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**Bentley**<sup>®</sup>  
Advancing Infrastructure

# Road and Highway

Reality Modeling for Going Digital Strategy

## Reality modeling is going mainstream in the transportation industry

Road and highway transportation is essential to sustaining economic growth and improving quality of life in a region. The daily movement of people and goods is constantly increasing, as is the size and complexity of projects being imagined, and assets operated. Owner-operators and their supply chains need effective and efficient solutions to design, build, and operate road networks around the world, and are adopting reality modeling to improve worker safety, start projects faster, iterate designs more efficiently, and share information more effectively.

Reality modeling is the process of capturing existing site conditions using photographs and, when additional accuracy is needed, point clouds to create high-fidelity georeferenced 3D models. Additionally, 3D reality models can be easily understood and shared, accelerating the decision-making process with real-world digital context and improving team collaboration.

ContextCapture, Bentley's reality modeling software, automatically generates high-fidelity, 3D reality models from simple photographs and/or point clouds. These rich reality models can easily and consistently be shared, consumed, and accessed, on desktop and mobile devices, in many formats, including native use within MicroStation, OpenRoads Designer, and many other applications throughout the entire design and construction workflows.

### Reality Modeling Provides Real-world Digital Context of Existing Conditions to Accelerate Your Design Workflow

- Simulate construction and evaluate potential impact
- Understand financial implications early
- Accelerate and improve decision making
- Optimize collaboration and coordination
- Leverage digital workflows
- Manage and mitigate risk

### Reality Modeling Helps Accelerate Project Delivery During the Construction Workflow to Provide an Accurate Perspective of Your Job Site, Monitor and Evaluate Progress, and Enable Verification of Performance Against Schedule

- Ease collaboration among stakeholders
- Provide up-to-date documents for construction and inspection
- Conduct calculation of cut/fill quantities as required
- Improve safety and enable right first-time construction
- Lower costs to perform as-built surveys

### Reality Modeling Helps Improve the Operation and Maintenance of Assets Through Easier Capture and Documentation of Assets in 3D and Linking Registered Equipment to Operations and Engineering Data

- Optimize maintenance and service activities
- Lower asset inspection costs
- Improve safety and coordination
- Develop more repeatable inspection processes
- Provide easier access in hard-to-inspect locations
- Contribute to reducing asset downtime

**Reality modeling is going mainstream and has been credited by the following rail and transit and roads and highways projects.**

## CCCC First Highway Consultants, Co., Ltd.

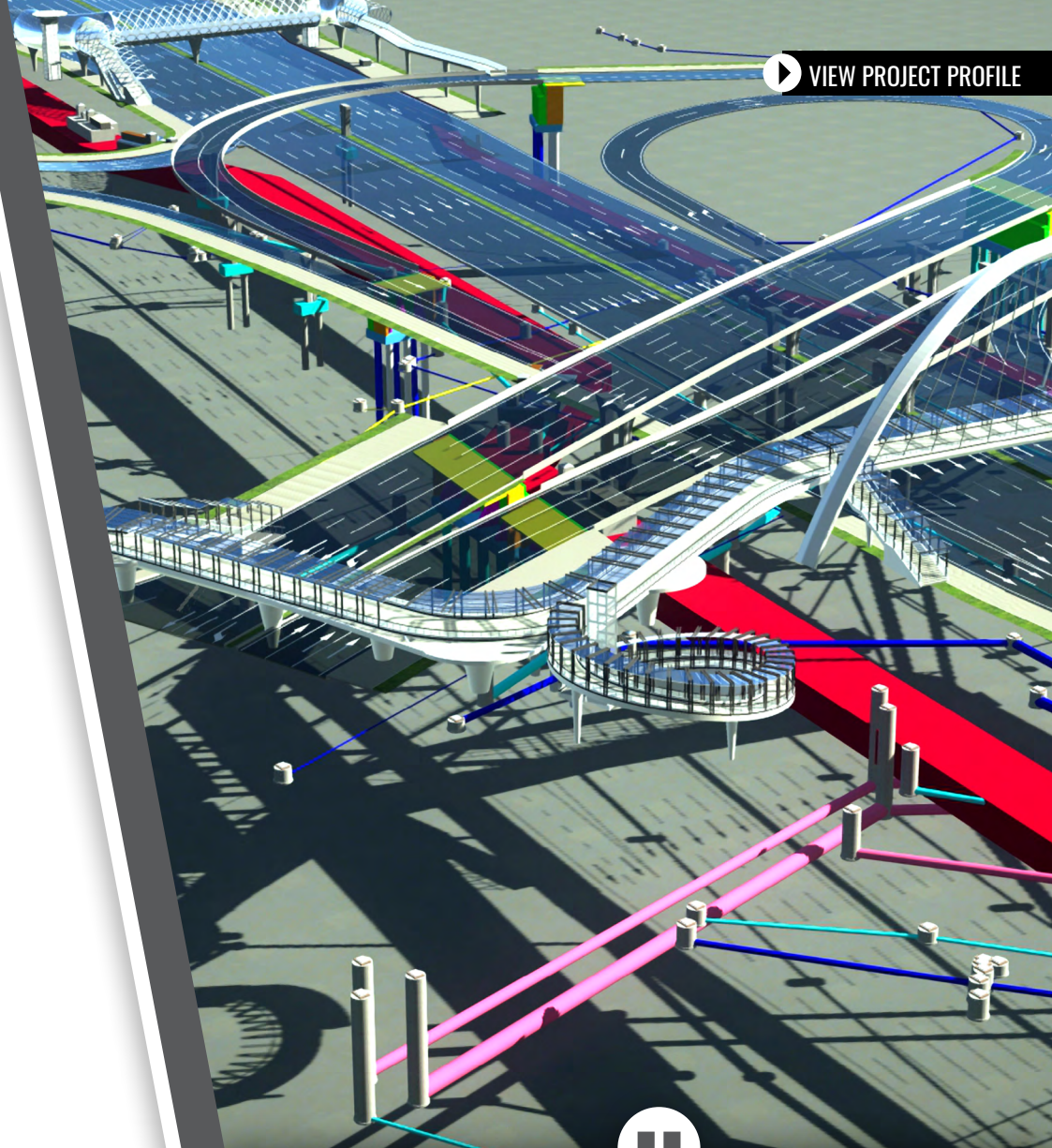
Shenzhen City, Guangdong, China

*Application of BIM Strategy on the Meiguan Expressway to Urban Road Design Project*

The CNY 9.4 billion Meiguan Expressway retrofit and expansion project spans approximately 8.5 kilometers and includes eight interchanges between the Meilin Inspection Station and Qinghu in Shenzhen, China. CCCC First Highway Consultants (CCCC) provided design services from planning through preliminary design and construction for the expansion of the original expressway and the newly built auxiliary roads. Faced with a dense road network, heavy traffic flow in the project area, and a nine-month design cycle, CCCC implemented a collaborative BIM approach to meet its deliverables.

The project team used Bentley's integrated BIM solutions, reality modeling, and OpenRoads technology for parametric 3D design. It also used ProjectWise to manage, store, and share information among the different design disciplines and stakeholders. Using Bentley applications to implement a 3D collaborative design workflow enabled project delivery 43 days ahead of schedule while reducing costs by CNY 2.2 million.

**Project Playbook:** ContextCapture, LumenRT, MicroStation®, OpenBridge Modeler®, OpenRoads™ Designer, ProjectWise®



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Based on the strategic cooperation reached with Bentley, the company has completed the project's 3D collaborative design, scheme optimization, and digital delivery by using Bentley solutions and professional BIM modeling software developed by our company. We used the reality modeling technology for design for the first time, achieved the innovation on design basic data and design methods, and minimized impact that the municipal retrofit project poses on the surrounding environment.

— Cheng Peng, FHCC President Assistant, CCCC First Highway Consultants, Co., Ltd.



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Bentley's ContextCapture, along with LumenRT, provided a quick and realistic representation of ALDOT's design. Stakeholders and the public can see exactly how the project will look in real life. This is very beneficial to ALDOT and keeps projects moving!

