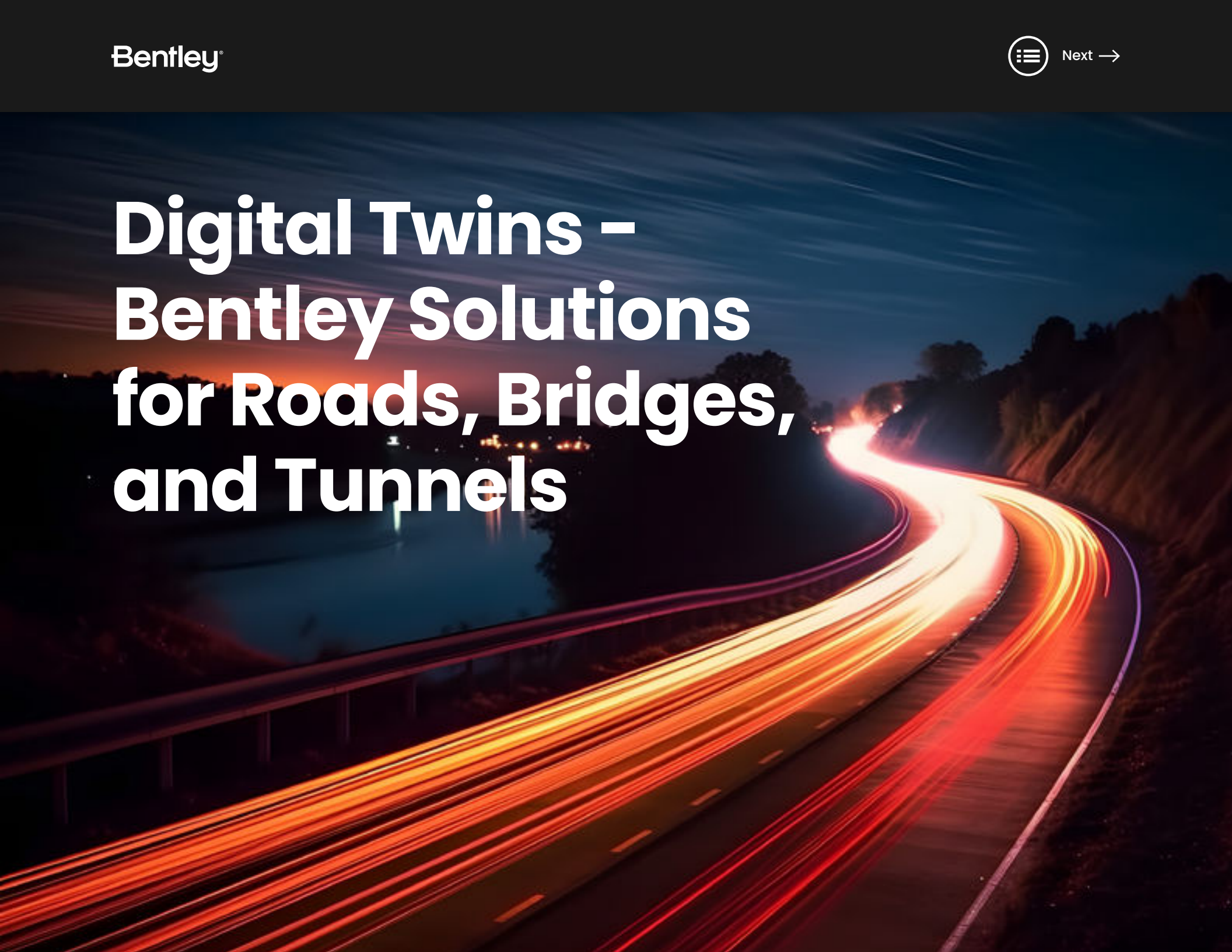


# Digital Twins - Bentley Solutions for Roads, Bridges, and Tunnels



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# Bogor-Ciawi-Sukabumi (Bocimi) Toll Road Project

PT Waskita Karya (Persero) Tbk | *Sukabumi, West Java, Indonesia*

The new Bocimi toll road is expected to relieve congestion along the Bogor-Sukabumi national road, reducing travel time from two hours to 30 minutes, as well as improving economic conditions in the surrounding Sukabumi area. PT Waskita Karya (Waskita) is the main contractor for section 2 of the toll road, spanning 11.9 kilometers. The high risk for potential landslides at the construction site presented earthworks challenges that current manual survey measurement methods could not timely accommodate. To address these issues and ensure precise construction sequencing, Waskita needed to establish digital construction processes.

