsoons and it is imperative for teams to be always prepared with a clearly laid out de-watering plan and equipment.

Moving mountains

With excavations, come the onerous task of manoeuvring the large, heavy earth moving equipment into place. "This is tricky," cautions Stephen Storey, Head – EHS, Heavy Civil Infrastructure, "because it involves large vehicles like tippers to remove the debris and while most of this activity is planned for the night, it can still cause traffic snarls, irate pedestrians and even residents cross with us for spoiling their sleep with the din we create."

Gigantic precast elements like piers, pier caps and girders used in the construction of metro rail systems need to be transported from the casting yard to the site for insitu erection. "Normally, these are transported on large flatbed trailers that are then manoeuvred in extremely confined spaces into position from where the precast elements are lifted and erected all during a small window that we are given. So," continues Stephen

Mannequins as flagmen to avoid putting people in danger

Girder erection using push launch technique with a marked secure zone for vehicle transit

ticks off on his fingers, "we have to work fast, quietly and super efficiently." Logistics and safe movement planning are critical; even the most minute aspect needs to be considered and factored in. Often big tasks come undone because of some small, seemingly insignificant error of planning or judgement. "Some of these are trickier as what we have to erect are off centre of gravity (CG)," adds Stephen, miming the tilt.

Lifting, shifting of heavy equipment like transformers, cable drums, masts and other big equipment warrants a well-thought-out and meticulous traffic management plan that is usually drawn up in consultation with various stakeholders: client, local authorities and other contractors. "We created an Interface Committee," Brij Mohan of LKM informs, "and our plan included prior approvals of road diversions, traffic blocks from local authorities, the deployment of traffic marshals and installation of blinkers."

Providing complete cover with safety nets and barricading for an elevated metro corridor construction

VOICES FROM GROUND ZERO

"All applicable risk assessments and method statements are reviewed before undertaking any heavy material handling activity and, as a matter of SOP, the condition of plant and machinery such as cranes, lifting accessories are regularly checked by the EHS department and by third parties to ensure safe usage."

G Divakar
Senior Manager EHS, HCI IC

Sanjay of Lucknow Metro, mentions a TRAP system that was implemented to ensure comprehensive safety at work especially along some of the sensitive places of Lucknow. At instances, where traffic cannot be fully restricted, hard barricading and reflective caution signs isolate the work area from public movement.

Careful and meticulous material handling is another key to success. "After a reassessment of the risk factors, lifting plans/permits are drawn up and shared with the client for approval and concurrence," informs G Divakar, Senior Manager EHS, Heavy Civil IC. "All applicable risk assessments and method statements are reviewed before undertaking any heavy material handling activity and, as a matter of SOP, the condition of plant and machinery such as cranes, lifting accessories are regularly checked by the EHS department and by third parties to ensure safe usage."

Fitness of equipment is another critical consideration. Meticulous pre-start checks certify that equipment is good to go like as Sanjay adds, "Cranes were specially checked for their safety and warning devices." Wherever required, the lifting area is cordoned off, barricaded and manned by traffic marshals. "Often, it is not human error but machine error that can spoil our day," remarks Divakar though for Palanikumar, the roadblock was of a different nature. "To get a 35 m man lift to work at the river bridge was a struggle because man baskets are not legally allowed in Mauritius and therefore finding the optimized medium to execute works at height within the Mauritian legal framework was a challenge."

For Sanjay and team, the heart of their project was a 177 m cantilever bridge across the Gomti River connecting old and new Lucknow including an

Communicating the message of safety

engineeringly challenging 85 m long central span at a height of 13 m without any pillar in between. "We also had to erect a 60 m ROB within 5 days across a 25000-volt railway powerline that called for a lot of detailing and microplanning right from fabrication of steel structures, logistics and preparing the lift scheme," remarks Sanjay.

Working at height and at night in cities

Lucknow Metro had multiple erections of bridges, large spans, portals across roads and over live railway lines at height. "The first task is to carefully choose suitable contractors and then put all workmen, ours and theirs, through a rigorous EHS training including compulsorily undergoing the Acrophobia Test (suitability for height work)," informs Sanjay.

A thoughtful departure from the standard use of ladders was the introduction of

"The first task is to carefully choose suitable contractors and then put all workmen, ours and theirs, through a rigorous EHS training including compulsorily undergoing the Acrophobia Test (suitability for height work)."

Sanjay Singh Gangwar
Project Manager - Lucknow Metro

Rail cum Road Vehicles (RRV) which are elevated work platforms enclosed from four sides for OHE works like installation of insulators, cantilevers, droppers, stringing of catenary and contact wires, etc. Subhamoy Maitra, says that "Group risk assessments define the best control measures which are "so far Reasonably Practicable" and such control measures are implemented." At the SW&C site at Ahmedabad, a dual level working platform equipped with knee roll handrails and toe guards was devised to accommodate workmen with materials.

The hazards of working at night are darkness, fatigue and sleep, lack of alertness and workmen indulging in alcohol. The Chennai Metro project team recall a bad accident that occurred a couple of years ago because some of these boxes were not ticked.

The most basic requirement is a well-lit site. An illumination level of minimum 50 lux, certified before start

Banking on staging and a secure lift method

"Group risk assessments define the best control measures which are "so far Reasonably Practicable" and such control measures are implemented."

Subhamoy Maitra
RREC - EHS Head,

of work, is normally used at sites to ensure that speed of execution does not slacken at night. At WET IC, the P&M department has ensured that all equipment at site have reverse horn and delayed start mechanisms to alert workmen. Sudheesh adds that they have implemented human proximity sensors to ensure public safety.

When dealing with high voltages, OHE charging is decided only after consulting with clients and procuring permits. "It's critical that everyone should be alerted of the charging," warns Subhamoy, "Induction current, if any, from the OHE wire or from any nearby power lines, should be first neutralized with discharge rods, the continuity of circuits checked for any faults by competent licensed electricians to ensure earthing." Lineman are deployed at all access points to restrict unauthorized entry into the charging zone.

Life in most cities are fast-paced and as builders of infrastructure, we are often hindrances, causing disruptions, throwing their well-planned lives out of gear. As planners, we need to be cognizant of that and ensure that they suffer least pain for the big gain that we are constructing for them. ■

LEADER SPEAK

S. Rajavel,
Senior Vice President & Head (Water, Smart World & Communication)

Over the years, we, at WET IC, have institutionalised the culture of responsibility and accountability towards EHS at all levels of the Management. Transparency in reporting of all Unsafe Acts, Unsafe Conditions and Unsafe Behaviour and implementation of various safe to-start systems through online and digital have brought an unprecedented level of safety and productivity improvement at the sites.

This is further exemplified by the fact that WET IC reported ZERO FATAL INCIDENTS in the financial year 2018-19. With the business growing exponentially and huge influx of skilled and unskilled workforce at our sites, we must gear up to ensure that the management of EHS policies, procedures, objectives and digital systems are practiced and implemented at all our sites through training and awareness programs.

Deploying a safe zone work policy at the Jebel Ali STP

MAKING EVERY DROP COUNT

Strategizing safe methods for building defining water infrastructure

When you turn on your tap, have you ever given a thought as to how water is flowing from it? It is in fact a long journey from the delivery end to the tapping point, a complex maze of conduit network, building which is an engineering challenge. Every water infrastructure project is fraught with many risk factors though for L&T Construction's Water & Effluent Treatment IC, it would be familiar ground with the experience of having constructed over 5 lakh+ km of channelized water & wastewater network, more than 7100 MLD of water,

wastewater and effluent treatment plants and irrigated 7.3 lakh hectares of land. With over 20 million people benefiting from these various water infrastructure projects, there is a lot to share on how we make every drop count!

Prioritising critical civil works

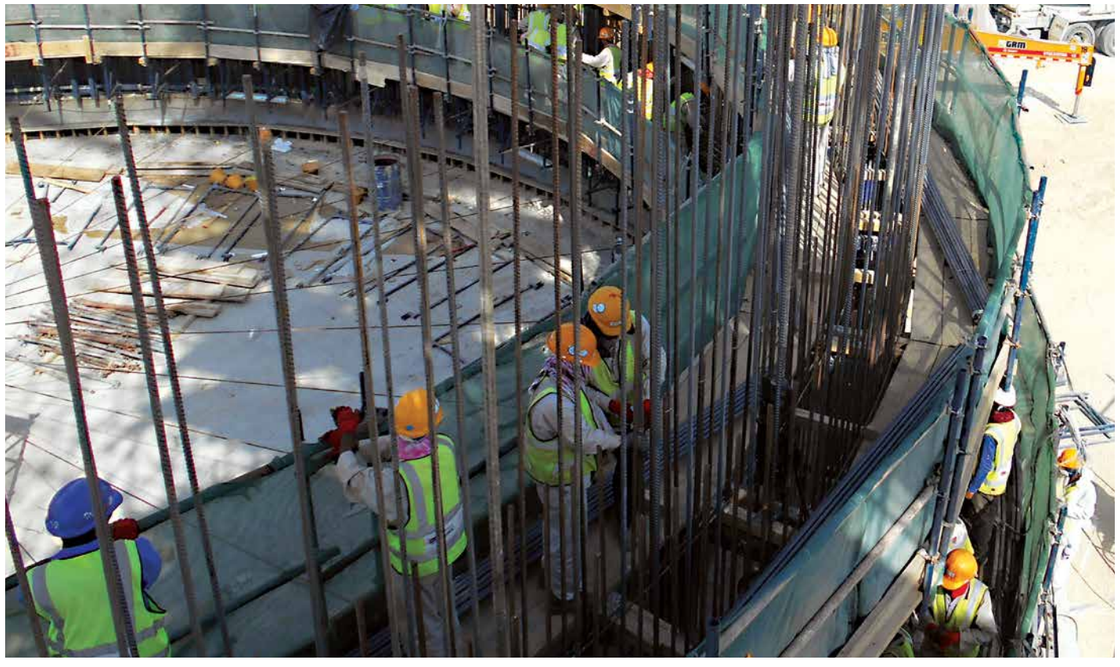
While pipelines are the arteries of water projects, the critical structures are the heart of the system that tap and treat water from its sources. Raising such structures calls for a detailed safe approach as the scope largely involves precise civil and mechanical works as Project Director, Syed Abdul Noor, and team at the 375 MLD Sewage Treatment Plant in Jebel Ali found out. "This is probably the largest STP that we have constructed covering an area of 4 km X 1 Km comprising 54 major civil structures with 12 large diameter clarifiers, 6 anaerobic digester tanks, 77 tank clusters and other building structures. There are 20 pre-sedimentation tanks to capture the settable solids and 16 aeration tanks in which oxygen breaks down the contaminants. All these structures are interconnected by an impressive network of large diameter pipes to move 375,000 tons of water for treatment, 24/7, all year long."

"With excavation as deep as 12 m and the water table around 6 to 8 m, it was critical to first stabilize the soil to prevent collapse of equipment in the trenches," shares K.A. Muralidharan, the EHS In-charge. "We conducted necessary soil testing prior to execution and engaged a dewatering specialist to implement continuous dewatering and necessary slope protection."

To make work secure, "We implemented a zoning system with the entire project divided into 7 control areas by breaking down the construction activities to align each activity with individual targets that were monitored daily through the Time Quality Report (TQR)," shares Noor adding that a time-tested safe methodology with on-field improvisations was largely instrumental for success. "Mapping the activities through TQR helped to add thrust wherever required with additional manpower for lagging tasks. During peak operations the site looked more like a heavy civil job with 21 tower cranes operating between 45 to 65 m boom lengths whose safe manoeuvring was backed by a 32-channel communication system comprising 123 radio sets among operators, riggers and supervisors."

"We implemented a zoning system with the entire project divided into 7 control areas by breaking down the construction activities to align each activity with individual targets that were monitored daily through the Time Quality Report (TQR)."

Syed Abdul Noor
Project Director - Jebel Ali STP



Creating a secure staging system

A tall order of constructing 179 structures across more than 40 locations at the Adilabad Water Supply Scheme, was brought down to 125, thanks to the team's strategic review of the alignment. "Whenever we hit a road block, we brainstormed a lot and ideas just flowed," quips R.K. Subramani, Project Manager, "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 facilitating seamless transportation and erection. With close to 10,335 valves under our scope, we raised the bar to ensure that the butterfly and sluice valves were preassembled in a centralized yard to safely meet the delivery schedules."