— Matt Taylor, Visualization Project Manager, Alabama Department of Transportation

## Alabama Department of Transportation

Centreville, Alabama, United States

### *Roundabout Bibb County*

The Alabama Department of Transportation (ALDOT) initiated a USD 2 million project to improve the intersection at State Route 5 and County Road 58 in Centreville, Bibb County, Alabama. The proposed solution was a roundabout design that would connect all roads and elevate dangerous side road connections. As a new design concept, the project faced public opposition, and ALDOT needed to incorporate public and stakeholder opinion and achieve buy-in. Upon completion, the new roundabout will reduce accidents by improving safe traffic flow in the area.

ALDOT used Bentley applications to combine a 3D model of the proposed roadway, a drone-captured photogrammetry reality mesh, and real-time projected traffic into a rendered environment to visualize the project for better understanding. Generating the reality mesh using ContextCapture saved three weeks, while LumenRT simplified the otherwise time-consuming incorporation of 3D features to significantly reduce costs.

**Project Playbook:** ContextCapture, LumenRT, MicroStation, OpenRoads

## JSTI Group Co., Ltd.

Nanjing, Jiangsu, China

### *Yangzijiang Avenue Rapid Reconstruction Project*

Located in Nanjing City, Yangzijiang Avenue is an important part of the city's planned rapid road network. The CNY 3.29 billion transformation project will eliminate three traffic lights and feature a newly built, 7.2-kilometer integrated pipeline gallery. Given the large volume of data and multiple engineering disciplines, a BIM process and 3D construction are being applied to the full lifecycle design, construction, operation, and management of roads and underground pipeline corridors.

A connected data environment supported collaborative design and provided integrated digital management to improve efficiencies. Leveraging OpenRoads Designer for parametric modeling with Bentley's reality modeling and structural design and analysis applications allowed the team to correct more than 320 design errors and reduce time for review and design change by 5,500 hours to save CNY 8 million.

**Project Playbook:** ContextCapture, Descartes, LumenRT, MicroStation, Navigator, OpenBridge Modeler, OpenBuildings™ Designer, OpenPlant™, OpenRoads ConceptStation, OpenRoads Designer, ProjectWise, ProStructures, RM Bridge



Bentley's complete life cycle solution provided support for our projects, enabling delivery of intelligent, quality designs, and improved collaboration and efficiency.

— Qingguo Ben, Deputy Director  
of the Special Bridge Structure Institute



## Gansu Province Transportation Planning, Survey & Design Institute Co., Ltd.

Lanzhou, Gansu, China

### *BIM Technology Application in Gansu Province's S104 Highway*

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With a total length of 23 kilometers, including 28 bridges and one interchange, Gansu province's S104 highway line connects the south of Lanzhou and serves as a gateway for economic and tourism development of the area. This CNY 3.73 billion project to upgrade the roadway infrastructure is expected to alleviate the long traffic delays that are restricting development of the regional economy. Faced with complex terrain conditions complicating the design, Gansu Province Transportation Planning, Survey & Design Institute implemented a BIM approach to deliver the project.

The team used ContextCapture and OpenRoads Designer to establish a comprehensive digital terrain model. Bentley's parametric design capabilities improved design efficiency by 50 percent. OpenBridge Modeler accelerated bridge modeling with its customizable component library and user-friendly editing features to shorten modeling time by 30 percent.

**Project Playbook:** ContextCapture, Descartes, LumenRT, MicroStation, OpenBridge Modeler, OpenRoads Designer

# POWERCHINA (Guangdong) Zhongshan-Kaiping Expressway Co., Ltd./POWERCHINA Zhongnan Engineering Corp. Ltd.

Jiangmen, Guangdong, China

*Engineering Corp. Ltd.  
Zhongshan-Kaiping Expressway Project*

The Zhongshan-Kaiping Expressway is a 152.3-kilometer-long, high-speed roadway project in China's Guangdong province. The roadway project that connects 21 towns via 13 main roads, two rail transits, and 12 navigable waterways along the line. The project presented numerous design, construction, and coordination challenges because there is a widely distributed construction area that requires complex technical processes to be coordinated among more than 40 consulting firms.

Using ContextCapture for reality modeling, POWERCHINA saved 100 working days on-site, and the organization optimized construction drawings, saving approximately CNY 80 million, by using Navigator. Bentley's 3D simulation and virtual construction applications shortened the construction cycle by 68 days, which saved an additional CNY 1.33 billion.

**Project Playbook:** Bentley Communications®, ContextCapture, Descartes, LumenRT, MicroStation, Navigator, OpenBridge Modeler, OpenBuildings Designer, OpenRoads, ProjectWise, ProStructures



Bentley's road solution adopted for the site optimized the design process and reduced costs due to design changes. Visualization enabled clear understanding of on-site conditions and provided information to enable technical discussions and decision-making based on oblique photography and BIM.

— Tonggeng Ji, chief engineer of POWERCHINA (Guangdong) Zhongshan-Kaiping Expressway Co.,Ltd.



Speedy completion of design was enabled by Bentley's OpenRoads ConceptStation, and interoperability with OpenRoad Design ensured real-world requirements were met. BIM-based bridge design was simplified with OpenBridge Modeler's parametric capabilities, and the powerful functions of Bentley's navigator and ProjectWise applied BIM technology to the project throughout its full lifecycle.

— Lizheng Wang, teacher at Liaoning Provincial College of Communications

## Liaoning Provincial College of Communications

Liaoyang City, Liaoning, China

*BIM Application from Hanjia to Xiuyan of the Dengta-Xiuyan Low-grade Mountain Highway*

The Hanjia-to-Xiuyan section of the Dengxiu line of low-grade highway runs almost 5 meters through the mountainous province of Liaoning, China. Liaoning Provincial College of Communications is responsible for planning, survey, design, and applying the BIM methodology to deliver the project. Faced with hilly terrain varying in elevation and subject to heavy rainfall, the organization needed an integrated BIM solution that met the CNY 5 million budget.

The team used Bentley's comprehensive BIM and reality modeling technology to shorten the construction period, save costs, and improve design efficiency. OpenRoads ConceptStation reduced design time to save CNY 50,000 in costs. ContextCapture and OpenRoads Designer facilitated reality modeling and point-cloud extraction, improving design accuracy, reducing errors, and saving CNY 60,000. Bentley's interoperable applications shortened the project duration by 27 days and increased the return on investment by 2.2 percent.

**Project Playbook:** ContextCapture, Descartes, LumenRT, Navigator, OpenBridge Modeler, OpenRoads ConceptStation, OpenRoads Designer, ProStructures

## Guangxi Communications Design Group Co., Ltd.

Autonomous Region, China

*BIM-based Collaborative Design and Construction Management of All Elements and Objects in the Lipu-Yulin Expressway Project*

The Lipu-Yulin Expressway has a main roadway spanning 263.1 kilometers. Guangxi Communications Design Group is responsible for design, coordination, and construction management. The CNY 23.06 billion roadway project featured technically complex structures, involved numerous engineering disciplines, and required a large amount of land requisition and demolition in an area with geological and geographical site constraints.

ContextCapture saved CNY 300,000 in survey and mapping costs, OpenRoads optimized the modeling of the highway elements, and Navigator facilitated collision detection to identify and solve issues in advance. Bentley's Connected Data Environment based on ProjectWise reduced communication and collaboration costs by CNY 400,000. Bentley's BIM solutions saved 10 percent in design and construction management, which reduced costs by 30 percent.