Leveraging iTwin, OpenRoads, and PLAXIS, Waskita developed 3D BIM workflows, shortening earthworks calculations and reporting times from two weeks to five days. They combined the 3D model with the work schedule data to simulate the construction plan using SYNCHRO. Working in a connected digital environment provided clear visualization of overall design and construction progress, identifying and resolving clashes prior to work on site to avoid costly rework.

**Project Playbook:** gINT®, iTwin®, OpenBridge®, OpenRoads™, PLAXIS®, SYNCHRO™





# Jakarta – Cikampek II Selatan Toll Road Project

PT Waskita Karya (Persero) Tbk | *Karawang to Purwakarta, West Java, Indonesia*

To reduce congestion and improve connectivity between Jakarta and Cikampek, the Indonesian government initiated development of this second Jakarta-Cikampek toll road. Spanning 27.85 kilometers and featuring three interchanges, seven main bridges, and 18 overpasses, the project was on a fast-track schedule to sustain economic growth in these two vital cities. PT Waskita Karya faced communication challenges, compounded by extreme terrain that previously used CAD-based and BIM software could not accommodate on the accelerated timeline.

To overcome the engineering challenges, Waskita leveraged iTwin, OpenRoads, and OpenBridge to produce a reality mesh of 574 hectares and 3D BIM models of the proposed roadway and bridges. They combined the models, generating a project digital twin on a web-based portal to visually communicate project progress to stakeholders in real time. Working in an open, connected data environment accelerated earthworks calculations and drawing production and reduced risks, saving approximately USD 100,000. The digital solution sets a benchmark for implementing sustainable construction business processes.

**Project Playbook:** iTwin, LumenRT™, MicroStation®, OpenBridge, OpenRoads, SYNCHRO



# Mandalika Urban and Tourism Infrastructure Project (MUTIP) Package-2

PT Hutama Karya (Persero) | Mandalika, West Nusa Tenggara, Indonesia

To prepare Mandalika to host MotoGP 2022, the Indonesian government mandated that PT Hutama Karya (Persero) carry out infrastructure development covering 1,035.67 hectares. The roadway portion of the project extends 11,265 kilometers and facilitates connectivity and accessibility between the street circuit and resort areas of the Mandalika Special Economic Zone, improving tourism and the economy. Faced with a large project area and multidiscipline engineering works, compounded by swampy soil conditions, PT Hutama Karya needed an integrated BIM platform capable of handling large data and models.

Leveraging Bentley's open BIM and reality modeling applications, PT Hutama Karya created a collaborative digital environment, streamlining workflows and facilitating eco-friendly construction. Using iTwin, they performed digital surveys three times faster than conventional methods. With PLAXIS, they saved USD 75,000 optimizing planning based on accurate geotechnical modeling and analysis. Performing collision detection with OpenRoads and OpenBridge saved USD 189,000 in rework. The successful BIM implementation supports digital transformation and collaboration throughout the company.

**Project Playbook:** iTwin, OpenBridge, OpenRoads, PLAXIS





# Serpong-Taman Tekno Toll Road

PT Wijaya Karya (Persero) Tbk | *West Jakarta, Jakarta, Indonesia*

This toll road project is aligned with the Indonesian government's program to create integrated infrastructure supporting national growth. Featuring 10 ramps as well as bridge and embankment structures, the roadway construction is impacted by the surrounding residential area, environment, and soil type. PT Wijaya Karya (WIKA) is piloting a BIM methodology instead of conventional construction methods, and faced technical and coordination challenges managing the constrained land acquisition, ramp alignment transitions, voluminous model data, and engineers and stakeholders.

To address these issues, WIKA used Bentley's open applications, providing a visual digital representation of the field conditions and more accurate volume calculations based on the 3D model. Working in an open, digital platform facilitated coordinated design and construction, which helped to identify and resolve clashes that resulted in the relocation of three piers, as well as optimize design of the ramp alignments while saving resources. Through comprehensive BIM application, WIKA improved time efficiency by 50% and cost efficiency by 8.9%, saving IDR 100 million.