Banking on inherent strengths

L&T's innovative formwork schemes always give us a safe edge especially when it comes to building complex structures like the anaerobic digesters, at the Jebel Ali Plant, that involved the construction of 22 m tall, 21 m dia tanks in confined spaces through an automatic climbing scaffolding system with three hanging platforms addressing different layers of work.

Elaborating on the scheme, Muralidharan, shares, "While the topmost platform catered to the reinforcement work, the middle focussed on continuous concreting and the bottom bench on finishing. This way, we achieved phase wise finishing by putting close to 150 workmen per shift and completing the entire activity in just about 5 days with utmost safety." Likewise, doing the 3-level tertiary filter beds needed process innovation, highlights Noor, "It was too risky at the lower levels because of the confined space, so we used a thermocol block as a dead bed for the base slab to align the sequence of works as per the schedule."

Raising critical structures the safe way

"For the construction of anaerobic digesters, we achieved phase wise finishing by putting close to 150 workmen per shift and completing the entire activity in just about 5 days with utmost safety."

K.A. Muralidharan
EHS In-charge - Jebel Ali STP

Training session for workmen

While executing Asia's largest microfiltration plant at Raichur, our expertise to customize a suitable formwork scheme came in handy to build the settling tank, a 3-part structure partly below and partly above ground with the walls tapering from 550 mm to 200 mm at the top along with a counterfort at 4 m intervals. The chemical house was another structure that needed precision planning during construction as it comprised RCC chemical tanks inside the first floor which was taken up only after completing the entire structure and roof works. Special care was taken to insulate the floor and tank with acid resistant tiles as the UPVC pipeline carries the chemical up to the stilling chamber, CMB ETP and centrifuge.

The project team at Kharkai Barrage came up with a suitable scheme to construct the flared-out wall of 80 to 90 m length and height of 18.5 m, both upstream and downstream along both banks of the barrage due to the varying slope, ranging between 90 degrees at the beginning to 26 at the end. "As close to 30 percent of the total concrete work was in this section, a novel formwork scheme for hinging the structure from the inside was developed using reinforcements

"We were spot on to ensure that safety and quality were stringently adhered to at site by having two construction managers assigned across both banks with another senior construction manager exclusively reviewing the entire activities through daily and weekly meetings with the on-field teams."

Dinesh Kharbhanda
Project Manager - Kharkai Barrage

and only the working platform was provided from the outside," mentions Dinesh Kharbhanda, Project Manager - Kharkai Barrage. For lifting the piers and abutment, a triangular shaped 1.5 m long climbing bracket system was used which was fixed to the bottom of the pier lift above which the lifting was done. The entire shuttering formwork was placed over this climbing bracket system and fastened from the inside using tie rods with supports provided from the outside. Adopting the bracket system prolonged the working season and mitigated the risk of flash floods during the pre-monsoon period.

At the Pokaran-Falsoond-Balotra Siwana Lift Water Supply Project, a major portion of the scope comprised construction of civil structures that included 34 elevated service reservoirs ranging from 20 to 25 m in height with storage capacities of 100 KL to 1250 KL across remote locations on the top of 40 m high sand dunes. The team accessed the work spot by making approach ramps that facilitated safe movement of materials. Geo-technical investigations revealed that the soil had chloride content and hence had to be treated before taking up the civil works. The team implemented a secure staging process with fall arrestors and the task was monitored by an EHS official and subjected to timely inspections during phases of construction.

Engineering secure methods around wet wickets

In the realm of water supply and lift irrigation projects, there are plenty of insights about how to safely raise critical structures. At the Upper Indravati Lift Canal project, EDRC stepped in to evolve a secure execution strategy to build the intake structure, highlights Project Manager, Udayagiri Srinivas. "The scope involved diverting the flow of running water through a tail race channel and constructing a 16 m deep coffer dam for the fore bay channel. Necessary silt protection measures were taken to prevent its entry as the design encompassed an open fore bay allowing water to be pumped directly to the suction chambers." From the safety front, we had it all covered, says Sujit Panda, EHS In-charge. "Appropriate sloping and benching methods were worked out along with additional protection such as safety nets to contain the earth. Other support elements

Testing the conduits

included hard barricading with colour coding, signage boards with safety messages while access to work spots was allowed only through authorized approvals backed with MS ladders supported by intermediate landing platforms for safe working."

The Kharkhai Barrage and TWAD Vellore water supply projects are unique in that the risks were high as a large part of the core works was along perineal waters. One of the most critical tasks at the TWAD Vellore project was the construction of head and intake works on an island-like mass (600 m wide) surrounded by the waters of river Cauvery and the surplus water from Mettur dam within a mean shutdown period of 32 days which was critically monitored by the farmers. A secure work strategy was formulated with a conventional method of earth replacement for accessing the land mass to mitigate a water level of 8 m around the channel by progressively laying well-gravelled soil over the slush to prevent sinking and seepage. An economic design enabled the construction of the entire structure within a limited space of 8.6 acres with provisions for future enhancement. Since the intake well was adjacent to the water column, coffer dams were constructed to arrest the seepage of water during execution and as the depth of the well increased, the bund sizes were enhanced accordingly. Excavation was carried out by the progressive earth shifting method with multiple excavators simultaneously engaged at different levels. The entire substructure was raised adopting the sequential dewatering and concreting method. The raw water pumping main for conveying water from head works to the proposed treatment plant runs to about 100 m.

Concreting formed the bulk of the works comprising close to 227,000, cu.m along with associated tasks such as

"Necessary silt protection measures were taken to prevent the entry of running water as the structural design encompassed an open fore bay allowing water to be pumped directly to the suction chambers."

Udayagiri Srinivas
Project Manager - Upper Indravati Lift Canal Project

109,000 sq.m of shuttering and 5800 t of reinforcement at Kharkai Barrage. "This was not a plain pour forward task as we had only 8 to 9 months a year to work in the middle of a flowing river and our asking rate for concreting was more

Building a water life line canal with secure sloping and benching methods

Head and intake works for TWAD Vellore

than 10,000 cum per month," highlights Dinesh Kharbhanda. Keeping vigil and having the right men at strategic locations made work safer he assures, "We were spot on to ensure that safety and quality were stringently adhered to at site by having two construction managers assigned across both banks with another senior construction manager exclusively reviewing the entire activities through daily and weekly meetings with the on-field teams."

Integrating water lifelines with precision

Integrating water transmission mains is always a challenge of channelizing safe zones with the alignment that run across habitations, villages and cities. The risk factors associated in such tasks are directly related to the size of conduits and limitations along the route. At times, things can get further complicated when there are different services especially in a plant water system as was the case at Jebel Ali where the scope involved

VOICES FROM GROUND ZERO

"Appropriate sloping and benching methods were worked out along with additional protection such as safety nets to contain the earth."

Sujit Panda
EHS In-charge - Upper Indravati Lift Canal Project

close to 120 km of pipe laying, 24 km of yard piping, 11.5 km of GRE piping, 6 km of fibre optic cables, 54 km of LV and MV cables, 2 km of HDPE, 21 km of street lighting along with CCTV cables and MEP services. Streamlining was the key, highlights Noor, "It was critical to finish the milestones synchronizing with the various services within the site. By recruiting a MEICA coordinator, we were able to merge all the different service drawings to mitigate the risks and clashes on the spot." Today, Jebel Ali stands safely having clocked more than 10 million safe-manhours, a feat that Noor largely attributes to the 'Look-ahead Planning meetings' that removed constraints and ensured safety across work fronts.

Zoning resources along strategic sections of the alignment is something that most WET projects have perfected according to site needs. In projects such as Adilabad and Nagaur-Bikaner Water Supply Schemes where the piping scope was close to 3000 km, a feasible and safe tactic was implemented. "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," mentions Planning Engineer, Kaushal.

Precast duct installed at a sewage pipeline project

Micro tunneling

A major portion of L&T's scope of work at the Sauni Yojana Link 3&4 comprised manufacturing and laying of 83801 RMT pipes of 3000 mm dia with each unit weighing close to 17 t with a plate thickness of 17.5 mm. To facilitate safe handling of the heavy pipes, the project team conducted a survey by coordinating with the local electricity department and strategized a secure mode of transport for the pipes on trailers by either increasing the height of the electrical conductors or by shifting the poles. To ensure that the special coating on the pipes remained intact, the team made a provision to unload the pipes onto sandbags to maintain both a minimum clearance from ground level and safe distances between the units to facilitate the lifting process.

Putting together the water transmission main across 256 km for the Nagaur-Bikaner Water Supply Scheme was tricky for Project Director, Shaik Yesdani Ahmed, and team. "Since we were dealing with close to 1,20,000 t of pipes in the scope, we chose a vendor who put up a plant that worked very well for it gave us a safe edge in costing, production and delivery."

VOICES FROM GROUND ZERO

"For certain tough terrain sections, a feasible round about routing was worked out taking into consideration the safety of the logistics."

Kaushal
Planning Engineer - Adilabad, WSS Project

Scaffolding when building the Kharkai Barrage

Perfecting the art of trenching and cross overs

It's never easy to make headway while laying pipes when the alignment runs across different zones. Safety is paramount both while breaking ground and making headway considering the dangers of unknown utilities. While modern digital tools like LiDAR has made life considerably easier, you still need to adopt a cautious approach.

While each site has its own risk mitigation measures there are a few significant projects like the Sauni Yojana lift irrigation scheme that saw some of the largest dia pipes handled across Asia where a range of measures were implemented that are now a benchmark in safe methods. To ensure hassle-free execution, the project team adhered to a maximum of 100 m long trenching activity wherein 8 pipes were laid in a single line. Welding of the pipe joints was a precision task for which the project team adopted an innovative method of creating a weld pit inside the pipe trench for the jointing works carried out by skilled welders using the Shielded Metal Arc Welding (SMAW) process.

Road restoration work

VOICES FROM GROUND ZERO

"Since we were dealing with close to 1,20,000 t of pipes in the scope, we chose a vendor who put up a plant that worked very well for it gave us a safe edge in costing, production and delivery."

Shaik Yesdani Ahmed
Project Director - Nagaur-Bikaner WSS

There were, in addition, a slew of critical cross overs with more than 120 high tension electrical lines crossing the alignment which called for utmost care while handling the pipes during excavation, blasting and particularly when operating cranes. The entire works were completed successfully by adhering to the highest safety standards by implementing SOPs such as lowering the ground profile which facilitated gradual excavation, adjusting the position of the crane and ensuring timely shutdowns.

A major crossover successfully negotiated by the team was across 10 m under an existing crude oil pipeline. Mock-ups were made to illustrate the possible hazards which enabled the workforce to master the precise procedures to be adopted. The project team made cautious headway manually excavating, as blasting was prohibited, around 200 m as per the safety guidelines, but always maintaining a 1 m clearance from the crude oil line throughout the trenching activity. The process involved 7400 cu.m of hard rock excavation: 85% of the strata using rock breakers and manual excavation of 400 cu.m using electric rock breakers. A MS casing pipe of 3.4 m ID was installed to 'push' and lay the pipes at the rate of 2.5 m per week. To make the system fool proof, the rising main was encased for 25 m on each side of the crossing with concrete and equipped with turbulence measurement sensors that assessed the water current vibration and automatically triggered alert messages to the oil and water.

Ensuring safe promises continue

The WET IC teams remain connected with their projects even after commissioning as most water infrastructure schemes have an operations and maintenance phase. It is then up to the O&M Department to continue the good work with appropriate hands-on training to the clients' teams as the onus with water projects is always about how safely water is delivered to the public at large. ■

LEADER SPEAK

Rajeev Jyoti,
Chief Executive (Railway SBG - TIIC)

At Railway SBG, Safe work practices are paramount to our business.