**Project Playbook:** ContextCapture, Descartes, LumenRT, MicroStation, Navigator, OpenBridge Modeler, OpenBuildings Designer, OpenPlant, OpenRoads, OpenRoads ConceptStation, ProjectWise, ProSteel®, ProStructures, RM Bridge

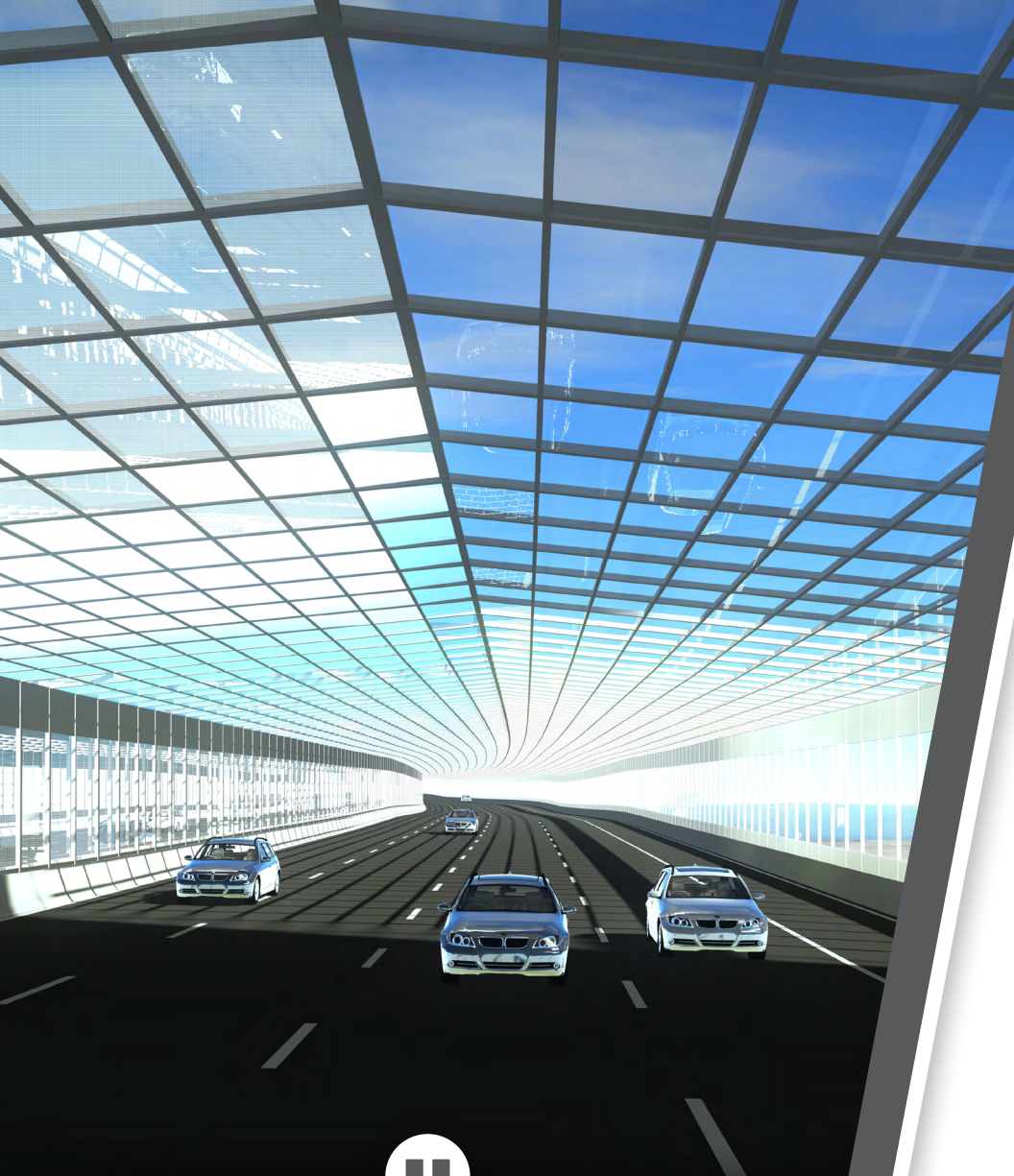


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This large-scale project, over 136 km in length and including about 40 km of bridges, inevitably involved numerous models. Bentley's software, including OpenRoads Designer, provided the solution for the whole project by improving efficiency and design quality, and reducing design changes which resulted in cost savings and a shortened the design cycle.

— Ke Qiao, Director of BIM Center, Sichuan Transport Department Highway Planning, Survey, Design and Institute

## Sichuan Chengde Expressway Co., Ltd. and Sichuan Provincial Transport Department Highway Planning, Survey, Design, and Research Institute

Chengdu City and Leshan City, Sichuan, China

*BIM Application in the Preliminary Design Project of the Chengdu-Leshan Expressway Expansion*

The Chengdu-Leshan Expressway expansion runs 136 kilometers, including approximately 40 kilometers of bridges and 23 interchanges. The CNY 23.4 million large-scale roadway project is subject to environmental restrictions, complex bridge design, and complicated traffic control in an urban area. Sichuan Provincial Transport Department Highway Planning, Survey, Design, and Research Institute implemented a 3D BIM approach.

By using Bentley's integrated BIM technology, the team identified at least 150 design errors, shortened the design cycle by about 20 percent, reduced costs by CNY 6 million, and eliminated unnecessary meetings by more than 10 times. The team created 3D mesh models and produced animated visual renderings with ContextCapture and LumenRT, which improved decision making and reduced approval time by approximately two weeks.

**Project Playbook:** ContextCapture, Descartes, LumenRT, MicroStation, OpenBuildings Designer, OpenRoads ConceptStation, OpenRoads Designer, ProStructures

## Finnmap Infra Oy

Riihimäki, Finland

### *Highway 3 Arolampi Interchange*

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The EUR 10.4 million road design project in Riihimäki, Finland will connect Highway 3 via a new teardrop interchange at Arolampi. Finnmap Infra Oy provided design and reality modeling services to ensure unhindered traffic flow during construction. The new interchange will enable zoning for new industrial and residential areas of the region and improve access to operating businesses in the area.

The project required design and construction of ramps, junctions, and an underpass; relocation of a frontage road; removal of an old bridge; and construction of two new bridges. Finnmap used OpenRoads to create machine control models and ContextCapture to monitor construction progress through photogrammetry. The machine control models improved the execution accuracy of earth-moving works and saved 5 percent in project costs.

**Project Playbook:** ContextCapture, LumenRT, OpenRoads





Bentley's comprehensive technology not only brought objective economic benefits for this project, but also provided efficient, convenient, and visible technical support for engineering management to cope with complicated project environments. The comprehensive management efficiency has been increased by 25 percent, and a shining 'digital label' has been affixed to this century bridge.

— Xuyuan Liang, Director, Technology R & D Center

## Long Jian Road & Bridge Co., Ltd.

Heihe City, Heilongjiang, China

*Heihe-Blagoveshchensk Heilongjiang River (Amur River) Road Bridge Project*

The Heihe-Blagoveshchensk Heilongjiang River (Amur River) Road Bridge connects Heihe City, China to Blagoveshchensk City, Russia. The length of the entire route is 19.9 kilometers, with the cable-stayed bridge portion spanning 1,284 meters in length. Located in the alpine region, the project is subject to extreme temperature variations and strict environmental protection. To meet these challenges and accommodate a short construction schedule, the project team implemented a collaborative BIM approach for delivery of the infrastructure project.

The project team used Bentley's BIM technology, reality modeling applications, and ProjectWise for collaborative design, modeling, construction management, and information sharing for optimal project coordination through construction. Accurate modeling with ProStructures reduced construction errors and rework, saving five working days and 30 tons of materials. Design and collaboration using OpenRoads and ProjectWise improved modeling efficiency by 35 percent.

