

PT. Wijaya Karya Employs BIM Methodology to Design the Longest Double-decker Bridge in the World

Bentley Applications Saved Time and Costs, Allowing for ROI 3 Years Early

CONNECTING A PATCHWORK OF HIGHWAYS

When PT. Wijaya Karya (WIKA), an Indonesia-based company that provides construction, mechanical, and electrical services to the civil construction industry, was contracted to design the Design and Build Harbour Road 2 Project in North Jakarta, Indonesia, budgeted at USD 530 million, the project team quickly realized that traditional 2D design methods would not deliver the large and complex 8.95-kilometer toll road development on time and under budget. “The total volume of the concrete is a quarter of that of the Giza pyramid,” said Fery Safaria, engineering manager at WIKA. “The total scale of the project is about four times that of Vatican City.” Though large, the project was sorely needed as residents of Ancol and Pluit needed a more efficient way to travel between the cities, with the existing path a frequently congested patchwork of existing toll roads, interchanges, flyovers, railroads, and waterways.

WIKA determined that, due to limited space, heavy traffic, and numerous intersection points, the development needed to include a 3.95-kilometer double-decker bridge along the Ancol River that will become the longest in the world. However, WIKA needed to overcome the challenge presented by the Indonesian government that mandated the organization should avoid placing piers in the water that could negatively impact the ecosystem and existing river traffic. The project team also had to avoid various underground gas pipelines, water pipes, and fiber optic cables, as well as buildings.

Moreover, WIKA faced a strict deadline to complete Harbour Road 2 before the start of the FIFA 2021 U-20 World Cup, being held at nearby Jakarta International Stadium. The new highway is expected to ease traffic to and from the facility. Aside from

completing the project prior to the tournament, Harbour Road 2 will improve access to the airport and reclamation islands being developed by the government. Lastly, the new highway will greatly improve economic activity and tourism in the area.

SAVING TIME USING A BIM METHODOLOGY

To design such a complex road system and meet the aggressive schedule, WIKA transitioned from a traditional 2D design method and adopted a 3D BIM methodology. The project team began the conversion with image capture via unmanned aerial vehicles, using generalized predictive control to produce a reality mesh within ContextCapture. The project team was able to photograph and process 166 hectares of land in just 15 days, or roughly six times faster than traditional surveying methods.

Throughout the process, Navigator facilitated communication and collaboration between teams and stakeholders, as well as allowing designers to access running costs and project data from the office, remotely, or in the field. WIKA estimated that using BIM methodologies reduced the time needed for communication and inspection by as much as 30%, compared to previously deployed methods.

OpenRoads helped WIKA review the alignment of the main road, ramps, and approaching structures, while OpenBridge allowed the team to iterate pier positions and heights based on real-world conditions. Careful pier positioning helped the project team avoid placing them in the river wherever possible and lowered the risk of flooding in the surrounding area. WIKAs design iteration within OpenRoads, OpenBridge, and gINT avoided 1,600 meters of costly waterway foundation work and reduced the design process by 25 days.

PROJECT SUMMARY ORGANIZATION

PT. Wijaya Karya (Persero) Tbk

SOLUTION

Bridges

LOCATION

North Jakarta, Indonesia

PROJECT OBJECTIVES

- ◆ To design an 8.95-kilometer toll road to improve transportation and the economy in North Jakarta.
- ◆ To engineer the longest double-decker bridge in the world at 3.95 kilometers.

PROJECT PLAYBOOK

ContextCapture™, gINT®, LEAP®, LumenRT™, Navigator™, OpenBridge®, OpenRoads™, PLAXIS®, ProStructures™, RM Bridge™

FAST FACTS

- ◆ The new road between Ancol and Pluit will accommodate 63,500 vehicles per day and cut the travel time between them in half.
- ◆ WIKA shot and processed 166 hectares of photographic data in just 15 days, six times faster than traditional methods.
- ◆ Design iteration within OpenRoads, OpenBridge, and gINT eliminated 1,600 meters of waterway foundation work and reduced design time by 25 days.

ROI

- ◆ The BIM methodology of Bentley applications increased the efficiency of bridge modeling by 40% and saved 10% of the construction budget.
- ◆ SYNCHRO's 4D visualization detected 85 potential clashes, saving USD 60 million and four months in design time.
- ◆ Due to lowered design and construction costs, the project will pay for itself three years ahead of schedule.