**Project Playbook:** iTwin, LumenRT, OpenRoads, PLAXIS, RM Bridge™



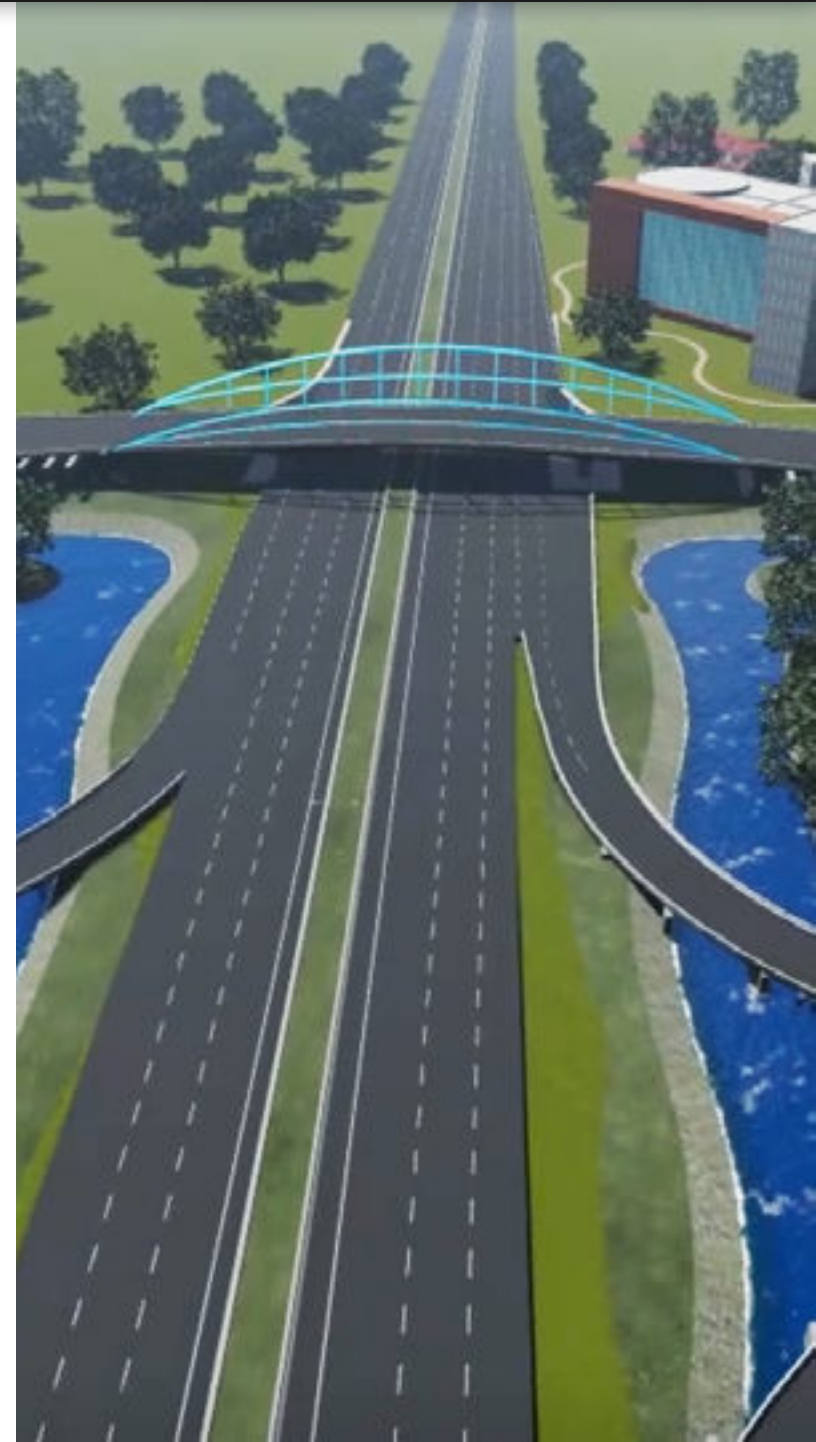
# Soekarno Hatta Airport Accessibility Projects

PT Wijaya Karya (Persero) Tbk | *Tangerang, Banten, Indonesia*

This toll road project is aligned with the Indonesian government's program to create integrated infrastructure supporting national growth. Featuring earth excavation and bridge and embankment structures, the construction is affected by the surrounding environments, soil type, resources capability, and cost efficiency. PT Wijaya Karya (WIKA) is piloting a BIM methodology and faced technical and coordination challenges managing the ramp alignment transitions, voluminous model data, and engineers and stakeholders.