**Project Playbook:** ContextCapture, Descartes, LumenRT, Navigator, MicroStation, OpenBridge Modeler, OpenBuildings Designer, OpenRoads, ProjectWise, ProSteel, ProStructures, RM Bridge

## Shenzhen Municipal Design & Research Institute Co., Ltd.

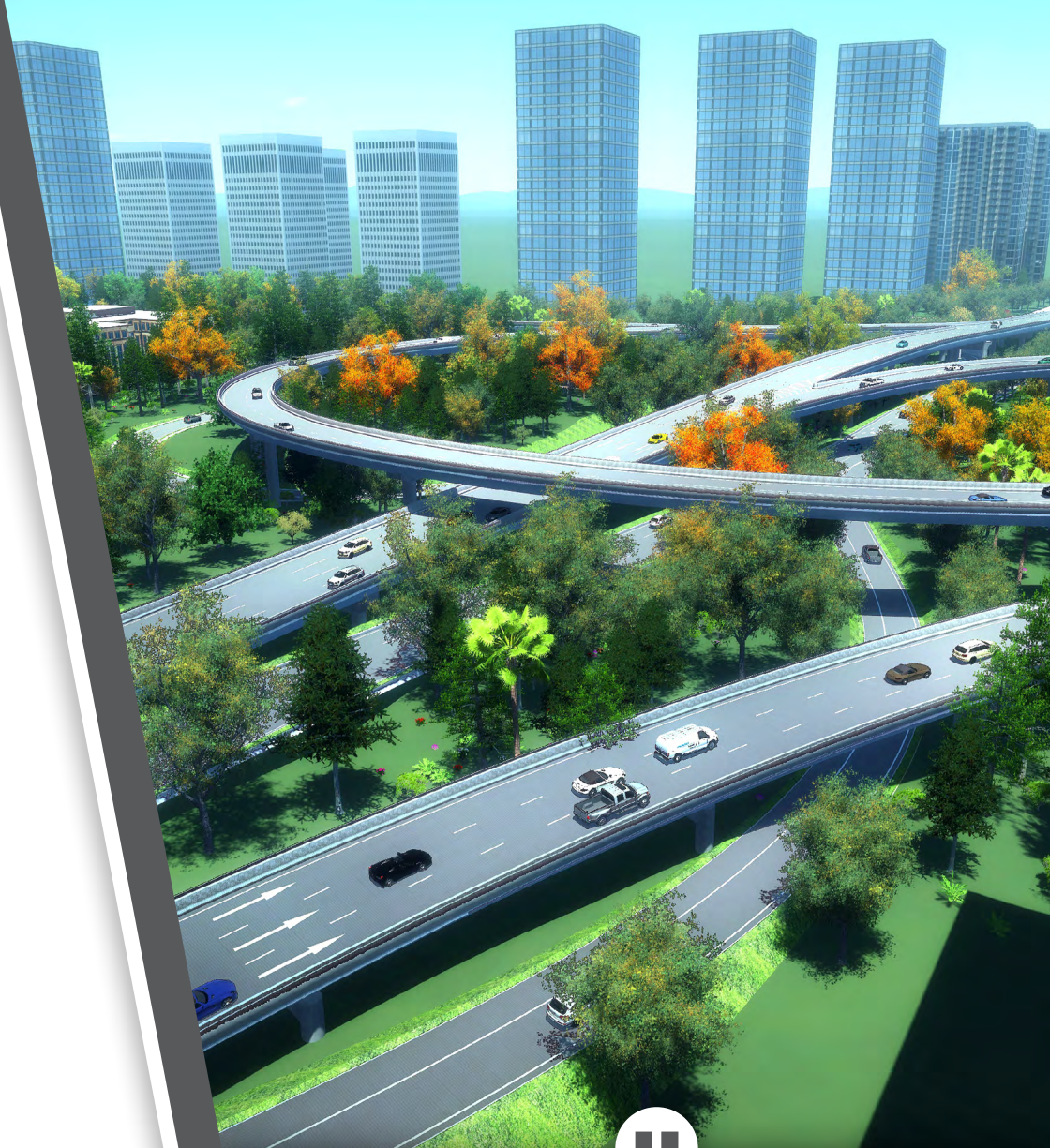
Shenzhen, Guangdong, China

### *Shahe West Road Rapid Retrofit Project*

In China's Guangdong province, the Transport Commission of Shenzhen Municipality launched the Shahe West Road Rapid Retrofit Project to improve the road network structure, increase traffic capacity, facilitate vehicle exit/entrance, and shorten travel time. Shenzhen Municipal Design & Research Institute Co., Ltd. won the CNY 1.6 billion contract to design all aspects of the project, which comprises 7.43 kilometers of roadway, junctions, auxiliary roads, and overcrossings.

Using ContextCapture, the Institute created a reality mesh as an accurate basis for the design scheme. The visual environment provided a powerful decision-making tool for evaluating the complex BIM designs developed with Bentley software. ProjectWise provided a collaborative environment to allocate tasks, manage models, and control progress. Bentley technology helped the Institute increase design efficiency by 10 percent and complete the project 28 days ahead of schedule.

**Project Playbook:** ContextCapture, LumenRT, OpenBridge Modeler, OpenRoads ConceptStation, OpenRoads Designer, ProjectWise



ProjectWise's collaborative environment improved the design progress management on this project. Based on ContextCapture's reality model, the optimum design was carried out, improving the design quality and rationality. It made the project and surrounding environment more coordinated, met technical requirements of the owner for landscape art, and greatly reduced the project's delivery time.

— Daming Wang, BIM Design Lead,  
Shenzhen Municipal Design & Research Institute Co., Ltd.



## Huadong Engineering Corporation Limited, PowerChina

Shenzhen City, Guangdong, China

### *Application of BIM Strategy for Shenzhen Qianhai Municipal Infrastructure*

In Shenzhen, Guangdong, China, the Qianhai Cooperation Zone is undergoing intense development, with nearly CNY 390 billion of dense construction covering an area of 14.92 square kilometers. The planned activity includes more than 180 kilometers of roads and 32 kilometers of rail lines aboveground and belowground, and CNY 68.2 billion in infrastructure. Huadong Engineering Corporation (PowerChina) is responsible for the infrastructure and other major projects.

Huadong Engineering's daily management and coordination of BIM implementation ensured that the team leveraged the technology to solve the numerous challenges. A 3D reality model of the zone, used with the project's multi-discipline 3D design models, created a GIS-based view for resolving errors, omissions, collisions, and deficiencies. Using the 3D collaborative design helped save more than CNY 21 million in averted rework alone.

**Project Playbook:** Bentley Raceway and Cable Management, ContextCapture, Descartes, LumenRT, MicroStation, Navigator, OpenBuildings Designer, OpenRoads Designer, OpenRoads Navigator

Through the introduction of Bentley's engineering 3D digital technology platform, the tough problems of overall technical and management planning of Qianhai infrastructure complex project group construction were removed. By dealing in advance with the error, omission, collision, and deficiency problems at the project planning and design stage, carrying out construction simulation of the project, and other means carried out through this platform, we avoided the management and control risks and investment waste caused by imperfect prophase design to the maximum extent. We achieved digital engineering construction, laying a solid foundation for building a 'smart Qianhai.'

— Jinfeng Wang, IT Director, Huadong Engineering Corporation Limited (PowerChina)

## PT. Wijaya Karya (Persero) Tbk.

Gresik-Surabaya, East Java, Indonesia

### *Design and Build of Road Bridge at Teluk Lamong Port Project I*

The IDR 1.3 trillion Teluk Lamong flyover bridge project is part of the National Strategic Program mandated by the Indonesian government to reduce severe traffic congestion. A unique bridge design with elevated, curved contours was required to accommodate three major crossing points and to avoid religious relics and ancestral tombs. PT. Wijaya Karya (WIKA) was the main contractor, providing detailed engineering design and construction.