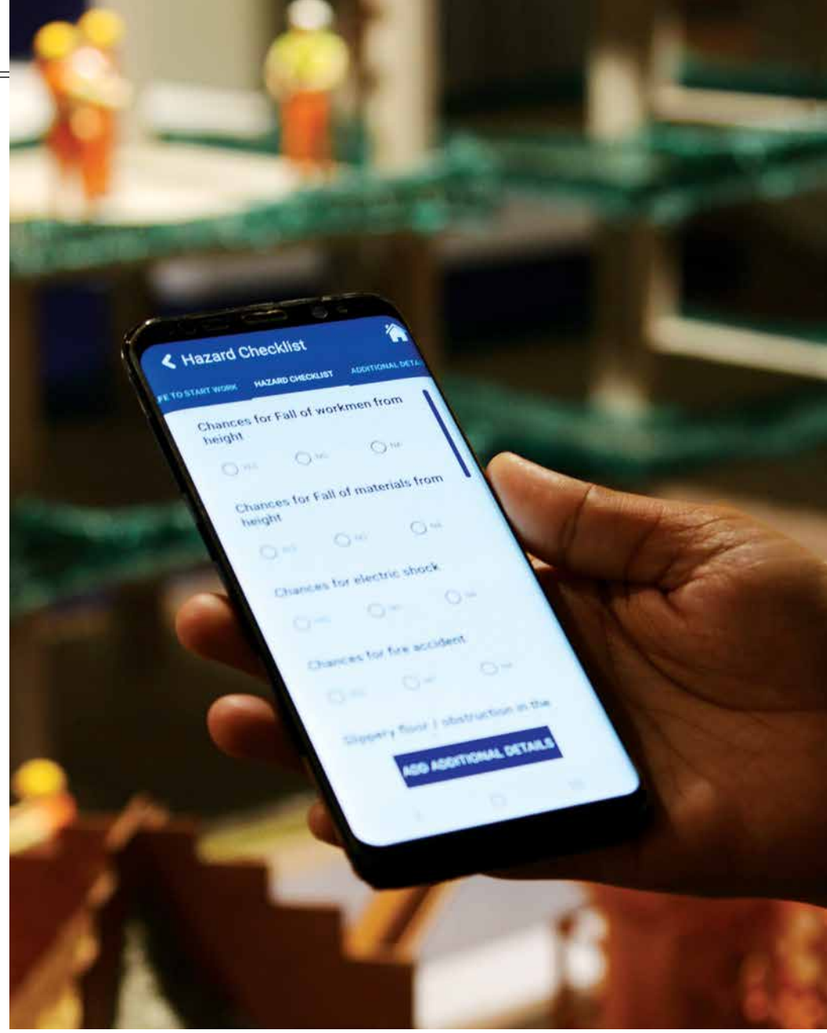
Railways projects, being linear in nature, are typically spread across hundreds of km with a multitude of discrete risks that are both location and task specific. Therefore, risk identification and mitigation is a continuous process involving multiple teams across various stretches of the project. Safety is a key priority for the leadership team and the project organization structure has been evolved to provide significant autonomy to the function of Safety.

Across projects, EHS methodologies are monitored and improved through regimented protocols and systems through Quarterly Audit Rating Score (QARS) – a 20-point comprehensive process to evaluate EHS performance and identify thrust areas that are further benchmarked through cross project reviews during periodic Safety Conclaves. Such methods allow us to update project specific requirements To mention, one of our projects in the Western Ghats involves OHE installation in over 70 tunnels and 125 bridges over a stretch of 428 km (90% single line) that brings in numerous challenges in the implementation of safe work practices while working amidst highly restrictive 'block sections' involving significant material handling and unique erection methodologies.

Our projects have won top category awards from National Safety Council of India - four year in a row including the prestigious 'Golden Trophy Award' in the Construction Segment twice in the last 4 years. Besides, we continue to be at the forefront in harnessing Digital technologies to evolve innovatives solutions towards mitigating Safety challenges.

Irrespective of the huge challenges, as a SBG, we remain committed a high level of Safety awareness and to improve our safety performance – towards 'Mission Zero Harm.'

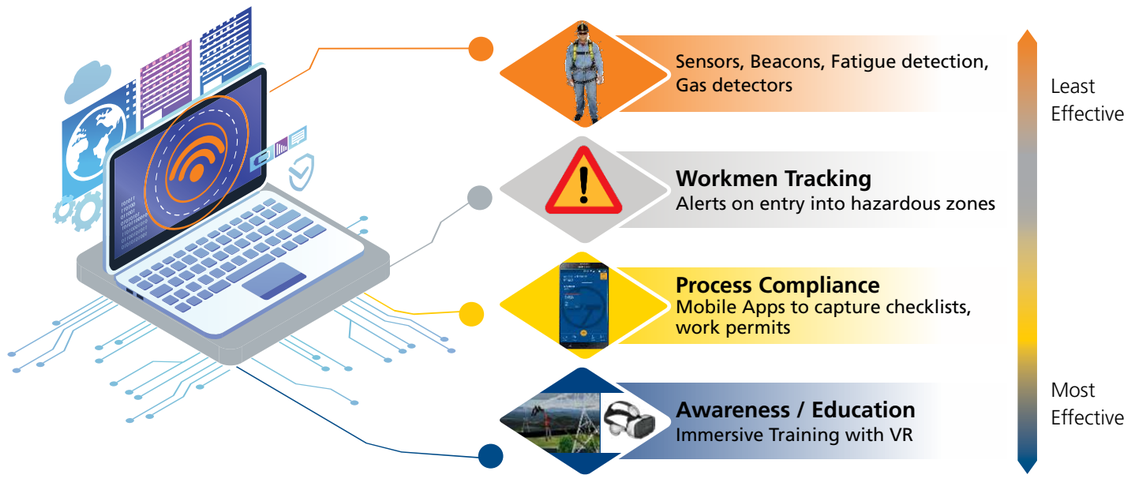
SAFELY DIGITAL!



Safety app in action

As the digitalization wave sweeps across the organization, its enormous benefits are gradually becoming evident to improve productivity, reduce waste, cut costs, quicken execution time and thereby enhance overall efficiencies. Multiple spheres are enjoying the positive impact of digitalization, none more than the realm of Safety.

"Our digital approach to safety is four-pronged," begins Chief Digital Officer, L&T, S Anantha Sayana, doodling on his favourite white board. "Our primary focus is on awareness building and education featuring immersive learning with Virtual, Augmented and, in some cases, Mixed Reality. Next comes process compliance involving mobile apps to capture check lists, work permits, manage EHSMS and EHS inspection processes, SOPs, and so on. Workmen tracking is another



area of implementation with alerts on entering 'no-go' or hazardous zones, to mark attendance, measure productivity. Finally, we have sensors, beacons, fatigue detection devices, gas detectors that stream 'live' data."

"We have developed around 40 modules, trained over 30,000 workmen across 5 of our businesses."

Krithika Venkatesh
Senior Manager - Digital

Digital reality checks

Safety training through immersive VR gives workmen and employees a 'real life' feel of situations. "We have developed around 40 modules, trained over 30,000 workmen across 5 of our businesses," informs Krithika Venkatesh, Senior Manager - Digital. The VR training modules cover a wide range of situations that are IC-specific: fall from temporary platforms, fall from lift shafts, vehicles parked on slopes, being B&F specific; fall from height when working next to water in a marine environment and fall from height when working on a cable stay bridge relevant for both B&F & Heavy Civil; excavation for TI; power tools operation, working over ladder

"We have been the early adopters to use Virtual Reality modules for our safety training of workmen and the response from workmen has been extremely positive."

Ashok Varadhan P
Digital Officer, PT&D

Pep talk

mobile scaffold working platforms, panel shifting and erection equipment installation, soil collapse foundation activities, horizontal movement on towers, dead-man anchoring and tower back stay specific to PT&D while fall from height straddles almost all verticals.

"We have been the early adopters to use Virtual Reality modules for our safety training of workmen," informs Digital Officer, PT&D - Ashok Varadhan P, "and the response from workmen has been extremely positive. In fact, some

Snapshot of a virtual reality module

"Apart from adopting Virtual Reality for Safety training, an app named SPARSH (Standard Precautions Using AR for Safety & Health) is under development."

Utkarsh Desai
Digital Officer of TI IC

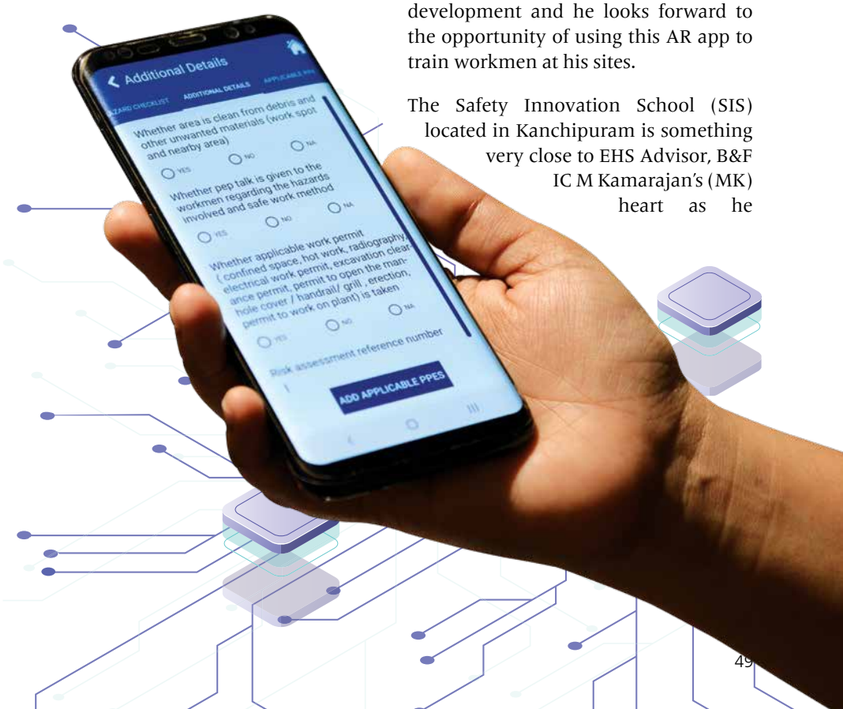
"We will also use existing VR modules through Oculus and Procus and soon SIS is set to make a marked difference to the efficiency of individuals who undergo sessions here."

M Kamarajan
EHS Advisor, B&F IC

of them became very emotional after the VR experience and commented that the experience had helped them realise the importance of safety. Another mentioned that henceforth he would think of his family every time he climbed a transmission line tower. This impact has motivated us to develop more such modules and today we have covered all the critical activities involved in our TL, UPD and substation businesses using VR."

Apart from adopting Virtual Reality for Safety training, Digital Officer of TI IC, Utkarsh Desai shares that an app named SPARSH (Standard Precautions Using AR for Safety & Health) is under development and he looks forward to the opportunity of using this AR app to train workmen at his sites.

The Safety Innovation School (SIS) located in Kanchipuram is something very close to EHS Advisor, B&F IC M Kamarajan's (MK) heart as he



> **Without doubt, this initiative (Safety App) of ours has the highest adoption, B&F IC has been both the early adopters and the most comprehensive users covering almost all the developed applications."**
>
> **Krithika Venkatesh**
> *Senior Manager - Digital*

holds forth with passion, "we are in the process of putting together the building blocks to offer an engaging experience to participants that will include interactive AR content on a mobile app, immersive VR experience using Oculus Rift for fire safety, safety when working in confined spaces and gas cutting." The app will provide participants real-time engagement for pre-visit, onsite and post-training activities, take up online tests and give feedback. "We will also use existing VR modules through Oculus and Procus and soon SIS is set to make a marked difference to the efficiency of individuals who undergo sessions here," he says confidently.