To address these issues, WIKA used iTwin to process drone-captured images of the project site, as well as OpenRoads and OpenBridge for structural modeling of the roadway and bridge. Bentley's applications helped to better visualize the field conditions and achieve faster, more accurate volume calculations. WIKA improved time efficiency by 50%, saving 255 days, and cost efficiency by 1.58%, saving IDR 6 billion, compared to traditional methods. Working in a connected digital environment streamlined coordination among the team and all stakeholders throughout design, construction, and handover to the client.

**Project Playbook:** iTwin, LumenRT, OpenBridge, OpenRoads, PLAXIS





# Jakarta – Cikampek II Selatan Toll Project, Indonesia

PT Waskita Karya (Persero) Tbk | Purwakarta, West Java, Indonesia

PT Waskita Karya needed a more efficient alternative to traditional design while working on construction of a toll road project in West Java. They were behind on development due to slow land acquisition and faced frequent design changes because the client took an insufficient site survey at the beginning of the project. PT Waskita Karya needed quick, accurate models to streamline construction and increase their profit margin. They realized the value of establishing a BIM platform for this USD 175 million project.

PT Waskita Karya created a 3D reality model of the site and all roadways, bridges, and interchanges. The interoperability of the software enabled model sharing on a third-party connected data environment for centralized management. They no longer produced cross-section drawings from scratch when the client changed horizontal and vertical alignments, cutting design time. They also eradicated unexpected costs by detecting clashes early in the construction stage.

**Project Playbook:** iTwin, LumenRT, OpenBridge, OpenRoads





# Projek Membina Jalan Dari Inanam ke Sepanggar (9.9 km)

Alamega Konsult | *Inanam, Sabah, Malaysia*

Alamega Konsult was hired to design the Inanam-Sepanggar link, one of three sections of the Kota Kinabalu Outer Ring Road, for the Borneo Highway in Malaysia. The nearly 10-kilometer section of the road includes construction of six bridges and two interchanges, but minimizing construction and earthwork costs was essential on the MYR 20 million project. They needed to create a design that easily configures with all other structural arrangements. Lacking a connected data environment and digital workflows, Alamega Konsult decided to strengthen their productivity with Bentley applications for design and 3D modeling.

They designed the optimal road alignment and calculated accurate earthwork volumes with OpenRoads. Comparing a variety of 3D models in MicroStation assisted them with generating the ideal configuration to fit with the two other segments of the ring road that were designed by other engineering firms. Alamega Konsult minimized design time and maximized effort by modeling precise civil roads and structures with Bentley software.

**Project Playbook:** MicroStation, OpenRoads



# Transit Oriented Development of Walini Region Road

PT Wijaya Karya (Persero) Tbk | *West Bandung, West Java, Indonesia*

The new, 46-kilometer Walini Road highway will run along the foot of a mountain with complicated topography. The USD 31 million design-and-build project is a part of Indonesia's plan to develop West Bandung. PT Wijaya Karya (WIKA) had to map the area, model the road and bridge, and analyze the slope and embankment within a two-week deadline, allowing construction to commence before the rainy season. They also had to accurately calculate volumes to deliver exact build costs. They decided to implement BIM technology to meet short project deadlines.

By using Bentley applications, WIKA created many design iterations of pier position and bridge structure and compared all design alternatives and engineering variables. iModels improved project data management and reduced errors, project costs, and inspection time. They met their two-week deadline and cut planning prices by 15% with streamlined workflows. The volume of the configured road alignment was 12% more efficient compared to the initial estimation.