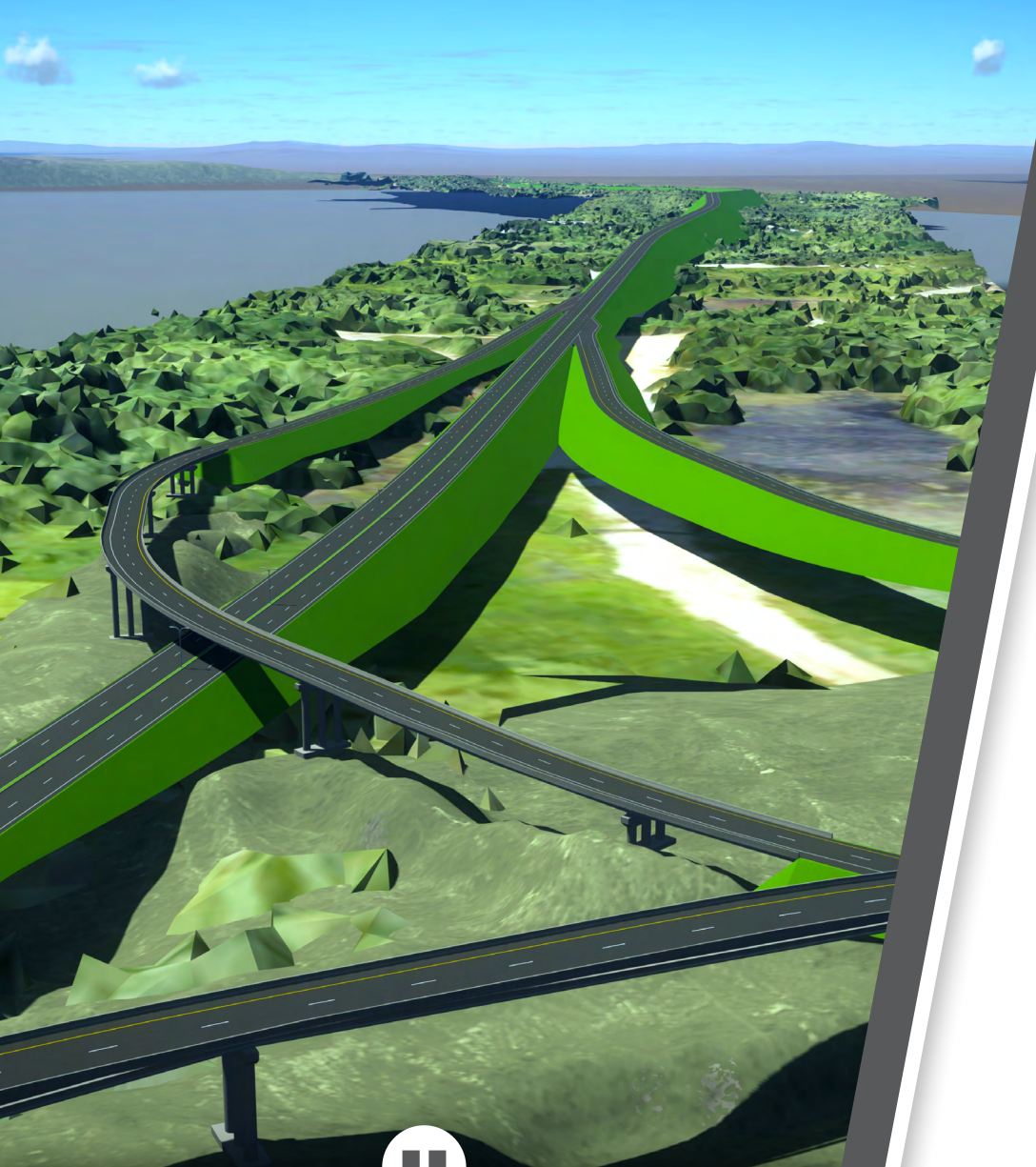
The project team used OpenBridge Modeler and AECOsim Building Designer to build intelligent 3D models and automate bills of quantity, reducing overall design time by 80 percent. WIKA created an immersive reality mesh to optimize design strategy and accelerate construction using ContextCapture and LumenRT. The team optimized collaboration and facilitated clash detection to save approximately IDR 5 billion in project costs by working in a connected data environment with Bentley's integrated BIM technology.

**Project Playbook:** ContextCapture, Descartes, LEAP®, LumenRT, Navigator, OpenBridge Modeler, OpenBuildings Designer, OpenRoads, ProjectWise, ProStructures



ProjectWise's collaborative environment improved the design progress management on this project. Based on ContextCapture's reality model, the optimum design was carried out, improving the design quality and rationality. It made the project and surrounding environment more coordinated, met technical requirements of the owner for landscape art, and greatly reduced the project's delivery time.

— Daming Wang, BIM Design Lead,  
Shenzhen Municipal Design & Research Institute Co., Ltd.



## PT. Wijaya Karya (Persero) Tbk

Balikpapan, East Kalimantan, Indonesia

*Balikpapan-Samarinda Toll Road Project,  
Sections 2, 3, and 4*

As part of a national strategic project in Balikpapan, Indonesia, the Balikpapan-Samarinda Toll Road is a 99.2-kilometer highway being executed in five sections with a short deadline. PT Wijaya Karya (Persero) Tbk (PTWK) was awarded the design-build contract for the 65-kilometer stretch, comprising sections two, three, and four of the project. The company was required to implement BIM methodology to ensure accurate designs for use during construction. Upon completion of the roadway, the new toll road will shorten travel time between Balikpapan City and Samarinda by one-and-a-half hours.

PTWK used Bentley applications to generate a 3D reality mesh, digital terrain and digital surface models, and provide an animated walkthrough for a 14-kilometer stretch of the project. Bentley technology enabled the team to deliver accurate roadway designs within three days. Based on the success of this portion of the project, the BIM team expects to deliver the remaining 51-kilometer section within two weeks.

**Project Playbook:** ContextCapture, LumenRT, OpenRoads Designer

Infrastructure development, such as the Toll Road Balikpapan – Samarinda project, is the main prerequisite for economic, cultural, and societal development. Bentley technology helps speed up the decision and execution processes for the infrastructure project.

– I Ketut Suarbawa, Project Manager of BALSAM Toll Road Project,  
PT. Wijaya Karya (Persero) Tbk

