Bentley
Advancing Infrastructure

CASE STUDY

L&T Construction Delivers Safe Drinking Water to 6.8 Million Residents across Scattered Rural Villages in Northern India

Bentley Applications Cut Construction Time by 90% and Reduced Project's Environmental Footprint

WATER TO EVERY HOUSEHOLD

As India's most populous state, home to over 241 million residents, Uttar Pradesh faces significant water scarcity issues that are exacerbated by low precipitation levels and an arid climate. Aligned with the country's Jal Jeevan Mission to provide access to clean water to every rural household, L&T Construction is delivering the Uttar Pradesh tube well project to improve potable water supply in the state's remote villages, where residents rely on uncertain water sources. The project aims to provide safe drinking water to 6.8 million rural residents through 1.7 million household connections.

Delivering the project required design, construction, and installation of overhead tanks (OHTs), pipelines, pumps, and solar panels to ensure energy efficiency and reliable power supply for the network. "This project involves the design and execution of over 3,000 number of OHTs and pump houses, scattered across the rural villages in seven districts of Uttar Pradesh, India, with operation and maintenance of 10 years," explained Pavani Saroja Kankatala, senior engineering manager at L&T. It includes arranging 37,500 kilometers of pipelines and installing more than 3,000 submersible tube well pumps, along with a 50-megawatt solar panel system.

OVERCOMING PROJECT MANAGEMENT HURDLES

The sheer volume of work on a limited schedule presented challenges right from the tender stage. L&T needed to analyze, design, and submit detailed bills of quantity for the 3,000 OHTs, considering four different potential construction staging options, ranging from steel staging with a steel container to precast staging with a steel container using bolted and coupler connections. "All of the four options include detailed analysis of 2,400 variants of the OHTs," said Kankatala. L&T had to perform comprehensive analysis to determine an optimal design and construction methodology, as well as quickly obtain approval for their preferred method, which deviated from traditional workflows. The team then needed to present their tender in a visual, easy-to-understand format to the government client.

Managing and monitoring the multiple disciplines, stakeholders, resources, and logistics across the dispersed villages with limited water, power, transportation and networking facilities compounded the difficulties meeting the accelerated project schedule. "Currently, similar projects are being executed at a rate of five months for a 16-meter staging OHT, whereas in this project, each package [has] a minimum number of 350 OHTs and is to be executed in a span of 18 months," said Kankatala. L&T realized that they needed a flexible and integrated 3D BIM, structural, and hydraulic modeling solution to design, evaluate, and determine the most time-efficient, cost-effective, and eco-friendly construction methodology.

INTEGRATED DIGITAL WORKFLOWS OPTIMIZE NETWORK DESIGN AND CONSTRUCTION

L&T utilized Bentley's 3D BIM technology with STAAD and OpenFlows to design the distribution network and determined that, compared to traditional on-site concrete pouring, the precast method of construction would improve quality control and risk management. "After thorough study, we came to [the] conclusion that going ahead with precast staging (coupler connection) with a steel container option is the most optimized," said Kankatala. With Bentley's applications, they modeled the structures and analyzed their behavior under high wind and seismic conditions, combined with varying water loads. Despite there being no Indian code for precast OHT staging design, STAAD perfectly captured the

PROJECT SUMMARY

ORGANIZATION
L&T Construction

SOLUTION
Water and Wastewater

LOCATION
Varansi, Sitapur, Gonda, Prayagraj, Ghazipur, Shravasti & Balrampur, Uttar Pradesh, India

PROJECT OBJECTIVES
- To provide clean drinking water through 1.7 million household connections across rural villages in Uttar Pradesh, India.
- To optimize design and construction of a massive tube well water distribution network on a short timeline.

PROJECT PLAYBOOK
OpenFlows™, STAAD®

FAST FACTS

- The Uttar Pradesh tube well network water project will provide access to clean drinking water to 1.7 million households across the state's rural villages.
- L&T Construction is delivering the project that included design and execution of over 3,000 overhead tanks on a short timeline.
- They utilized Bentley's 3D BIM technology with STAAD and OpenFlows to standardize design and determine an optimal construction methodology.

ROI

- L&T Construction saved 80% in optioneering time working in Bentley's integrated design and analysis environment.
- The new construction methodology shortened the construction period by 90% and minimized the project's environmental footprint.

"With the help of STAAD.Pro® and 3D BIM, we have submitted 2,500 design documents and 10,000 drawings to the client."