Safety reporting made simple

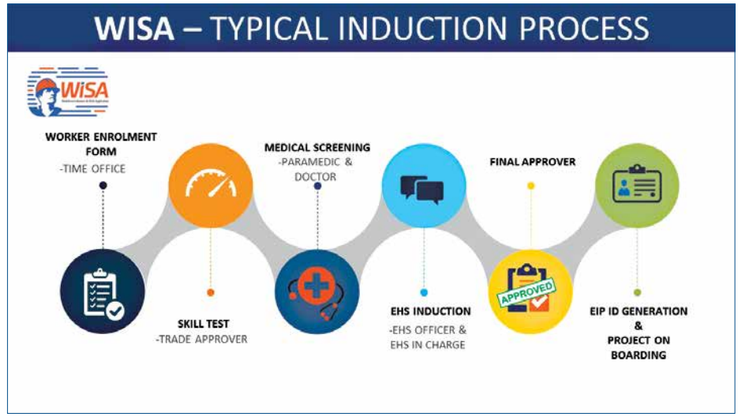
Launched in November 2016, the mobile Safety App has been a runaway hit with 16,000+ users, covering some 550 projects cumulatively raising 1.5 lakh forms per month. 'Without doubt, this initiative of ours has the highest adoption," enthuses Krithika. "B&F IC has been both the early adopters and the most comprehensive users covering almost all the developed applications. The modules that have already been rolled out include pre-start, work permits, safety improvements, near miss reporting, EHS violation memos, EHS observations, escalations for non-compliance, audit modules with mailers and escalation, CAT module with mailers and escalation, inspection checklists and executive feedback."

The safety app assists site engineers and managers to update site workers on safety rules at the mere tap of a screen.

> **"It works like a perfect interactive communication medium, it reduces physical interactions and has made documenting workplace safety incidents extremely easy."**
>
> **Mohan Babu**
> *Digital Officer, HCI IC*

"It works like a perfect interactive communication medium," shares Mohan Babu, Digital Officer, HCI, "it reduces physical interactions and has made documenting workplace safety incidents extremely easy. Upload of photographs as evidence to the pre-start form has helped us to improve the efficiency of our safety staff." Apart from enhancing site efficiency, documents are now available anytime, anywhere on the cloud.

EHS observation dashboard on PowerBI



What's your safety score?

Welcome 'ViewEHS', a revolutionary and one-of-its-kind digital solution, that captures all EHS data, compares them with baseline data and assigns KPI scores to analyse EHS performance of all sites in real time. "It has brought in unprecedented transparency in overall site EHS assessment with minimal human intervention," for Head - EHS, WET IC & SWC BU, K S Sudheesh Kumar and a matter of great relief too which is why he has promptly implemented 'ViewEHS' across all sites in both WET IC and SWC BU.

The 'ViewEHS' platform comprises 37 objectives clubbed under '5 Arms of EHS' to monitor day to day EHS implementation. The five areas being Proactive Measures, Audit Inspection Outcomes and Compliances, Incident Communication, Investigation and Corrective Action, Training & EHS reviews and IMS Implementation & Documentation. All the activities and sub-activities in WET and SWC have been mapped comprehensively with their respective hazards, risks, SOPs, checklists and permits.

Sudheesh declares proudly that "We received the copyright for 'SafeArmz', the earlier version of ViewEHS, so this is surely a world-class digital EHS management solution and we plan to go a step further and apply for patent rights as we believe no such solution exists right now across the EPC Industry."

> **"The mobile app features asset registration, online and offline inspection of assets and ready reports while the web app enables user and project on-boarding, QR code generation and dynamic report generation."**
>
> **V Prabhu**
> *Senior DGM - Digital*

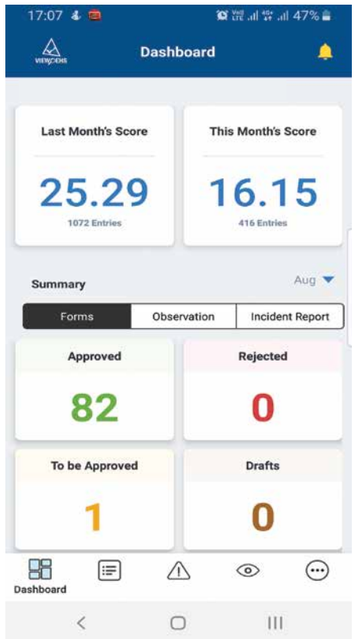
Ib4U aka Inspect before Use

Periodic safety inspection of assets and facilities is now possible with Ib4U, that has both a "a mobile and a web avatar," informs V Prabhu, Senior DGM – Digital. "The mobile app features asset registration, online and offline inspection of assets and ready reports while the web app enables user and project on-boarding, QR code generation and dynamic report generation."

Canteens, offices, stores and workmen habitats have been on-boarded while some of the P&M assets on-boarded include tower cranes, DG sets, passenger hoists, plants, supplier vehicles, rope suspended platforms, vehicle & earth moving equipment, RCCB and power tools. Fire extinguishers, ladders, safety harnesses and scaffolds are other aspects that can also be inspected with Ib4U.

Knowing your workman up close and personal!

WISA or Workforce Induction & Skills Application is an end-to-end worker information system that comprises a complete induction process including a digital health screening kit. A QR-coded worker ID can be generated for all on-boarded workers, which in turn can be used to capture worker attendance at work site, view his details, training records, site passes, etc. The mobile interface can record observations,



ViewEHS - Performance scorecard

"All sites are constantly struggling with the lack of skilled manpower but once you find this rare commodity, we will go a long way to have the right man for the right job."

Balaji Kasiram
Head Digital – Technical

appreciations and make behaviour notes. "All sites are constantly struggling with the lack of skilled manpower but once you find this rare commodity, we will go a long way to have the right man for the right job," says Balaji Kasiram, Head Digital – Technical, "WISA is a repository of information of workmen that are relevant for sites especially at the point of deployment and execution."

Face recognition is possible in WISA using a reference image uploaded at the time of induction. The worker is captured on camera at site through a mobile app and identified using an AI engine. WISA is therefore ideal to find out attendance or to just observe the behaviour of a particular workman.

"WISA has helped us improve our worker on-boarding process at several B&F sites. We feel WISA has huge potential to transform our interface with workers and contractors in a big way."

S. Suresh Kumar
DGM - Site Administration & IR, B&F IC

"WISA has helped us improve our worker on-boarding process at several B&F sites," shares S. Suresh Kumar - DGM - Site Administration & IR, B&F IC. "We feel WISA has huge potential to transform our interface with workers and contractors in a big way."

How healthy are you?

The VinCense Health Screening process is about making occupational health screening oh-so-easy. When a workman arrives, he is registered as a new person following which his vitals like blood pressure, glucose, weight, pulse rate, etc. are screened using the VinCense HSP. This data is updated real time into the WISA platform which is then made available to the doctor on the platform during physical examination. "The entire screening process takes only about 4-5 minutes per person," says Krithika, "saving time to the tune of some 77% from our erstwhile processes. Induction is so much easier," she laughs.

Alchemy - turning data into insight

In olden times, alchemy was considered the science of turning base metals into gold. The role of the 'Alchemy' analytics platform for the Digital team is almost as crucial as it ingests data from multiple sources and derives insights by capturing patterns and trends from the data. It sources data every month from P&M, IoT devices, Procube, Safety and Quality solutions and presents them as business intelligence dashboards with the capability to perform - descriptive, diagnostic, predictive and prescriptive analytics. In the realm of Safety, Alchemy processes approximately 1 TB a month from 1.5 lakh forms to provide safety performance dashboards such as submission time analysis for permits, rejection analysis of permits, types of observations recorded, time analysis for closure of observations, and so on.

"We capitalised on this opportunity and were able to build the ML model based on the rich data generated from the forms submitted during 2017."

P S Rajkumar
Digital Officer - B&F

"Currently, we are analysing events before and after an observation submission, correlating findings with work permits and their rejections and are able to predict potential hazards that could lead to near misses."

Ashwin VK
Senior Manager – Analytics

Machine Learning (ML) models have been next on the Digital team's agenda, developed to mine insights from the textual data generated from the various forms submitted through the Safety App like reasons for rejection, classification for permits and EHS observation classifications. Digital Officer - B&F, P S Rajkumar traces the IC's digital journey from 2016. "We capitalised on this opportunity and were able to build the ML model based on the rich data generated from the forms submitted during 2017. For example, we were able to unearth the major categories for rejection of permits based on the type of project and prioritise focussed training interventions for the site staff."

Matters have progressed a fair bit, emphasizes Ashwin VK, Senior Manager – Analytics. "Currently, we are analysing events before and after an observation submission, correlating findings with work permits and their rejections and are able to predict potential hazards that could lead to near misses. After we develop the model, we believe, that we will able to predict unsafe practices and give prescriptions to prevent such incidents."

AI is already making safety A1

Artificial Intelligence (AI) has opened a huge new vista of intervention in construction and safety is a big gainer. "The versatility of AI is what makes it a game-changer," is how Anantha Sayana describes the veritable AI invasion. "A typical construction site covers a large area, multiple zones and varied activities, posing a challenge to the safety staff at site to maintain safety controls. AI aids our staff to detect unsafe acts and conditions through live video feed from CCTV cameras."

For example, computer vision (CV, a branch of AI) can detect unsafe acts like not wearing a helmet or harness, working at edges without a harness or working without safety shoes. It can detect unsafe conditions like missing barricades, absent safety nets or sense loose material around edges. AI can also answer questions like "How many workmen are on site at a given point in time," "How many machines are at work," "What is the current stock of material at site?" or even a question relating to whether it is safe to walk on a platform or not.

Apart from CV, AI can churn out safety form texts into meaningful insights using Natural Language Processing (NLP) and the two together can provide a comprehensive view of safety risk levels and hazards for the site, enabling site personnel to take proactive measures and controls.

At present, AI predicts exciting times ahead!

Enter the digital EHS Man Friday!

A common sight at construction sites is of EHS managers constantly running around attending to a variety of never ending issues. An equally common complaint from EHS personnel is that they are forced to be too action-orientated with very little time to think and contribute strategically. This situation could undergo a sea change soon thanks to digitalization.

Imagine a scene circa 2022. An EHS Head, just starting from home for work, checks his mobile and finds all the designated tasks for the various sites under him, across geographies. The AI tool alerts him of a non-compliance at a residential site: a workman is on a top floor without full body harness. He can immediately alert the EHS In-charge to rectify the situation. Another ping: another alert; an unsafe activity has just commenced at another site without proper sanctions. Depending on the severity of the issue, the EHS Head can act. By the time he reaches his site office, all the immediate issues have been tackled. He is now free to settle down and think beyond.

"We see our AI and other digital tools to soon play the role of a Man Friday for the EHS Head, giving him timely alerts and prompting action that enables immediate decision-making and, most importantly, saves his time. The future is almost here!" Anantha and his merry band are preparing to usher it in sooner rather than later! ■

"We see our AI and other digital tools to soon play the role of a Man Friday for the EHS Head, giving him timely alerts and prompting action that enables immediate decision-making and, most importantly, saves his time. The future is almost here!"

S Anantha Sayana
Chief Digital Officer, L&T

LEADER SPEAK

T Madhavadas,
Senior Vice President & Head (Power Transmission & Distribution)

The colour of a person's helmet at any of our jobsites may be white, blue, green or yellow; but the blood that runs in all of us is red. Safe behaviour is therefore a shared imperative irrespective of cultural backgrounds, positions in hierarchy, personal beliefs, urgency of the task, constraints, limitations, etc. There is no way of undoing a loss and there's no such thing as right amount of compensation.

Behaviour modification, beyond awareness creation, is essential. Technology can be leveraged to make such training more effective. That is why we use immersive Virtual Reality modules and gamified microlearning apps. Perhaps we are the only EPC player in T&D space to do so with such scale and minutiae. Given the big churn the subcontractor labour pool undergoes these days, we must be extra careful in imparting training to each and every one of the newly joined workers. A construction site is an edifice of labour, effective demonstration of leadership by site staff, interplay of engineering disciplines, actualization of meticulous plans and unfolding of a vision – undoubtedly not a death trap. This is what we endeavour to demonstrate always!

400 kV Wangtu Substation

EXPLORING NEW HORIZONS; CONQUERING EVERY TERRAIN

Understanding how the challenges of different terrains are met

As the 'Columbus' of L&T Construction, the Power Transmission & Distribution IC has the unique distinction of exploring a cross-section of terrains, both at home and overseas. Be it stringing the 220 kV Alusten-Drass Transmission Line across Jammu's predominately snow-clad regions or constructing the 400 kV GIS at Wangtu, Himachal Pradesh; bringing light to 226 villages in Bihar as part of India's largest rural electrification project or braving

A view of snow clad terrain around the Wangtu Substation

the deserts of Oman to build the 400 kV Izki transmission line or even venturing into the dark continent to construct the 500 kV HVDC Ethiopia-Kenya interconnect, Africa's largest, PT&D has been redefining the rules of project execution. It is equally commendable how the IC has strategized to effectively mitigate execution risks across varied and challenging terrains while consistently raising the safety bar.