## Composite Structure Lab, Chung-Ang University

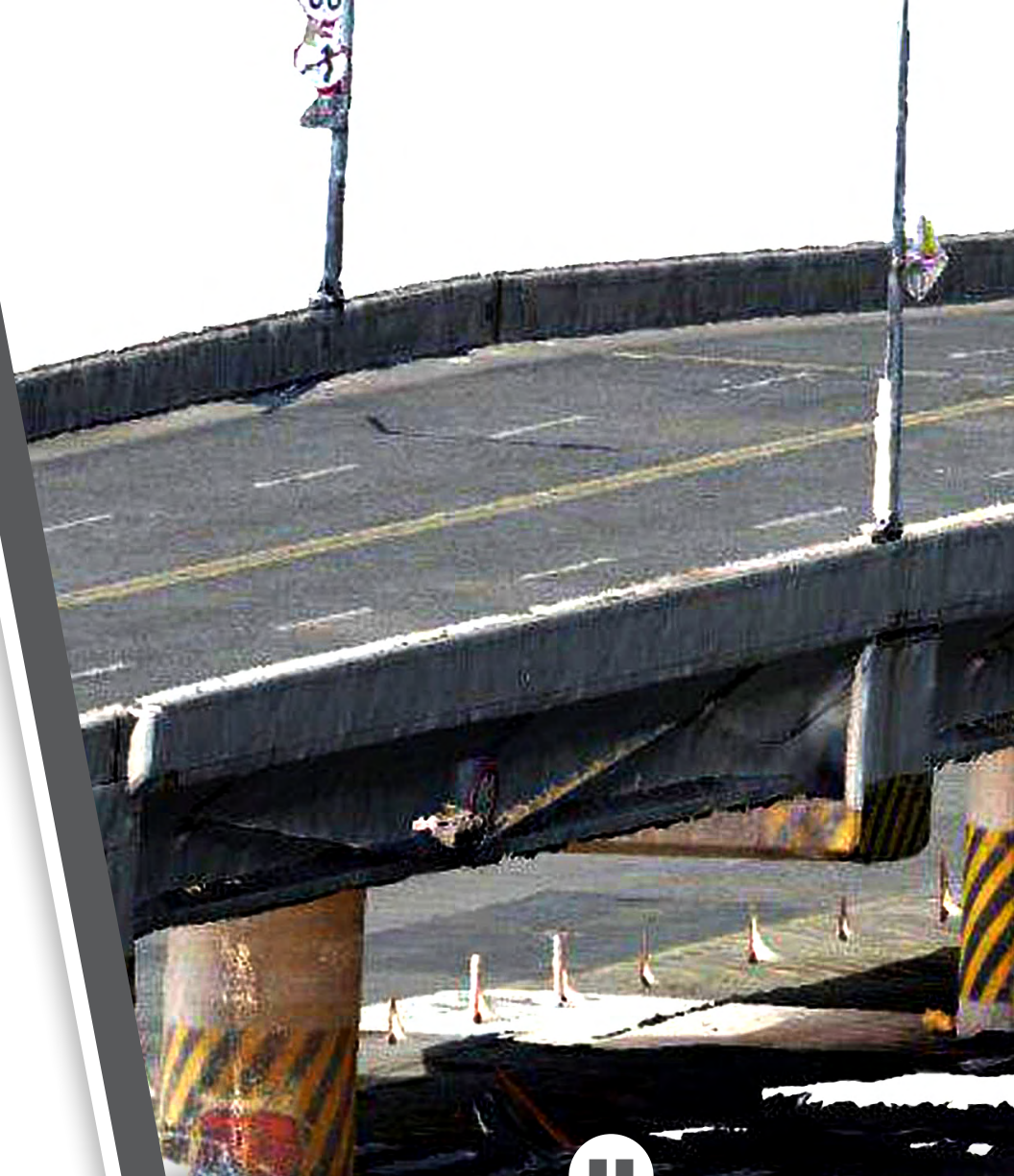
Seoul, Gyeonggi-do, South Korea

### *Innovative Bridge Maintenance System Using Digital Twin Model*

Hundreds of bridges in Seoul are aging and deteriorating, having almost reached the end of their design life. The South Korean government recognized the demand to establish a proactive bridge maintenance system for more reliable infrastructure operation and management. To determine a cost-effective solution for preventive maintenance, the government initiated a KRW 30 million bridge modeling project. The project team created a digital asset model to help with the detailed analysis and data exchange necessary for accurate design and prediction of the bridge structure's future state.

To generate this hybrid engineering model, the project team developed a collaborative 3D BIM model and reality mesh using Bentley's modeling and analysis applications. The flexibility and interoperability of Bentley software facilitated real-time collaboration to optimize design accuracy while significantly reducing modeling time. These capabilities also enabled the integration of BIM processes and reality meshes to create the digital asset model.

**Project Playbook:** ContextCapture, OpenBridge Modeler, RM Bridge



ProjectWise's collaborative environment improved the design progress management on this project. Based on ContextCapture's reality model, the optimum design was carried out, improving the design quality and rationality. It made the project and surrounding environment more coordinated, met technical requirements of the owner for landscape art, and greatly reduced the project's delivery time.

— Daming Wang, BIM Design Lead,  
Shenzhen Municipal Design & Research Institute Co., Ltd.



Bentley BIM system will bring us a qualitative change, and 3D design will be achieved. JSTI will also get ready to meet the arrival of the big data era.

— Qingguo Ben, Deputy President, Special Bridge Institute, JSTI Group

## JSTI Group

Xuzhou, Jiangsu, China

### *Xuzhou Yingbin Road Rapid Retrofit Project*

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The CNY 3.78 billion Xuzhou Yingbin Road Rapid Retrofit Project will alleviate congestion on the main connector route for Xuzhou City in Jiangsu, China. The combined length of the 10.18-kilometer project area encompasses a 6.8-kilometer viaduct section, a 1.26-kilometer ground section, seven entrances and exits, and three grade-separated junctions. Xuzhou City Transportation Bureau selected JSTI Group to design the retrofit and develop a construction management platform.

JSTI adopted a BIM approach using Bentley software to solve the project's technical challenges. The technology decreased the error rate by 95 percent, reduced review and modify time by 60 percent, saved nearly CNY 1 million in design costs, and achieved millimeter-level accuracy in the construction models. Using BIM technology for 5D construction simulation added the dimensions of quantity, cost, and schedule, making the MicroStation-based platform an effective management solution.

**Project Playbook:** ContextCapture, Descartes, gINT®, LumenRT, MicroStation, OpenBridge Modeler, OpenRoads Designer, OpenRoads Navigator, ProjectWise

## GS E&C Corporation

Gwangyang, Jeolla-Namdo, South Korea

### *Jungkun-Jinjeong Bypass (Sueo-chon Bridge)*

The USD 27.5 million Sueo-chon Bridge project is part of a new 7.8-kilometer bypass connecting Jungkun and Jinjeong in Gwangyang, South Korea. A prestressed concrete box girder bridge, the main bridge spans 745.8 meters over a tidal river. GS E&C Corporation was retained as the main contractor to provide design review and construction services. Faced with revising the original bridge design and obtaining approval from the client and stakeholders, the team implemented a 3D BIM and structural analysis solution and piloted its integrated engineering platform.

The organization reviewed the original design using Bentley software, visually demonstrating its flawed structural integrity to the owner. The project team performed an efficient review of design alternatives and provided an economical redesign. Bentley applications saved USD 2.3 million in costs and resolved 245 potential clashes, shortening the construction schedule by 14.5 days.

**Project Playbook:** ContextCapture, MicroStation, Navigator, OpenBridge Modeler, OpenBuildings Designer, ProjectWise, RM Bridge





## Alabama Department of Transportation

Mobile, Alabama, United States

### *Mobile River Bridge*

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The Alabama Department of Transportation (ALDOT) was tasked with increasing capacity on Interstate-10 between the existing Wallace Tunnels and the Eastern Shore, which is experiencing some of the worst congestion in the state. The estimated USD 2 billion project required ALDOT to use integrated 3D modeling and visualization applications to simply communicate its proposal to stakeholders and the public.

With Bentley applications, ALDOT could capture 3,075 photos and use them to create a digital twin of the bridge and surrounding area. ALDOT used OpenRoads to model the project, which increased project delivery by 30 days. It allowed the team to quickly and efficiently make changes to the 3D models, reducing resource hours and keeping the project on schedule. Using ContextCapture, ALDOT reduced visualization production time by 80%. Currently in the planning stage, ALDOT is expected to begin construction in late 2020 to early 2021 and complete the project in 2026.

**Project Playbook:** ContextCapture, LumenRT, MicroStation, OpenRoads

## Xie Sheng Engineering Consultants Ltd.

Taichung City, Taiwan

*Commissioned Engineering Design and Technical Supervision Services for Pifeng Bridge Reconstruction Project in Dongshi District*

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Located in Taichung City, Taiwan the estimated TWD 520 million Pifeng Bridge reconstruction project includes redesigning a 400-meter-long, 15-meter-wide bridge in the Dongshi district. Xie Sheng Engineering Consultants designed the bridge and provided technical supervision, as well as traffic, drainage, and ground works. The team also needed to demolish the existing bridge and manage transportation during construction.

The project team used unmanned aerial vehicles for work area inspection and photography of the site, reducing surveying by one day. The images were then uploaded into ContextCapture to create a 3D model. The application revealed existing terrain conditions and helped communicate the relationship between the current situation and the proposed bridge design to the owner. The model presented the design in a clear, visual way so that nearby residents could fully understand the design concepts and results.

**Project Playbook:** ContextCapture





## Arcadis

Perth and Cockburn, Western Australia, Australia

### *Armadale Road/Northlake Road Bridge Tender*

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This proposed AUD 200 million upgrade will provide road and bridge infrastructure to support economic and regional development. Arcadis is responsible for civil and structural engineering services, including bridge tender design that required submitting two design options within a short 12-week period. To optimize design, communicate design intent, and minimize impact on area residential and commercial properties, Arcadis implemented reality modeling and visualization technology.

MicroStation facilitated reality mesh manipulation of the surrounding area, created with third-party software. Integrating LumenRT for 3D modeling and animated renderings provided accurate visualizations to illustrate how traffic congestion could be alleviated and show stakeholders how the design options would impact the local community. Using Bentley applications, Arcadis produced two simultaneous designs within the tight timeframe and demonstrated the benefits of implementing digital processes during the tender phase.

**Project Playbook:** ContextCapture, LumenRT, MicroStation, ProjectWise

## CECI Engineering Consultants, Inc., Taiwan

Changhua, Taiwan

### *Taiwan Provincial Highway 1 New Motor Lane Construction for Extension and Diversion*

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This TWD 2 million initiative includes reconstructing a bridge and elevating it to more effectively control flood instances. CECI Engineering Consultants is responsible for bridge planning, design, and supervision. The project required a BIM methodology to be implemented during construction, and a 3D model using BIM and orthophoto mapping was generated. To verify the BIM model once construction was completed, CECI used reality modeling technology.

The team used unmanned aerial vehicles to capture images of the bridge construction in half a day and ContextCapture to process the photos and generate a 3D reality mesh. The interoperability of ContextCapture with third-party software facilitated integration of the bridge BIM design model with the reality mesh. Using the construction reality mesh, CECI compared and verified the design model. Bentley's digital visualization solution demonstrated the effectiveness of reality modeling for planning, design, and construction supervision of future projects.