**Project Playbook:** iTwin, LumenRT, OpenBridge, OpenRoads, PLAXIS





# West Coast Expressway – Changkat Cermin Interchange

Perunding ZKR Sdn. Bhd. | *Sitiawan, Perak, Malaysia*

The 233-kilometer West Coast Expressway (WCE) runs north to south on Peninsular Malaysia. The Changkat Cermin Interchange is located on a section of the WCE that traverses palm oil fields and comprises four toll plazas, four interchanges, and a rest area. Since the region's economy is based on palm oil farming, engineers Perunding ZKR had to ensure that land acquisition for the interchange and its environmental impacts were minimal. They decided that implementing iterative design and dynamic modeling would let them examine many arrangements and quickly alter designs.

Perunding ZKR developed 3D models in OpenRoads, manipulating different aspects of the configuration based on site topography to reduce land use. The visual clarity of the intelligent models accelerated decision-making. All stakeholder-requested modifications were optimized to stay within budget and executed quickly to meet the scheduled deadline. They envision that using BIM workflows throughout construction will drastically lower project costs.

**Project Playbook:** OpenRoads



# Design and Digital Construction of the Padang-Pekanbaru Highways Project Section Bankinang-Padang

PT Wijaya Karya (Persero) Tbk. | Pekanbaru, Riau, Indonesia

Part of Indonesia's national strategic projects, the Pekanbaru-Padang Highway is a 254.8-kilometer toll road that is expected to increase economic activities. PT Wijaya Karya (WIKA) is the contractor responsible for a 56-kilometer section. The large, landslide-prone construction area presented site challenges that required voluminous, costly earthworks, significantly affecting the construction budget. Therefore, WIKA needed to determine an alternative and cost-effective solution.

iTwin helped rapidly generate a reality mesh from survey data of the complex topography, while gINT and PLAXIS were used to perform calculations for reference cut-and-fill volumes. OpenRoads and OpenBridge facilitated accurate 3D modeling to optimize road alignment and bridge geometry, which, fully integrated with LumenRT, helped create a realistic visualization. WIKA was able to timely review the earthworks calculations, saving INR 1 trillion in cut-and-fill volumes and 20% in overall construction costs.