Higher the altitude, greater the challenge

Apart from hydro power projects, transmission and distribution jobs constitute a major portion of L&T's high-altitude sites. At any given point of time, PT&D would be executing projects across the upper reaches of India like the Karcham-Wangtu-Abduallpur line.

For Atul Singhal, Project Manager and team at the Wangtu Substation, the stakes were always high while executing one of India's highest located gas insulated substations at an altitude of + 2000 m above mean sea level. "Apart from the varying hilly terrain, there were a range of critical factors to be addressed such as working in freezing temperatures, safe movement of bulk equipment across the ghat roads, hard rock excavation, construction of RCC retaining walls, and of course, being prepared for the unexpected natural calamities," shares Sr. Planning Manager, K. Sivakumar.

At the 220kV S/c Alusteng-Drass (Part-II) Transmission Line, the challenge for Project Manager Subash Chander Sharma, and team was larger as the 50 km section passed through the Drass-Gumri-Zoji-La pass which is normally closed for more than six months in a year due to avalanches, massive snowfalls with snow accumulating to as high as 5 to 6 m. "Route finalization was of utmost importance," highlights Subash, "the survey was undertaken by the National Remote Sensing Agency and approved by the Snow and Avalanche Study Establishment after a thorough review with critical recommendations for the alignment. Further, we segregated the areas into sections and worked with consultant teams to arrive at the most feasible and safest route."

An inside view of the Wangtu GIS

Weathering the adverse weather

Unlike several of the well-defined construction projects, power transmission and distribution projects are vast spanning, at times, even cross-country that calls for detailed risk assessment of the weather conditions and varied terrains. PT&D has been largely successful in formulating control measures for specific natural events especially for projects across hilly and arid zones.

Both at the Wangtu substation and Alusteng–Drass transmission line projects, the working hours were realigned with the prevailing conditions. "We categorised the various tasks going by the risk index matrix as critical, high, medium and low and scheduled the activities accordingly. Work started as early as 6.45 am to overcome the threat of rain and low light. The teams were provided adequate warm clothing and safety essentials. In critical tasks where more thrust was required, customized safe methods were devised to make the entire exercise secure," shares Atul.

Citing a typical turbulent phase at site, Atul sighs, "On 27th May 2017, there was a severe hail storm followed by a cloud burst at around 5 pm but timely alerts ensured that the entire team and the workmen gangs were moved from the site to a safer place via a temporary exit. The damage caused to structures and material was extensive, but not a single life was lost. Together, we achieved more

Virtual Reality training for workmen

Safety messaging for public during the movement of hulking transformers

A section of the Alusteng–Drass transmission line across snow-clad slopes

"The survey was undertaken by the National Remote Sensing Agency and approved by the Snow and Avalanche Study Establishment after a thorough review with critical recommendations."

Subash Chander Sharma
Project Manager,
220kV S/c Alusteng-Drass TL

than 3 million safe-man hours." Atul's sense of achievement is apparent.

With the working season limited to only between mid-June to October-end, the project team at Alusteng–Drass had to hit the ground running. "With close to 164 locations earmarked for civil works along with construction of temporary bridges and access ways, in addition to special foundation works, it was a tough task that had to done with utmost safety," asserts Subash. "The focus was on providing workmen with amenities such as special shoes along with adequate winter clothing, with appropriate temporary facilities like tents and sheds along the alignment. Further, a range of special monitoring tools were deployed to gauge adverse weather conditions to alert the working crew."

Similarly, for international projects adequate control measures are implemented such as procuring specific PPEs to protect workmen from the extreme weather. To mitigate risks, emergency plans are darwn up, and mock runs familiarize teams to safe response during any crisis. In addition, separate EHS advisories relevant to the hazards across specific terrains are released on a timely basis and workmen are briefed on how to safeguard themselves from wild animal attacks, climb steep hills and overcome lack of oxygen at higher altitudes.

Keeping a safe distance

Working as a team is something L&T-ites excel at, and at remote locations, this is critical especially when the alignment is close to a forest. "We advocate workman gangs to move only in groups to face and overcome the threat of wild animals while our EHS coordinates had dedicated people to keep vigil and prompt alerts," mentions Subash.

With the ever-present threat of wild animals in the ongoing transmission line projects in Botswana, game wardens have been roped in for extra vigil and accompany construction teams in specific areas where wildlife activity is more. Routes are inspected with drones wherever accessibility is a challenge. Local EHS professionals with comprehensive insights on their country's specific requirements have been brought on board to assist teams to implement and enforce legislative requirements.

Establishing firm footings

Transmission and distribution projects are all about integrating the structural elements by establishing firm footings across various terrains where excavation is a challenge either because of limited approach ways and/or varying soil strata of mostly dry fissured or hard rock. It is interesting that project teams vouch for controlled blasting as a safe method to make headway. "Of course, this is a critical task," highlights Atul but he reaffirms, "With close to 3 lakh cu.m of excavation of which 50% was hard rock, we ensured a combination of safe blasting methods that included chemical cracking and diamond cutting backed by a 4-tier safety scheme comprising blasting mats, alarm and flagging systems with appropriate road closures."

Rock breaker deployed for breaking hard rock

The level of precision required to arrive at the exact foundation requirements for towers is a key factor before scaling up the steely elements, shares Subash "At the Alusteng – Drass project, we had to align with the distinct tower foundations designed by the Snow and Avalanche Study Establishment to withstand the extremities of the region. Grade 'C' steel was used in the tower elements and hardware fittings to withstand the extreme cold temperature. It is worthwhile to mention that, "We used an admixture for quick setting of concrete while for special foundations, self-load transit mixers with boom pressure was used for concrete pouring in avalanche prone areas that significantly increased our productivity and reduced time," he adds.

Establishing firm footings

"With close to 3 lakh cu.m of excavation of which 50% was hard rock, we ensured a combination of safe blasting methods."

Atul Singhal
Project Manager, Wangtu Substation

While accessibility is an issue across the ghats, terrains in arid zones across the Middle East and Africa have their own share of ground engineering issues to resolve. The 400 kV Izki-Ibri OHL across a span of 265 km had a safe strategy in place, assures S. Ayappan Project Manager, giving an insight on the scope: 645 towers spread 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. "Depending on the ground profile, most of the towers were configured aligning to deviations as per actual soil parameters against the norm of fixed parameters that considerably reduced foundation volumes. Further, at the initial stage itself, each tower was marked and inspected, and risky locations and watercourses avoided."

Engineering safe passage ways

The ghats are always challenging and more so when transporting heavy equipment such as transformers and transmission line tower elements. At the Wangtu substation site, our Special Projects and Construction Methods team stepped in to provide the required know-how to move 9 hulking transformers, two of them weighing 122 MT each and the other 7 weighing 80 MT each across the Solding Khad and Jaypee Bailey Bridges. The challenge was to negotiate the critical stretches as the bridges are the only link to Kinnaur and Lahal Spiti Districts and extremely important for army movement to the border areas.

Workmen on lifelines to raise the steely tower members

Safely moving a hulking transformer across an old bridge

"We carried out a thorough analysis of the bridge and developed a customized solution by reducing the self-weight of the system (without puller and trailers) and pulled it using a skid system. To meet the bridge design requirements, the lattice girder system configuration was devised as an easy assembly and dismantlable pin connection," shares Sivakumar. "The transportation system was reconfigured with variable load distribution and simulated to reciprocate with the IRC Standard of the vehicle to enable transportation without any need to either strengthen or modify the existing bridge."

The site had its own share of learnings, admits Sivakumar, "In total, there were 24 near mises but then, we had the right back-up to ensure that things did not go out of hand." Today, the Wangtu site is a repository of EHS benchmarks that is a ready reckoner to execute for high altitude power infrastructure jobs.

Configuring a safe method for moving a heavy weight transformer

"We carried out a thorough analysis of the bridge and developed a customized solution by reducing the self-weight of the system (without puller and trailers) and pulled it using a skid system."

K. Sivakumar
Sr. Planning Manager, Wangtu Substation

Raising towers safely

You may be skilled, bold and raring to go but scaling heights is akin to mountaineering, remarks Ayyappan, and cautions, "You don't get a second chance and thus it was mandatory to close all gaps with double linear rope fall arrestors that made all the difference." Lifeline ropes were further secured with a rope grab fall arrestor to ascend and descend along with a positioning belt. This meant a workman would

Scaling heights with secure rope grab fall arrestors

not fall! This was planned across the 200 plus span in case of any unlikely incident backed by the "Provision of an emergency rescue kit with trained rescue teams stationed at each height work location." At intermediate points of 20 km, there were mobile units that could reach the locations swiftly.

To make working at heights safer with 360-degree monitoring, a unique buddy system was implemented by making one person responsible for a group of 8 workmen. "It is a simple bonding scheme that worked very well as each gang had a monitor who was placed outside the scope of work to look into

"Double linear rope fall arrestors were used that made all the difference. Lifeline ropes were further secured with a rope grab fall arrestor to ascend and descend along with a positioning belt."

S. Ayyappan
Project Manager, Izki TL

details like weather conditions and inform the crew about any adversities." Additionally, a safety work log was maintained for linemen so that none of the team worked at a stretch for more than 4 hours or climbed more than 3 times a day. This initiative significantly addressed work stress and fatigue levels of the crew while, at the same time, created a safe work environment.

For the snow-clad terrain in Alusteng - Drass Transmission Line, the team came up with some timely process enhancements to facilitate tower erection. "Motorized 5 t winches were used across accessible areas to lift the tower parts while special plateena rope was used to pull the conductor through winches due to its light weight and ease of handling in hilly terrains. Further, S-rollers were deployed for crossing steep hills and deep valleys," mentions Atul.

Being cautious at crossovers

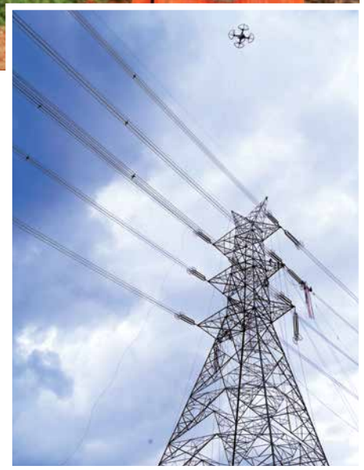
Scheduling power corridor crossings are always critical as it largely depends on the status of Permit To Work (PTW) and calls for stringent safety measures. At the Izki transmission line, there were 3 EHV cross overs and two underground lines that had to be mitigated. Meticulous paperwork aligning to the distribution

A strategic power corridor with crossovers

Strategic power line crossovers with drones

requirements of the existing grids were prepared. "One of the crossings was a high-density power corridor where closure was not possible," shares Ayyappan. "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.

The 500 kV Yong Peng East Substation to Point A Transmission Line in Malaysia is another example of how critical crossovers were safely executed over existing 275 kV and 132 kV lines aligning to the standard operating procedures. Apart from the hotline crossings, other critical crossovers include railway lines, highways and water bodies that called for a cautious PTW approach within



a limited window for working. At the Kudgi transmission line project in Karnataka, the team successfully enabled crossovers across strategic sections with the help of drones, an interesting and safe execution strategy involving high-level D-electric 16 mm Plateena rope tied to the drone and guided over to the

"Today, the IC, has developed unique SOPs for safe execution of every task while digitalization has given the much-needed edge through Virtual Reality (VR) training programmes as workmen are made to realise the risks and reinforce the essence of safe working."

V. Ramanathan
Head-EHS, PT&D

new tower location where it is fixed by a fitter while maintaining minimum sag at the desired locations.