**Project Playbook:** ContextCapture





## Christopher B. Burke Engineering, Ltd.

Kane County, Illinois, United States

*Bentley's Reality Modeling Brings Home the Kane County Win for Christopher B. Burke Engineering*

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Illinois' Kane County initiated a USD 5.3 million project to improve two high-volume roadway intersections. Christopher B. Burke Engineering (CBBE) sought efficient workflow processes to produce a cost-effective design proposal. The project required maintaining traffic flow and preserving the surrounding roadway improvements. The team also needed to address community concerns and create an accurate 3D representation of the existing site and infrastructure.

The team used ContextCapture to process drone-captured data and integrate it with an existing engineering model. This process helped create a 3D reality mesh of the site, eliminating time-consuming data conversion. It demonstrated the project could be executed without expensive land acquisition, shortening the project by two years and saving USD 650,000. LumenRT provided rich, 3D visualizations to stakeholders and the public, improving design concept communication and accelerating acceptance by 30%. The applications helped save CBBE 80 resource hours and identify potential issues during conceptual design to save time.

**Project Playbook:** ContextCapture, LumenRT, MicroStation, OpenRoads

## Drone ID

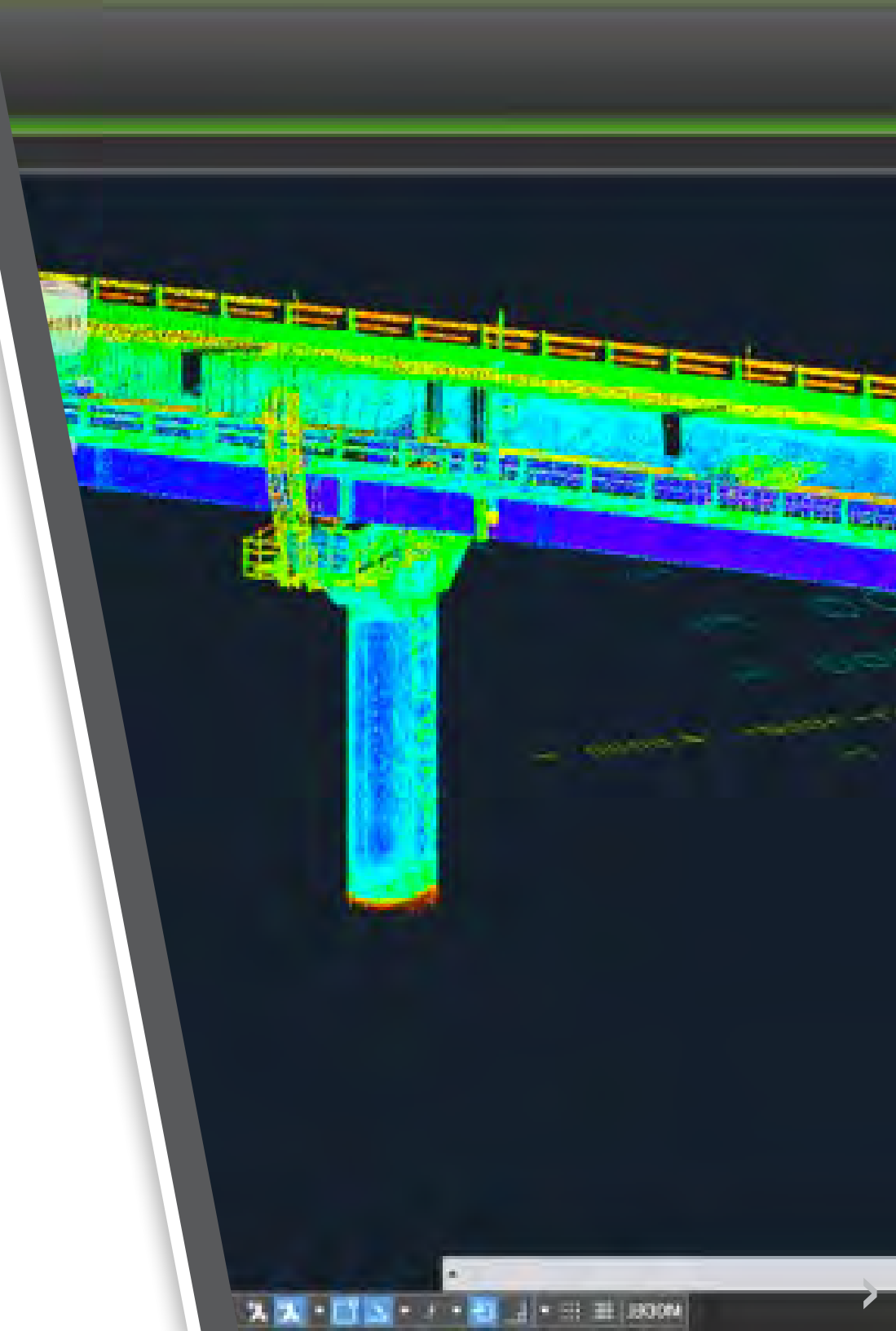
Seoul, South Korea

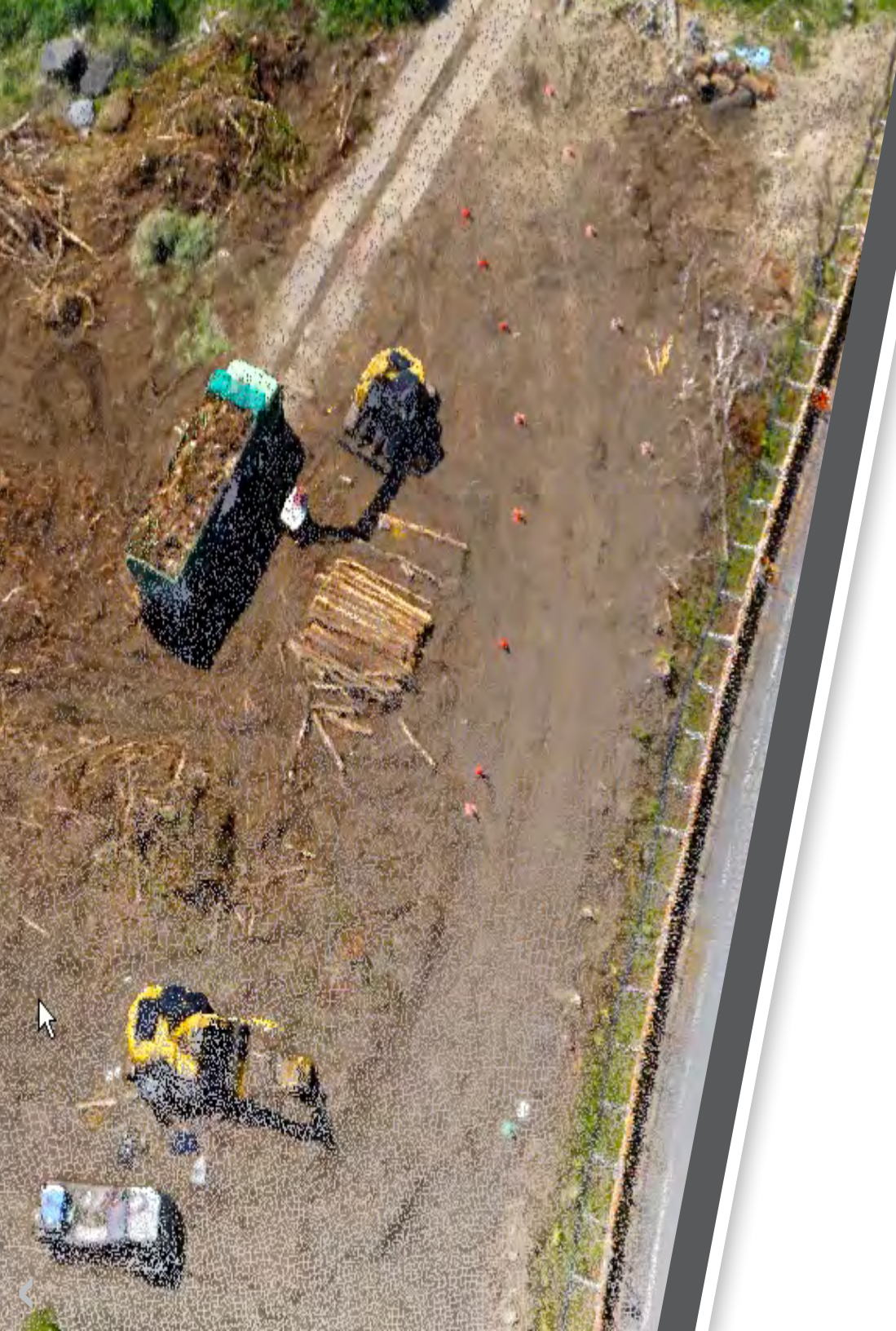
### *Installation of a 3D Model for Bridge Safety Check Using Automated Drones*