**Project Playbook:** gINT, iTwin, LumenRT, Navigator, OpenBridge, PLAXIS, OpenRoads, ProStructures





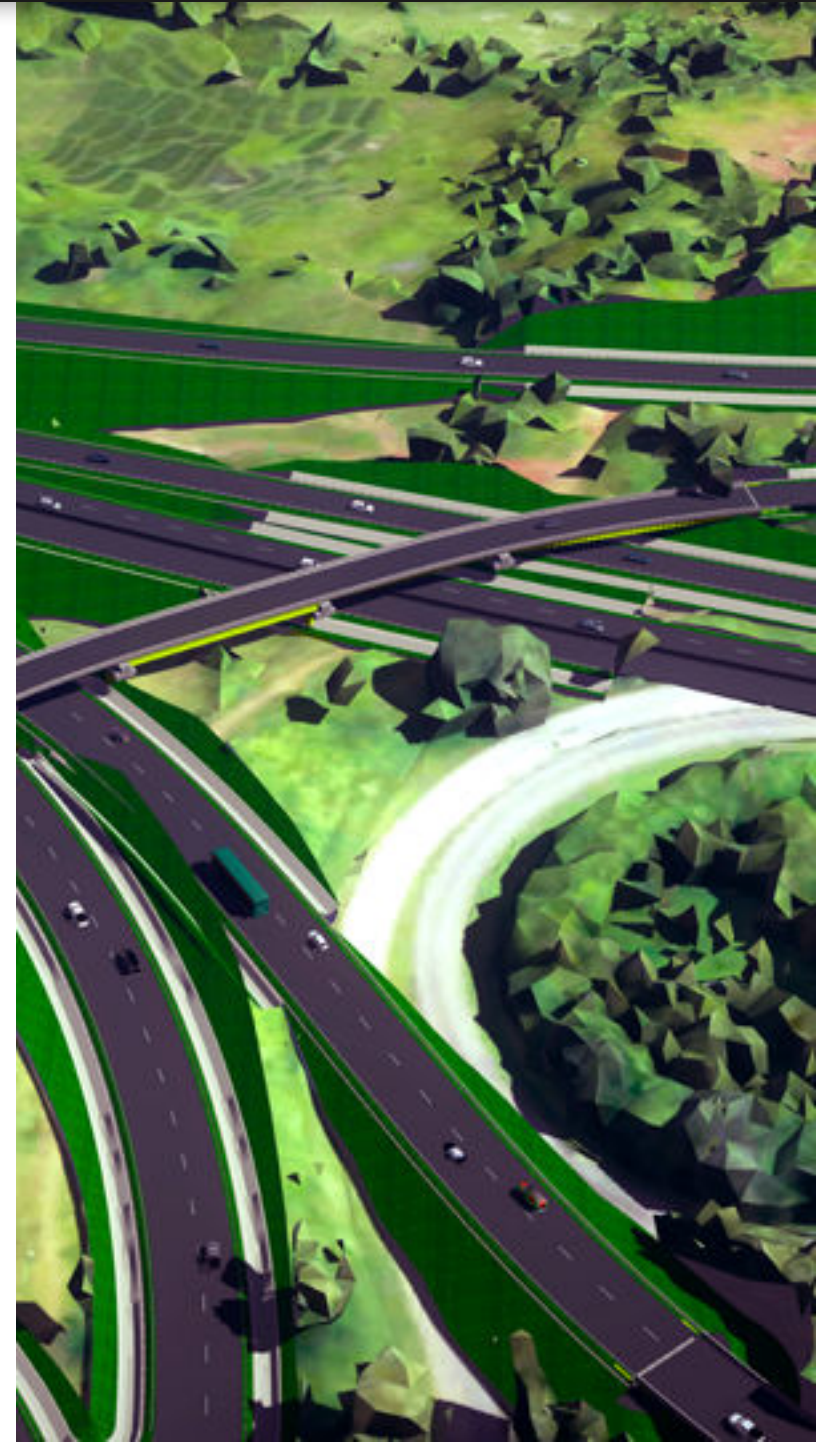
# Jakarta-Cikampek Selatan II Paket 3

Reveron Consulting, Sdn. Bhd. | Purwakarta, Jawa Barat, Indonesia

Located in Sadang, Indonesia the Jakarta-Cikampek Selatan Paket 3 highway project is a 28-kilometer-long corridor that includes a balanced cantilever and prestressed concrete bridge structure. The USD 210 million initiative is intended to alleviate congestion along the Jakarta-Cikampek toll road and accelerate Indonesia's economic growth. The project team needed to connect the Sadang junction with existing infrastructure, which requires replacing two ramps with one new ramp.

WKA used iTwin Capture Modeler, OpenRoads, OpenBridge, and LumenRT to accelerate the survey and design process. Working with a digital version of the project saved significant costs. Bentley applications optimized conceptioneering, enabling the team to perform collision detection to identify and resolve clashes prior to construction. The interoperable digital solution automated previously manual methods—reducing errors and resource hours—and generated accurate earthworks volume calculations, optimizing data application to industrialize production and project delivery.