Prepping up safely for a quantum leap

In its continuing effort to power nations, PT&D has the onus of being a safe player across geographies and terrains a task that it has addressed comprehensively through orientation and skill based training programmes both for employees and workmen at site. "Today, the IC, has developed unique SOPs for safe execution of every task while digitalization has given the much-needed edge through Virtual Reality (VR) training programmes as workmen are made to realise the risks and reinforce the essence of safe working," says, V. Ramanathan, Head-EHS. Certainly, for PT&D, it is all about raising the safety bar time and again as they go about accomplishing powerful landmarks. ■

A PRECIOUS LIFE LOST BUT SOME SERIOUS LESSONS LEARNT

A TFC 280-75 T crane in action

A hired boom lift arrived at a site one morning on a flatbed trailer. The site team immediately commenced preparations to unload it by rolling it down a ramp as per SOP. The boom lift for some reason could not be started – the first sign that all was not well – necessitating an alternate plan to unload it. A TFC 280-75 T crane was requisitioned, and the lifting team decided to lift the boom down with the help of four web slings, each with a lift capacity of 5 T. The plan was approved by the P&M In-charge and the lifting team were all set to go.

"Special attention must be paid when developing an alternate plan especially if SOPs cannot be followed in potentially high-risk activities due to whatever reason," offers M Kamarajan, Advisor (EHS), B&F IC. "Unfortunately, alternate plans are often hastily evolved with not enough time or attention given to check and verify all details."

The gross weight mentioned on the equipment was 9.163 MT and the team blindly, without any verification, considered that weight for their lifting plan. This was a blunder because the actual weight of the equipment was 17.19 MT! "This is such a basic error and absolutely unpardonable," fumes Stephen Phillip Storey, Head EHS – Heavy Civil IC. "The team should have double checked and verified the actual weight by simply referring to the product catalogue which comes along with the equipment. It sounds common-sensical but then the essence of a safe work culture is to do the routine things repeatedly until they become second nature for us."

There was a disaster waiting to happen!

After a visual inspection of the guide rope, approximately 3.5-4 m length, and the four web slings, each 6 m long, the lifting process began.

The miscalculation in the gross weight of the equipment was immediately

> **"The team should have double checked and verified the actual weight by simply referring to the product catalogue which comes along with the equipment. It sounds common-sensical but then the essence of a safe work culture is to do the routine things repeatedly until they become second nature for us."**
>
> **Stephen Phillip Storey**
> *Head EHS - Heavy Civil IC*

> **"Everyone is fighting against time at a project site and therefore it is very easy for someone somewhere to cut corners to save time."**
>
> **K P Ravinath**
> *Head EHS - L&T GeoStructure*

evident as the web slings started to strain dangerously. Suddenly, one broke and with the weight mis-aligned and too much to bear, the other 3 slings gave way too. The boom lift fell from the trailer hitting one of the workman on his arm and chest. Immediate first aid was administered at the medical centre and then he was rushed to the nearest government hospital but tragically his life could not be saved.

"Everyone is fighting against time at a project site and therefore it is very easy for someone somewhere to cut corners to save time," remarks K P Ravinath, Head EHS – L&T GeoStructure, "Sometimes such accidents occur due to sheer time pressure and the reluctance of people to rigorously follow the clearly laid out procedures, which, ironically, are prepared by themselves. That mind set should be corrected and changed."

The detailed investigation into this incident threw up some unsettling findings.

1. The first and most basic error was in planning the entire exercise on a wrong data point – the weight of the equipment.
2. Internal technical evidence (load capacity chart of the crane that was used for unloading) stipulates that it is not possible to lift a weight of 17.191MT at a load radius of 12 m.
3. The lift should ideally have been called off the moment visually it was obvious that the load was getting dragged and unnatural stress was being brought to bear on the web slings.
4. 4 lugs are used for lifting while 2 are for securing the equipment during transportation. The uncertainty of the lifting team to understand the selection of the lugs is one of the reasons for the instability of the load.
5. The operator does not seem to have noticed (or has ignored) the ASLI alarm – he could have stopped the lift if he had been alert enough to see the signs of unbearable stress on the web slings.
6. To top it all, as it were, there were no proper lifting plan, no risk assessment and no method statement for the exercise.

Surely, there should be NO action replays and in our collective quest for Zero LTI, here are a few action points that could have prevented this tragedy.

- ✓ Familiarizing oneself thoroughly with the equipment to be handled in terms of specs and nature of task
- ✓ The EHS system is based on the Plan → Do → Check → Act principle. Plan is the first vital step and therefore it is imperative to always have a plan and risk assessment. A proper lifting plan could have saved the day in this case.
- ✓ The plan will dictate whether the loads are correct, whether the lifting radius is enough, whether the number of web slings are adequate and so on.
- ✓ Visual detection of the first signs of trouble should be acted upon immediately, and the situation re-assessed.
- ✓ Unloading of such equipment is only down a ramp. In this case, more effort should have been taken to start the boom lift so that it could have been rolled down as per SOP.
- ✓ The P&M team must check and certify the competency of all operators & riggers on the relevant type of equipment.
- ✓ 3rd party certification training should be given to all concerned especially crane operators & riggers to enhance their knowledge, skills and competency to operate cranes and riggings

> **"It is only human to make mistakes and mistakes will happen, but the important thing is to learn from mistakes so that they are never repeated, not at that project site, not in that IC, not in our entire organization."**
>
> **Malay Kumar Mahanta Maitra**
> *Head - EHS, TI IC*

"It is only human to make mistakes and mistakes will happen," says Malay Kumar Mahanta - Head - EHS, TI IC "but the important thing is to learn from mistakes so that they are never repeated, not at that project site, not in that IC, not in our entire organization. In fact, near-misses are huge sources of learning and we should change our safety to make reporting of near-misses absolutely imperative."

We, along with all at L&T, share our deepest condolences for the loss of that life and extend our sympathies to the bereaved family. ■

LEADER SPEAK

S Kanappan,
Head & Chief Executive (L&T Geostructure)

Business growth needs speed. Speed drives people to perform. Safety is a culture and value enhances performance. Attitude and discipline are required to observe, learn and practise. These are the most important behaviours for safe working. In today's digitalised world, people across the globe are connected 24x7. To be 'live' and active we must be online, otherwise we become offline! Mobile phones have revolutionised our life, but its abuse and misuse can cause us great harm. Let us show restraint by using phones only in safe locations at the required time, giving it our undivided attention. Multi-tasking while on the phone can cause serious damage and harm and should be avoided. Safety and environment protection do not stop with the workmen. It is applicable from the top to bottom of the organization. Safety being top-driven, it is every senior's responsibility and duty to give utmost importance to safe working.

BEING PREPARED TO MEET THE FLOW

Evolving strategies to mitigate the threat of water

Bridging the sea at the Mumbai Trans-Harbour Link project

Water has a mind and a force of its own that EHS managers and project teams must be wary of when constructing infrastructure on or close to water. Hazards vary from drowning, boats or barges capsizing or colliding, machinery sliding into the water on slippery surfaces, spillages, erosion of soil and sandbanks to fire and health. "During the monsoons, all these hazards become doubly dangerous," informs K P Ravinath (KPRn), Head – EHS, L&T GeoStructure. "In fact, at times the threats posed by different types of water bodies are varied. The challenges posed by the sea when we are building a diaphragm wall are so very different from those thrown up by a river when constructing a bridge while the challenges of the backwaters are even more unpredictable, so we need to be prepared for any and every exigency."

While Project Manager, Samir Sarkar and team are being constantly challenged by the "deep, perennial and extremely turbulent river Ganges" during their offshore construction of an inland waterways terminal at Sahibganj, the Heavy Civil Infra team at the Patna Bridge project find themselves pretty much in the same boat constantly wary of the temperamental Ganges springing unpleasant surprises. The might of the River Godawari was always the focus of Project Manager, M.V.Ramakrishna Raju and team at the Medigadda Barrage as they built a huge 1.6 km long barrage across it, while the team working on the Mumbai Trans Harbour Link (MTHL) project need to keep adjusting to the tidal shifts of the Sewri backwaters.

"Of course, working on or near water carries important and serious risks, which should be properly considered and controlled through an efficient process of risk assessment," adds KPRn "While the risks can be varied, the prevention of drowning must always be

"While the risks can be varied, the prevention of drowning must always be our key priority."

K P Ravinath
Head – EHS, L&T GeoStructure.

our key priority." The legal requirements concentrate on the need to perform 'suitable and sufficient' risk assessments, which can only be achieved if the risk assessment process is effectively planned and managed.

Nature of work & threats

Operations near or over water can be of various kinds: pile driving, breakwater or jetty construction, working platforms close to the water, watercraft operations, vessel or barge transfers including their mooring and unmooring and diving works. Only recently, there were reports of a boat carrying some government officials to the site earmarked for the Shivaji Statue capsizing and claiming a life. There are several other potential hazards to workmen close to the water: flash floods, natural calamities like storms, cyclones & earthquakes, toppling of a vessel or barge due to loading imbalance, people falling to lower levels or getting knocked over by moving objects or equipment, extreme weather conditions or even oil spills into water bodies. There is also the risk of Weil's disease if workmen are exposed to contaminated water.

Gearing up for a safe venture

Understanding risks

Forewarned is being forearmed. It is therefore important to understand and consider the various hazards that can be faced when working on or near water, all of which carry both safety and potential health risks.

- Risk of falling into the water and drowning
- Trips, slips and falls
- Hypothermia
- Sunburn and heat stress
- Insect/bee stings
- Contact with contaminated water
- Exposure to chemicals
- Impact with submerged objects
- Floating or submerged debris
- The effect of extreme weather
- Boats or barges colliding or capsizing
- Spills & contamination that impact the environment
- Manual handling and lifting hazards
- Electrical hazards

"The shifting of the 330 MT gantry loaded with a 150 MT piling rig BG 36 and 80 MT crawler crane after each row of piling and turning the entire set-up 90 degrees, was a hugely risky operation."

Shashanka Pakreh
Gantry piling In-charge, Sahibganj

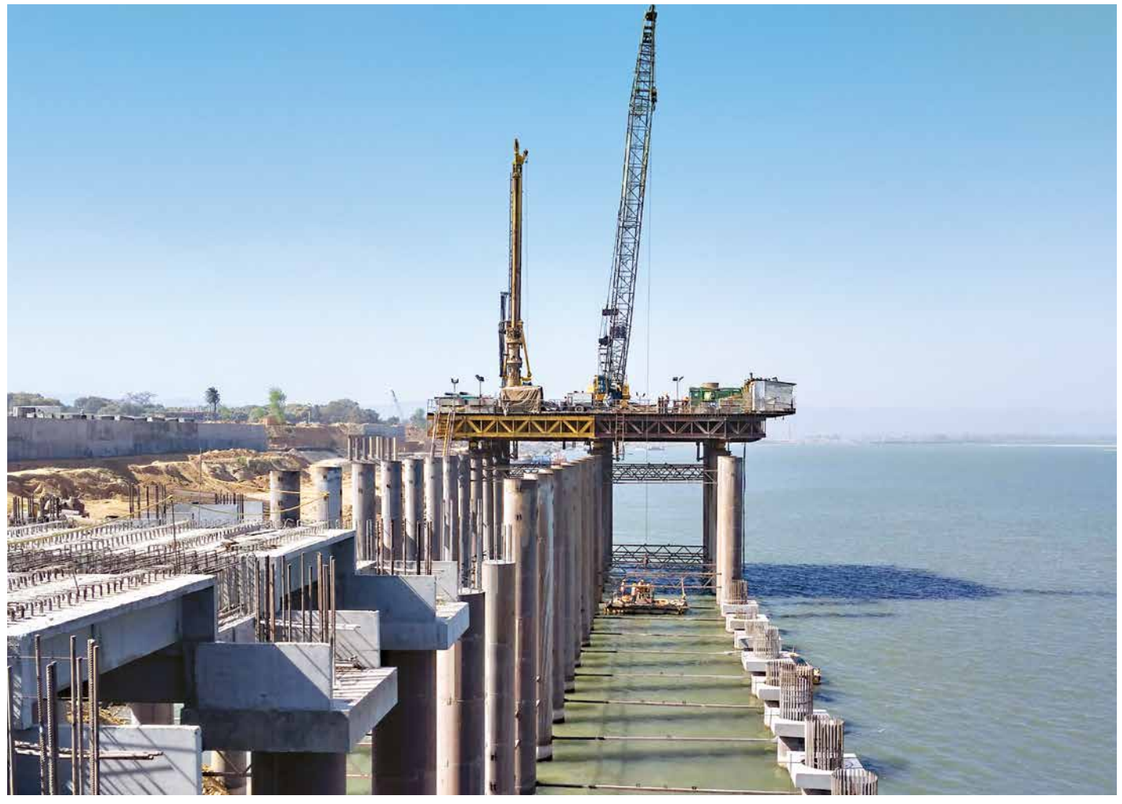
A peculiar challenge for the Sahibganj team constructing an offshore jetty was using the gantry pilling method with a 600 MT gantry to do DCIS piling. "The shifting of the 330 MT gantry loaded with a 150 MT piling rig BG 36 and 80 MT crawler crane after each row of piling and turning the entire set-up 90 degrees, was a hugely risky operation," shares gantry piling In-charge, Shashanka Pakreh but along with Project Manager Samir Sarkar, the whole exercise was flawlessly executed. "Every aspect was meticulously checked, followed and the enormous task was completed without incident to everyone's satisfaction," sums up KPRn.

