Bentley
Advancing Infrastructure

CASE STUDY

Laing O'Rourke and SEPA Create a Digital Twin of Rail Redevelopment, Removing 85 Level Crossings for Safer Travel

SYNCHRO™ Helped Teams Visualize Construction in 4D and Cut Development Time to Three Months, Minimizing Traffic Disruption

UNTANGLING ROADS AND RAIL

Rail networks inevitably cross paths with roads. Many of these intersections in the Australian state of Victoria are level crossings – both the road and the rail intersect at ground level. Though these crossings are easy to develop, they naturally cause conflict between both sets of traffic. In addition to bringing road travel to a halt for long periods as lengthy trains pass by, they create the risk of trains colliding with cars or pedestrians.

The Victoria Government wanted to solve this ongoing problem, and initiated a program to remove 85 level crossings within the state. The South Eastern Program Alliance (SEPA), a joint venture consisting of the Level Crossing Removal Project (LXRP), Metro Trains Melbourne, Laing O'Rourke Construction, and Jacobs Groups Australia, was tasked with an AUD 600 million project to remove level crossings between Union Road in Surrey Hills and Mont Albert Road in Mont Albert, as well as to build a new station between the cities.

Lowering the area's railway into a trench and constructing roads over it would eliminate traffic congestion when the project was completed. However, the construction process was challenging and caused massive road and rail traffic disruptions during development. "The project is situated on a live rail network, and due to the scale and complexity, a large proportion of the construction works was undertaken during a 93-day occupation where the rail network was shut down to complete excavation of the trench and development of the premium station," said Stephen Corney, digital engineering lead with Laing O'Rourke.

SPEEDIER CONSTRUCTION WITH OFFSITE MANUFACTURING

To limit the chance of delays and reduce the risks associated with traditional construction on site, Laing O'Rourke and SEPA decided to use a Design for Manufacture and Assembly (DfMA) approach. Instead of building major structural components at the site, they would be manufactured off-site, then moved to the project area for installation. "Pioneering the DfMA approach within Australia requires upskilling the industry with knowledge and expertise of offsite manufacturing of the station, and has enabled many benefits such as program efficiency, reduced community disruption, quality control, environmental control, and the health, safety, and wellbeing of workers operating in such a tight space in the rail corridor," said Corney.

Though the DfMA approach brings an array of benefits, it also produces challenges, especially with the size of the Surrey Hills project. A total of 1.7 kilometers of new rail was laid in a trench, requiring construction teams to excavate 200,000 square meters of material and drill over 700 piles. The reinforced concrete base slab included 3,000 tons of reinforcement that was lowered into the trench, along with 15,000 cubic meters of concrete pumped into it to complete the slab. Coordinating all construction activities and the transportation of numerous large elements to the site was crucial, but the task was too complicated to entrust to traditional 2D design methods, or even static 3D models.

REHEARSING CONSTRUCTION BEFORE BREAKING GROUND

SEPA determined that creating a 4D model would enable them to not only visualize the project, but also gain a clear understanding of the construction process and anticipate any issues that could arise. They first used drones to survey the site, then used iTwin Capture to process the imagery and create a digital twin of the project site. The process

PROJECT SUMMARY

ORGANIZATION

Laing O'Rourke

SOLUTION

Construction

LOCATION

Melbourne, Victoria, Australia

PROJECT OBJECTIVES

- To eliminate level crossings along a rail line, eliminating roadblocks and collisions.
- To create a 4D simulation of construction and make the construction time as short as possible.

PROJECT PLAYBOOK

Descartes™, iTwin® Capture, OpenBuildings®, ProjectWise®, SYNCHRO

FAST FACTS

- The Surrey Hills project placed 1.7 kilometers of rail track in a trench, enabling road traffic to pass over trains.
- Though development was complex, it had to be completed in 93 days to minimize disruptions to traffic.
- The project achieved a 30% reduction in embodied greenhouse gas emissions, and the shortened schedule significantly reduced fuel use.

ROI

- The 4D model enabled the team to develop construction staging plans 71.5% faster than with 2D diagrams.
- Compared with traditional methods of interface checking, the construction simulation improved visibility of the project by 50%.
- Sharp perception of the project lowered the risk of clashes by 75%.

> "Addressing the challenges highlighted from the 4D model resulted in significant productivity savings for engineers and supervisors on the project, allowing them to focus on forward planning and responding and mitigating the impact to issues identified early."
>
> *– Stephen Corney, Digital Engineering Lead, Laing O'Rourke*

eliminated the need for on-site measurements, reduced hazards to workers, and saved time. The digital twin was used as the central record of completed works, with teams developing models of the railway, station, and other associated assets within it.

Once the digital twin fully represented the project in 3D, teams used SYNCHRO to link the project schedule to the digital twin, adding the 4D element. Multiple designers worked in the model simultaneously, as they could focus on specific areas while gaining awareness of developments in the rest of the model. The joint venture quickly assembled a comprehensive construction sequence. "All construction staging utilized SYNCHRO throughout the program development to clearly understand scope and constraints," said Corney. Since many of the components were developed off site, teams used SYNCHRO to plan their transportation, as well as the movement, placement, and use of cranes.

KEEPING WORKERS SAFE WITHOUT BREAKING DEADLINES

By simulating the construction sequence in advance with SYNCHRO, the project team and stakeholders clearly understood the scope and constraints of construction. The 4D model enabled the team to develop construction staging plans 71.5% faster than with 2D diagrams. Compared with traditional methods of interface checking, the construction simulation improved visibility of the project by 50% and lowered the risk of clashes by 75%. Digitally planning all logistical haul routes for earthworks and deliveries helped the teams prevent critical structural components from arriving late. By simulating 90% of the crane movements, the team optimized where to place the cranes, which identified and mitigated potential safety risks. Designers continued to adjust the construction schedule as plans evolved during the build. "The 4D model was updated dynamically during the occupation in the form of dynamic visual reporting as weekly lookaheads linked to the ever-changing P6 construction program," said Corney.

As they monitored development progress within the digital twin, teams could quickly and easily identify which elements were behind schedule and which were ahead of schedule, enabling them to reallocate resources to keep the overall project on track. Additionally, preplanning construction logistics significantly lowered fuel use and associated greenhouse gas emissions, as well as reduced noise for those living and working in the vicinity. The Surrey Hills project was finished in 93 days, keeping traffic disruption to a minimum during development and ensuring unimpeded travel for trains and road traffic alike.

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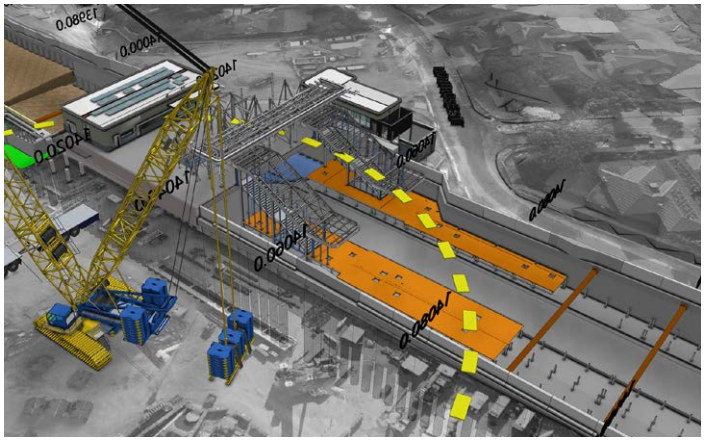

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