**Project Playbook:** iTwin, LumenRT, OpenBridge, OpenBuildings®, OpenRoads



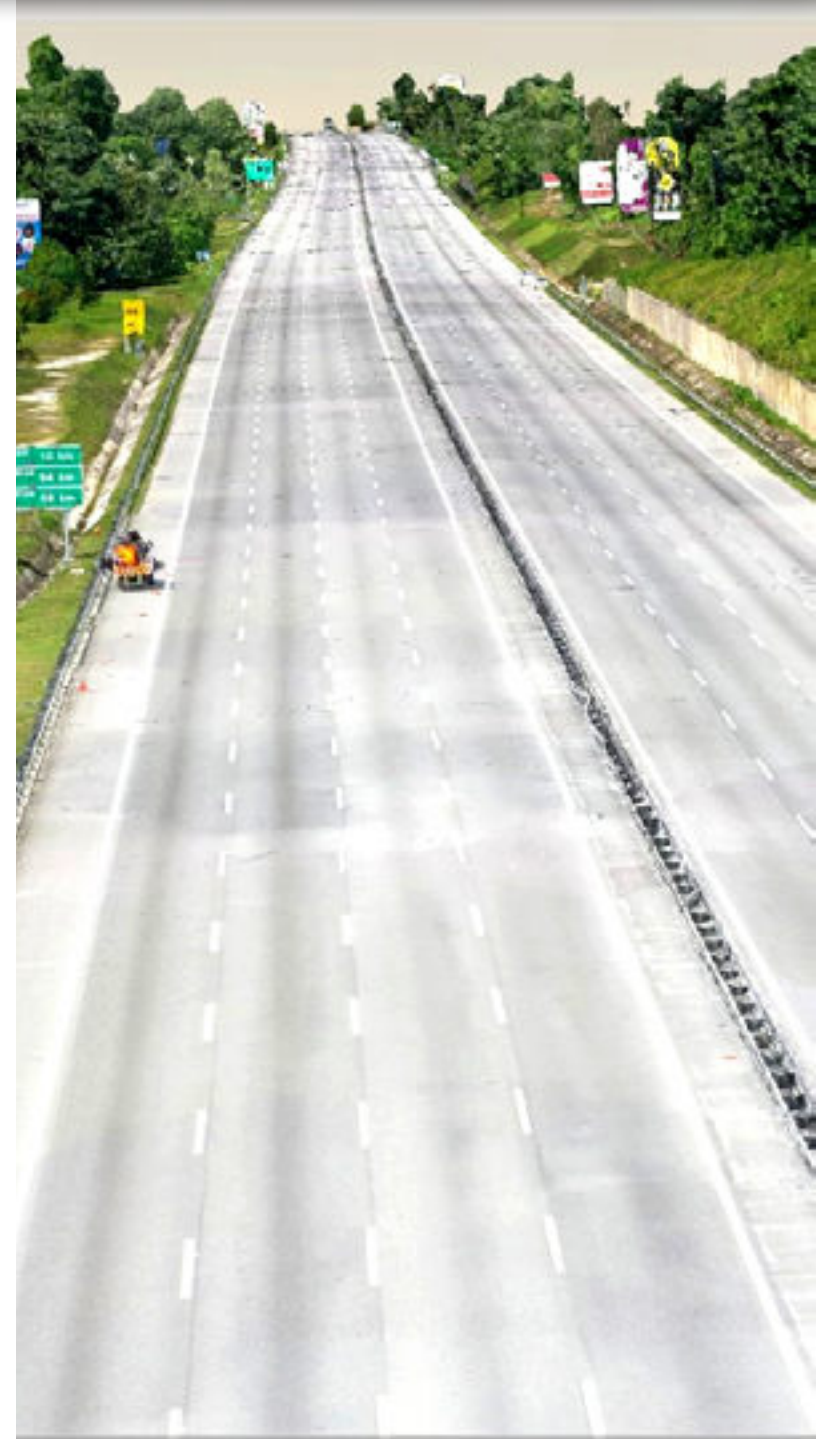
# Opus International Malaysia Berhad C3 Highway

RITES Limited | *Petaling Jaya, Selangor Darul Ehsan, Malaysia*

Opus International Malaysia retained Reveron Consultants to create a risk management report for a 3-kilometer section of C3 Highway. Reveron Consultants was required to demonstrate the viability of using the latest digital technology for asset management of infrastructure and built environments. The project team relied on 3D BIM and reality modeling applications to deliver the MYR 350 million project.

The team generated a reality model of the highway infrastructure, using OpenRoads Designer and LumenRT for model refinement and visual renderings. The interoperability of Bentley technology facilitated seamless integration with the 3D model created using third-party CAD software. Using Bentley applications to conduct the assessment and create the risk management report improved productivity and design efficiency with fewer resources, while reducing costs and shortening the project schedule.

**Project Playbook:** LumenRT, OpenRoads







# Digital Twins for Roads and Highways

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## About Bentley Systems

Bentley Systems (Nasdaq: BSY) is the *infrastructure engineering software* company. We provide innovative software to advance the world's infrastructure – sustaining both the global economy and environment. Our industry-leading software solutions are used by professionals, and organizations of every size, for the design, construction, and operations of roads and bridges, rail and transit, water and wastewater, public works and utilities, buildings and campuses, mining, and industrial facilities. Our offerings, powered by the *iTwin* Platform for infrastructure digital twins, include *MicroStation* and *Bentley Open* applications for modeling and simulation, *Seequent's* software for geoprofessionals, and *Bentley Infrastructure Cloud* encompassing *ProjectWise*® for project delivery, *SYNCHRO* for construction management, and *AssetWise*® for asset operations. Bentley Systems' 5,000 colleagues generate annual revenues of more than \$1 billion in 194 countries.

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