"You can never be too careful when working around water, so it is essential that workmen are well protected at all times," warns Sanjay Mishra, EHS In-charge, MTHL. "When working over water without fall protection if a workman falls from a height of say even 10 feet, in all probability, he'll be knocked unconscious but without a life jacket or buoyant work vest, he could drown!" A very important consideration when constructing bridges especially when the bridge being constructed is between two other fully functioning bridges as was the case with Goa's Mandovi Bridge. "It threw up several seen and unseen risks," shares Assistant Engineering Manager, D Naveen Babu. "In fact, for the foundation we encountered rock boulders left behind from the construction of the other two bridges that were loose and couldn't support our piling operations. We had to chisel and ground them to reach solid rock."

Large crowds congregating at funeral points close to the project site is one of EHS In-Charge at the Patna Bridge site, Paras Nath Singh Abhaya's unique headaches. "Many a time, the local villagers forcefully use our boats without using life jackets which is extremely dangerous for all of us," he laments.

"The effectiveness of a safety plan depends on it being regularly reviewed, the situation continuously reassessed and the plan reviewed as and when necessary."

Sanjay Mishra
EHS In-charge, MTHL Project



Multi-model terminal at Sahibganj, Jharkhand

Safe placing of an equipment

Floating barge intake at Sahibganj, Jharkhand

VOICES FROM GROUND ZERO

"In fact, for the foundation we encountered rock boulders left behind from the construction of the other two bridges that were loose and couldn't support our piling operations. We had to chisel and ground them to reach solid rock."

D Naveen Babu
Assistant Engineering Manager

To ensure smooth sailing

A sound safety plan is a good starting point that should essentially establish work plans, method statements, safe working procedures and emergency preparedness replete with contingency plans, rescue/evacuation arrangements and drills. Sanjay Mishra, EHS In-charge at the MTHL project chips in that "the effectiveness of a safety plan depends on it being regularly reviewed, the situation continuously reassessed and the plan reviewed as and when necessary."

The significant movement of men and machinery in vessels and barges as work proceeds in top gear at the MTHL project, sternly tests Sanjay's protection plan every day. "All the vessels and barges we use are carefully maintained, always inspected before use by certified and operated only by trained and competent personnel with records kept," elaborates Sanjay. "Although designed for loading people and material, we ensure that these barges and vessels are never over-loaded and by segregating them with signage and physical barriers, they are out of bounds for unauthorized people and members of the public." In addition, these are fitted with handrails, appropriate warning, running lights and lifesaving equipment such as personal buoyancy aids.

Workmen being trained to remain safe in water

Life-saving emergency response kit when working over and near water:

- Life jackets
- Lifebuoys with an attached buoyant heavy line
- Distress flares
- First aid box & oxygen bottle with mask
- Dry powder or foam type fire extinguishers
- VHF radios (in crafts longer than 35 feet)
- Chemical/oil spill kits

Keeping safe on or near water

Life jackets, or, in some cases, immersion suits, are an imperative for all people working over or near water; in heavy swells it is advisable to have safety lines and a harness too. Adequate training in the use and maintenance of lifesaving and rescue equipment is vital like for example, the operation of a lifebuoy comes with its own set of rules and regulations. It should have enough lifeline of not less than 30 m, located at intervals of not less than 50 m around where the work is being carried out and should not be tightly tied to posts. The life jacket or buoyancy aid should be fitted with a whistle, a self-activating light, be regularly and thoroughly inspected and checked by a competent person.

Stable platforms to work from: Guard rails and toe-boards along the edges of access ramps, covered openings and strong, stable work platforms with safe access and egress will prevent people from falling into the water. For the LNG pipeline project of L&T GeoStructure, work at height was unavoidable therefore to monitor erection and fitness of scaffolds, weekly inspections were carried out by the scaffold foremen, green tags pasted, and workmen were given demonstrations and trained to work safely.

All floating work platforms are normally fitted with cranes or lifting devices as per the requirements of IC Lifting Operations procedures and standards and the crane operators and riggers who carry out these lifting operations from floating work platforms are specifically trained and experienced in such operations. Constant communications are a must during lifting operations ideally via the radio; hand signals are generally avoided. There are prescribed number of lifebuoys that are to be available on a craft depending on its length.

VOICES FROM GROUND ZERO

> **"All our electrical components and accessories (distribution boards, switches, fuses, circuit breakers, cabling, sockets and splitters) are ISI-approved."**
>
> **Paras Nath Singh Abhaya**
> *EHS In-Charge, Patna Bridge*

Someone to watch your back: It is imperative to work with a partner, always in sight of each other. The operation zone should be clearly demarcated, properly fenced off with a signaller positioned if the operator's view is obstructed.

Combating Weil's disease: PPE should be provided to protect workmen against hazards like exposure to chemicals or contaminated water. "Operators need to cover broken skin and wash their hands thoroughly after coming into contact with water in rat-contaminated areas," advises KPR. Early symptoms of Weil's disease are non-specific and can be misdiagnosed at the stage when treatment is most effective. Those who work in rat-infested areas should consult their doctor if symptoms such as feverish headaches and general aches and pains like influenza occur. Insect repellent should be worn along with long-sleeved work wear.

Electrical hazards: All electrical installations and equipment should be constructed, installed, operated, protected and maintained to prevent the risk of danger from electric shock or burns after duly considering foreseeable weather conditions and the environment in which they are being used. Special attention should be paid to "earthing" if the supply is from portable generators. "All our electrical components and accessories (distribution boards, switches, fuses, circuit breakers, cabling, sockets and splitters) are ISI-approved," adds Paras Nath. Cables, accessories are periodically checked for insulation resistance and fitness for use while electrical panels are inspected on a monthly basis and the green card system followed.

Closely inspecting finishing processes

Constructing the Ennore offshore facility

Rescue and emergency arrangements involve evacuation, escape and rescue. Evacuation involves leaving an installation or site systematically without entering the water with rescue boats or service/tugboats. Escape is resorted to when the evacuation has failed while 'recovery & rescue' is taking people at site to a safe place.

Steps to be taken in the event of a person falling into the water:

- Make sure that the person is conscious and that his PPE has inflated
- If conscious, assist the person to the nearest man overboard ladder and/or throw him a life buoy if required
- If unconscious, consider having someone enter the water to assist (ensure the rescuer has a PPE and is a capable swimmer)
- Consider deploying a vessel or a barge to assist
- Provide first aid assistance and, if necessary, call for an ambulance
- Raise an alarm verbally, by radio and/or to the port emergency number as necessary

The IOCLPL LNG terminal project in Chennai had to face the wrath and 205-km winds accompanying cyclone Vardah in December 2016. While there was extensive damage to the flotillas and workstations and operations had to be suspended, the oil spill as a result of two ships colliding inside the Kamarajar Port gave the team several sleepless nights.

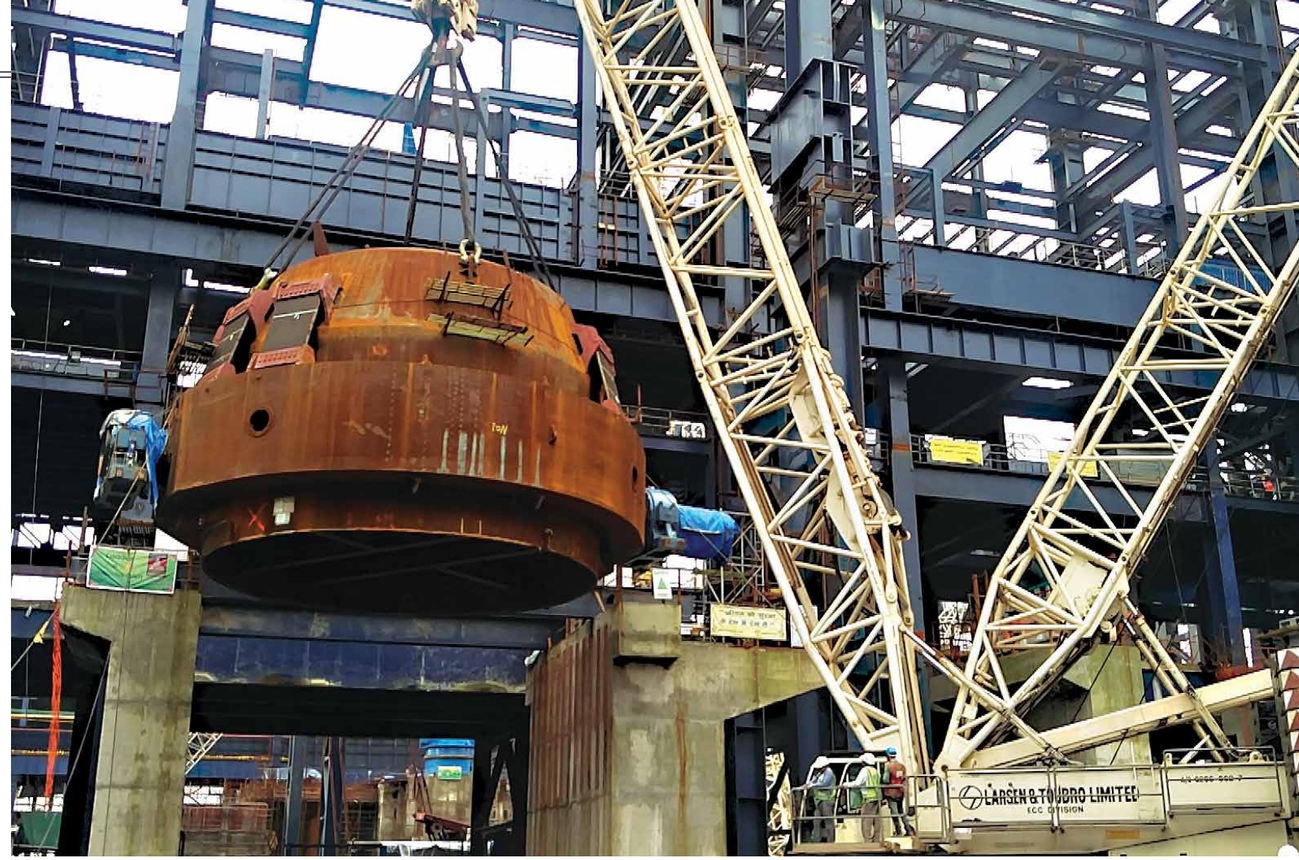
Just like all other construction activities, working on or around water is fraught with risk which if identified, assessed and planned for can ensure safe project progress. ■

LEADER SPEAK

Anupam Kumar,
Vice President & Head (Metallurgical & Material Handling - SBG)

For a sustainable business model, construction should be planned and carried out in a socially responsible manner, augmenting tenets of health and safety at various phases including engineering, procurement and execution. As we move forward, digitalization and implementation of BIM will help project visualization, hazard identification, efficient scheduling and improvement in safety which will soon enable us to migrate from labour-intensive to equipment intensive operations to reduce exposure of workmen to hazards.

A committed approach and the adoption of new technological solutions will help us to standardize processes, improve overall quality of the products and services rendered and thereby drastically reduce unsafe acts that result in Loss of Time and Cost.