– Pavani Saroja Kankatala, Senior Engineering Manager, L&T Construction

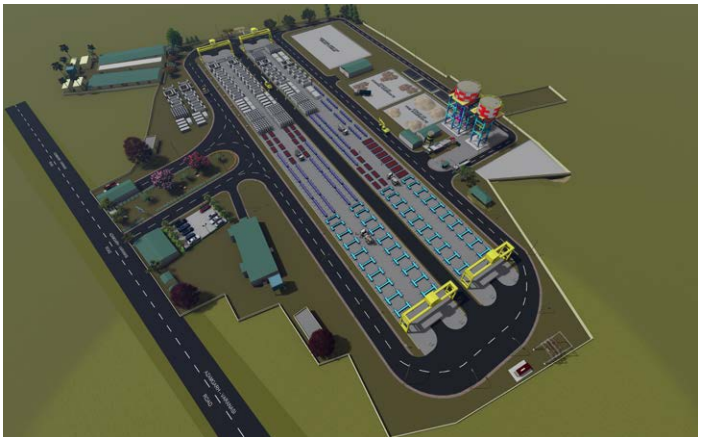
behavior of the OHTs, surpassing the limitations of manual design codes and enabling the team to strategically select the precast connection locations. "STAAD.Pro has greatly enabled us to pick the right location of precast connections, [...] which is not at all an easy task if we would have followed manual excel sheet analysis methods," said Kankatala.

By developing 3D BIM models, L&T visually presented the construction sequence to the client, enabling them to better understand and ultimately approve the precast construction methodology. The 3D models of the OHTs were integrated with mechanical piping, electrical, and instrumentation, and through advanced structural and hydraulic modeling, L&T evaluated over 600 design variants, standardizing the design and drawings, optimizing fabrication, and ensuring architectural harmony across the project. "The breakthrough of design is [that] all 3,000 OHTs were grouped to 600 design variants in such a way that just 30 types of molds were fabricated for the entire project, which includes total 75,000 precast elements," said Kankatala.

SUCCESSFUL, SUSTAINABLE DELIVERY SETS BENCHMARK FOR FUTURE DIGITALIZATION

Through digital modeling and analysis, L&T streamlined and standardized design workflows. They determined that the precast construction method was optimal in terms of time, costs, and resources. "Almost 90% of construction time savings results in overall cost reduction by reducing overall requirement of plant machinery and workmen," explained Kankatala. Working in Bentley's collaborative BIM, structural, and hydraulic design environment reduced the time required to arrive at the optimal construction solution by 80%, ultimately resulting in saving 4,500 workforce resources per day, which is a time equivalent to 5.4 million resource days. By reducing the amount of on-site work required, L&T improved safety, minimizing potential hazards associated with crew members pouring concrete. The construction method also optimized site utilization, reducing site development costs, and accelerated production and execution of the precast elements to timely deliver the project, achieving approval and accolades from the client.

In terms of quality, material quantities, and sustainability, by using digital design workflows and 3D models to simulate construction and network behavior, L&T achieved high-quality deliverables while reducing wastage and energy consumption to minimize the project's carbon footprint. "STAAD.Pro enables us to provide more accurate and efficient design, which reduces the material wastage and energy consumption during the construction stage. This reduces the environmental footprint of the construction project," said Kankatala. The prefabricated, precast molds are reusable not only across this project, but also for future projects, adding to the cost savings and sustainability of the new methodology. Overall, the digital design and construction innovations achieved in this project set a benchmark for digitalization of future rural infrastructure projects. "The success story and recognition has made us to take new steps in pre-casting for water retaining structures too," saidon Kankatala.



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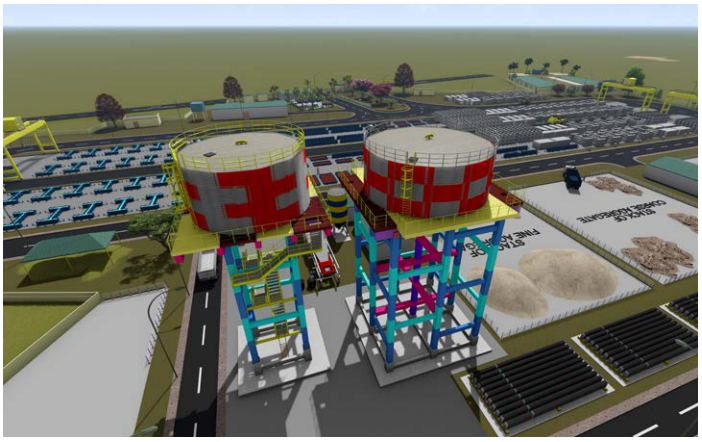

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