“Bentley’s BIM solutions provide comprehensive infrastructure applications that help us optimize project costs, improve the efficiency of the design process time, and ensure project safety. Bentley’s technology and interoperability have played a vital role in this project becoming a new benchmark in the construction industry in Indonesia.”

– Romi Ramadhan, BIM Manager, PT. Wijaya Karya



MEETING GOVERNMENT STANDARDS WHILE IMPROVING EFFICIENCY

Using RM Bridge informed the project team where to place tendons, undertake design analysis of the box girder structure, model deformation, and test work method variations on the double-decker bridge. Within LEAP Bridge, WIKA analyzed the precast girder structure within the concrete to ensure that the project met national bridge loading standards. With ProStructures, WIKA designed bar mark reinforcement, created a bill of materials, and issued reports. Since the three applications are intraoperable, WIKA increased the efficiency of bridge modeling by 40% and saved up to 10% of the construction budget.

WIKA deployed PLAXIS to conduct soil stability and retaining wall analyzes to reduce the risk of bridge piers settling along the river banks. Once the project team fully surveyed and modeled the design, it used LumenRT to produce a digital representation of the project to help all parties understand the current status. The digital visualizations streamlined communications and improved decision-making.

WIKAs design work included a 4D model of the construction process. The project team simulated the movement of heavy equipment in a tight area using RM Bridge to improve efficiency and minimize fuel consumption. Navigator and SYNCHRO™ helped project engineers determine work schedules, estimate costs, manage supply chains, and analyze progress to ensure the project is completed on time and within budget. “With SYNCHRO, we can identify the massive project schedule and help find any potential for construction delay,” said Rizky Yusuf Ramadhan, bridge BIM engineer at WIKA.

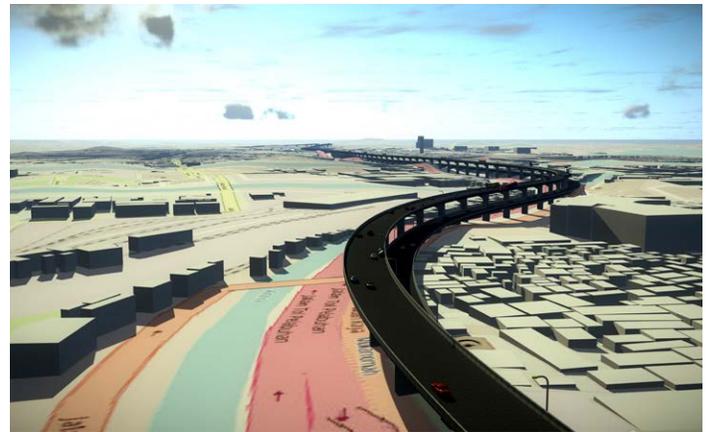
DELIVERING A RETURN ON INVESTMENT THREE YEARS AHEAD OF SCHEDULE

By using a BIM methodology to visualize data, WIKA boosted the accuracy of the model, shortened build time, reduced inspection time, and improved the overall quality of the development. Strong visualization of the design and construction process improved reviews among stakeholders and accelerated decision-making. In the end, visualizations and intraoperability among the Bentley applications helped WIKA detect 85 potential clashes, which could have caused USD 60 million in cost overruns and up to four months of delays.

“We used a comprehensive set of Bentley solutions to improve efficiency far more than they would have individually,” said Ramadhan.

Additionally, BIM methodology helped WIKA reduce carbon emissions during construction and allowed contributors from numerous locations to collaborate without traveling to the site. Modeling the travel paths of heavy equipment during construction will make movement more efficient and lower fuel consumption, while simulating traffic movement during construction will reduce congestion and, in turn, lessen vehicle emissions.

Though WIKA projected the design of Harbour Road 2 would take seven months using traditional 2D survey and design methods, its decision to switch to a BIM methodology helped the project team complete the design in only four months. When construction is completed, an estimated 63,500 vehicles will cross the new toll road each day, which will speed economic and tourism development in the area and facilitate access to the U-20 World Cup matches. Combined with the cost savings gained through design efficiencies, the government expects Harbour Road 2 to pay for itself by 2032, or three years earlier than anticipated.



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