Erection of convertor at JSW Dolvi, SMS#2

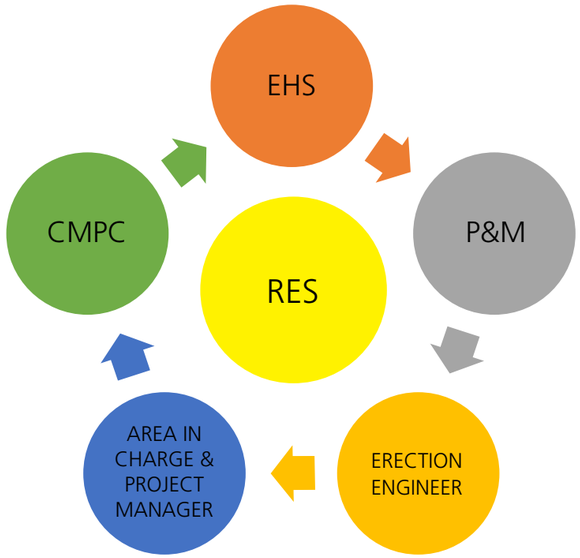
IT PAYS TO PLAY SAFE WHEN LIFTING HEAVY WEIGHTS

Working out safe rigging methods for heavy lift erection

The rules of the game are never defined for heavy lift erection, as every lift is unique depending on the weight of the equipment, its placement and other on-field constraints. There is, however, a common thread to all such critical tasks, acknowledges K.N. Sen, EHS Head, Metallurgical & Material Handling SBG, "The ground work is important before taking up the mantle as it is akin to moving a mountain where even a slight error can be disastrous." A seasoned past master, Sen has much to share on the evolution of heavy lifts at MMH and how digitalization is now giving project teams the safe edge. "Earlier, it was a lot of hard work at site involving hours of preparation to arrive at the right weight and proposition through mathematical calculations. Now, with the Rigging app, the entire process has become streamlined, and one only has to follow the system that is completely secure."

A digital approach to rigging

As trailblazers in heavy equipment erection, MMH has executed innumerable successful critical lifts but going forward the challenge will be to ensure pre-defined accountability at different levels which Sen acknowledges has been lacking at times. "Hectic schedules at site meant that nitty-gritties could often get neglected or even taken for granted. Moreover, compliance across stage-wise scrutiny amongst stake holders led to execution delays, lapses and unlikely consequences. The need for a digital intervention was keenly felt," mentions Sen for a user-friendly, coordinated and safe execution approach at site while, at the same time, reinforcing trust among clients. "One of the first things lined up

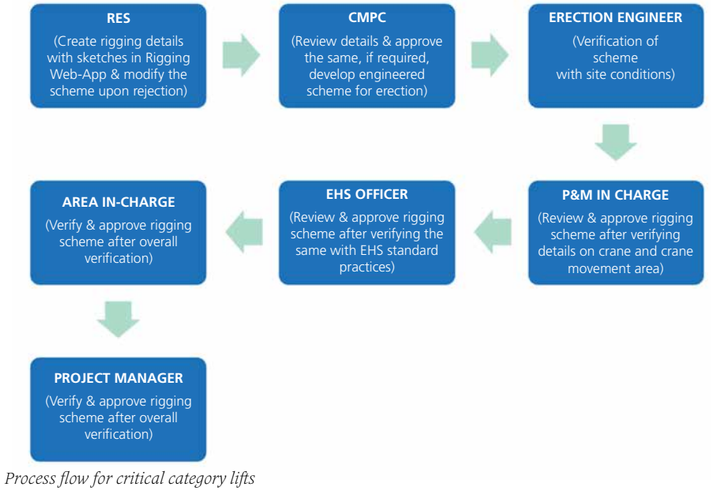


Aligning to a digitally secure approach for rigging involving multiple stakeholders

to implement this process was a new position of a Rigging Engineer across sites to coordinate with stakeholders for multiple level approvals prior to the execution of tasks."

Defining the criticalities

Modern-day apps empower users to make the right choices and the Rigging app does exactly that. Developed on the underlying principle that lifts are predominately across three major categories: low, medium and critical, the platform details erection/ rigging activities that are aligned at sites with predefined objectives and SOPs established by the Construction Methods Planning Centre (CMPC). For users, it's just a swipe that connects with the essentials, acknowledges Sen. "Every technical parameter involved in rigging covering crane configurations, equipment parameters, tools and tackles, load distribution including feasibility checks are ensured through this app." What makes this app doubly secure is the stringent approval flow mandatory for users, a feature that was developed collaborating with L&T Infotech (now LTI) factoring in the likely on field requirements at site such as crane clearance checking and loads on cranes in tandem lifting. "We have a category wise approval flow and multi-level scrutiny involving all concerned stake holders to minimize risks," adds Sen.



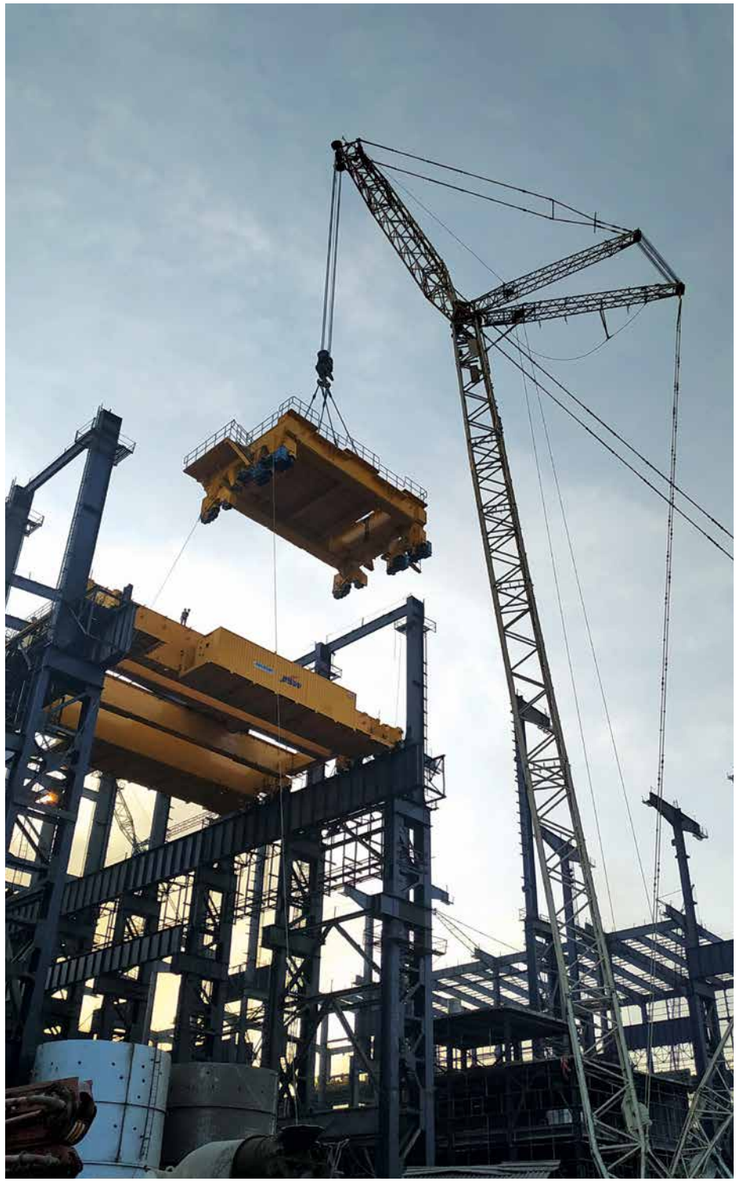
Process flow for critical category lifts

How the system secures

A typical lifting process begins after classifying the nature of lifts, informs Kausik Dutta, Head CMPC, "The Rigging Engineer is entrusted with the responsibility to create a new rigging permit where all the inputs required for the lift, based on site conditions, are updated that are perused by the erection in-charge to verify the scheme, ratified by the EHS personnel and finally approved by the area in-charge. For larger lifts, the process runs through the respective site P&M In-charge and Project Manager." Of course, CMPC steps in when there is a critical lift, he adds, "We have a long list of tall achievements, the most recent one being the converter erection at JSW Dolvi, the heaviest lift done in MMH, wherein we safely planned and lifted the equipment comprising trunnion ring, pin lamella, vessel guide, barrel & bottom cone weighing 415 t using a 600 t Demag CC 2800-1 crane."

"We have a category wise approval flow and multi-level scrutiny involving all concerned stake holders to minimize risks."

K.N. Sen
EHS Head, MMH



EOT erection at JSW Dolvi, SMS#2 project

Satyajit Kaity, Rigging Engineer, elaborates on the process, "It was a complex task as the erection weight handled was close to 438 t considering the weight of both the rigging and hook block. With many stake holders involved, all aspects of the lift needed to be cross-checked multiple times and each update had to be communicated precisely. Without the app, the lift would have been very difficult as we were doing the convertor module lift using a crawler crane for the first time while earlier it was done with an EOT crane or by skidding."

"The Rigging Engineer is entrusted with the responsibility to create a new rigging permit where all the inputs required for the lift, based on site conditions, are updated and finally approved by the area in-charges."

Kausik Dutta
Head CMPC

Another critical lift at the Dolvi site was the 300 T lower structure erection of Blast Furnace#2 which was in line with the critical path of the project. To minimize the risk of working at heights, Gagan Pal Singh, Rigging

"Without the app, the lift would have been very difficult as we were doing the convertor module lift using a crawler crane for the first time."

Satyajit Kaity
Rigging Engineer, JSW Dolvi

"Using the rigging app to load data on cranes for tandem lifts, the scheme was pre-planned and the lift was safely executed."

Vishal Kumar Chandel
Rigging Engineer, JSW Paradip Port

Engineer, shared the criticalities of the task with CMPC as this was the heaviest single lift of blast furnace#2 involving in-plane and out-of-plane inclinations. "After a detailed analysis backed by stability calculations, a safe way forward was conceived through a stage wise scheme that included horizontal lifting, upending and final erection."

At JSW Paradip Port Project, Vishal Kumar Chandel, Rigging Engineer, had the onus of seeing through a complex lift involving the tilting and erection mast weighing close to 80 T with one tyre mounted and two crawler-mounted cranes. "Using the rigging app to load data on cranes for tandem lifts, the scheme was pre-planned and the lift was safely executed."

"We planned this critical lift in a brown field environment ensuring safety and optimising erection time and cost."

Susanta Swarnakar
Rigging Engineer, CHP TANDA

Erection of a stacker reclaimer at the Paradip Port Terminal

Rafter erection in high rise area at JSW Dolvi, SMS#2 project

A complex lift in progress

Virtual secure decisions are made at site, shares Susanta Swarnakar, Rigging Engineer at CHP TANDA, "I did not have the hassle of doing complex calculations such as boom clearance checks, tandem lift load distribution as the rigging app has it all inbuilt and just requires inputs like the number of galleries to be lifted, the span, weight and erection elevation. With CMPC's guidance, we planned this critical lift in a brown field environment ensuring safety and optimising erection time and cost."

Gearing up for safer breakthroughs

There are some of very significant direct advantages derived through the rigging app. Transparency is almost 100 % with roles and responsibilities defined and drawn on a single platform accessible to all the stakeholders, credits Sen. Going forward, he assures that the huge pool of data being generated for various types of heavy lifts will augment analytics and serve as a ready-reckoner to provide inferences to ensure that every lift is a safe one at sites. ■

A.M. Naik Receives CEO Mentor Award; S.N. Subrahmanyan Conferred Emergent Award at CEO Awards 2019

At the sixth edition of CEO Awards held in Mumbai on August 05, 2019, Mr. S.N. Subrahmanyan, CEO & MD, chose Mr. A.M. Naik, Group Chairman, for the prestigious CEO Mentor Award for 2019. A remarkable leader with great strategic foresight, Mr. Naik has led L&T to extraordinary heights and SNS considers Mr. Naik as his guide and mentor.

The evening also saw SNS being conferred the Emergent Award for showcasing extraordinary leadership and delivering seamless growth for L&T.

The high-profile award ceremony was graced by a galaxy of top business leaders and the Who's Who of India Inc.

The CEO Awards are one of India's most well-researched awards, where a distinguished panel of jury reviews industry leaders based on their performance at work, their work-life balance and the larger impact of their actions on industry and society.

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