Over the next 20 years, 89% of Seoul's total infrastructure will be aged and need rehabilitation. Conventional manual methods for inspecting lower bridge portions and difficult-to-access structural areas are costly, time consuming, and unsafe for inspectors. Supporting intelligent safety inspections with artificial intelligence and digital data, Drone ID initiated a project using unmanned aerial vehicles and reality modeling to safely and efficiently check city infrastructure.

The project team used a UAV capable of 3D automated flight to capture 1,348 images, a laser scanner to obtain point clouds, and ContextCapture to process the data into a digital twin model. The integrated UAV and reality modeling solution accurately models and monitors the bridge areas that are difficult to view, identifying cracks, leaks, and other problems. The solution also predicts the progress of these defects to facilitate smart infrastructure management. Compared to time and costs for traditional, static manual methods, the return on investment increased by 75%.

**Project Playbook:** ContextCapture





## Obayashi Corporation

Minato, Tokyo, Japan

### *Expressway Renewal Construction*

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Built in 1963, the Metropolitan Expressway has deteriorated along several sections due to severe usage conditions and corrosive environments. To remodel the infrastructure for secure, long-term safety involves designing and constructing extensions totaling approximately 1,900 meters. With no original construction drawings to record and manage information for structures no longer visible after construction, Obayashi relied on 3D reality modeling to establish a digital data infrastructure lifecycle.

ContextCapture supported the integration of two types of acquired data for construction management, delivering actual positions and work progress of hidden data beneath the surface. The software helped reduce data management time by 67% and optimized the integration of asset attributes to reduce costs by 10%. The interoperability of ContextCapture facilitated semi-automated data transfer with third-party infrastructure maintenance technology.

**Project Playbook:** ContextCapture

## Ratio Engineering Corp., Ltd.

Tainan, Taiwan

### *Taiwan 19A Xinhua Outer Ring Road Project*

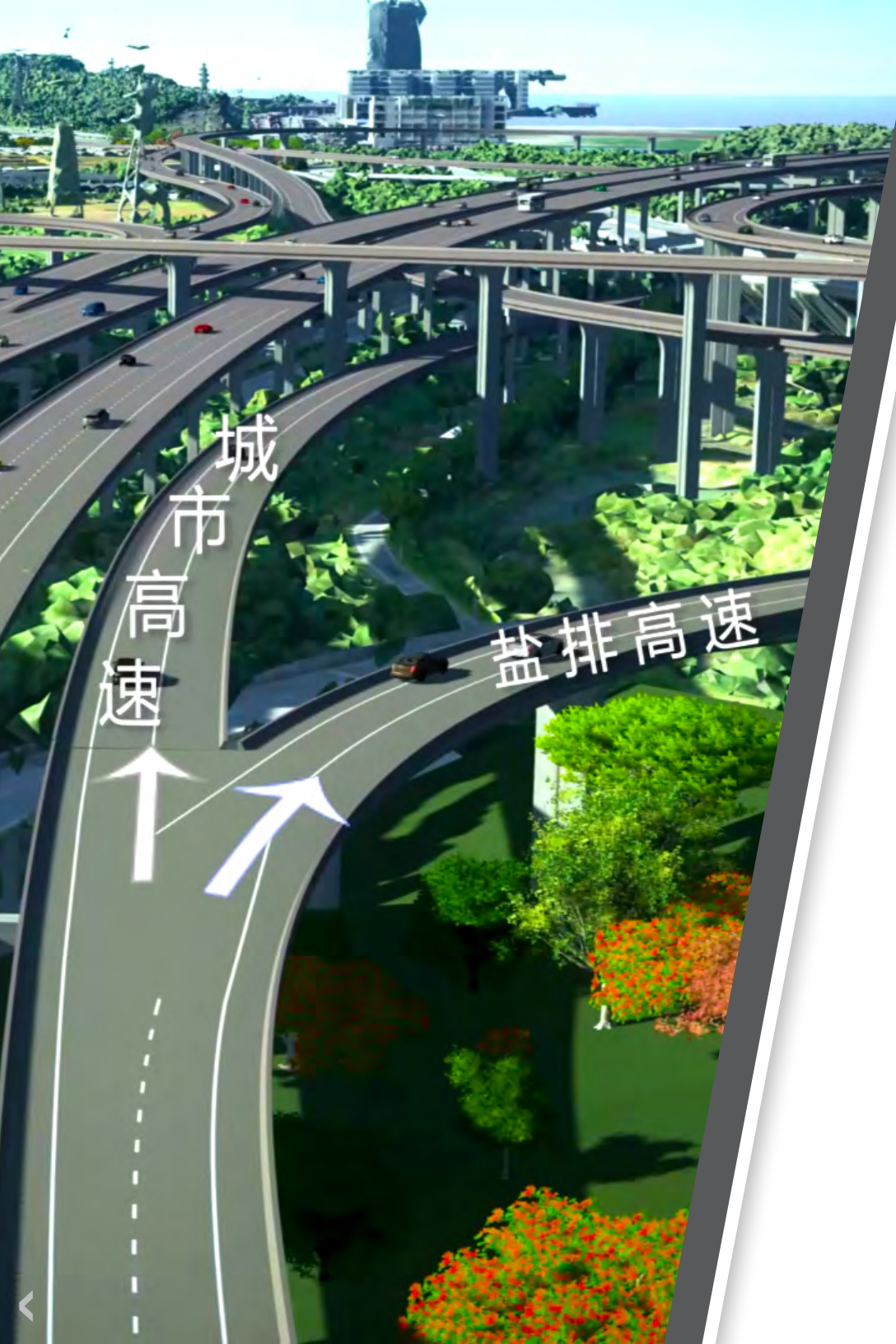
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The North Outer Ring Road is being built along the Yanshuei River to alleviate traffic congestion and shorten driving time between Southern Taiwan Science Park and the center of Tainan. A mostly elevated roadway with four-lane traffic, the planned 2.7-kilometer eastern section of the roadway will avoid overuse of the Zhongzheng Road in the Xinhua district. The project presented complicated site conditions to accommodate the elevated sections. Ratio Engineering adopted reality modeling during the bidding stage to better understand the existing site conditions.

The project team used ContextCapture to create a 3D reality mesh of the site and accurately assess the construction environment, reducing errors when estimating the project budget. Using the software enabled the owner to visualize and understand the construction process. Bentley's comprehensive reality modeling application helped the company win the project contract and establish a digital context for the entire construction process.

**Project Playbook:** ContextCapture





## CCCC First Highway Consultants Company Limited

Shenzhen, Guangdong, China

*Application of BIM Design on the Expansion of JiHe Expressway*

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Located amid a dense road network, this large-scale municipal initiative is a 3D reconstruction and extension of the JiHe Expressway in Shenzhen, Guangdong, China. The CNY 45 million project involved multiple engineering disciplines and presented site and design challenges. CCCC First Highway Consultants Company was tasked with improving coordination and management while optimizing design.

The project used ProjectWise to manage and streamline workflows, saving 33 days. Unmanned aerial vehicles and ContextCapture helped capture images and create a reality model along the 43-kilometer line, reducing survey time by 42 days and saving nearly CNY 8 million. OpenRoads enabled the development of BIM models of roads, bridges, and landscaping, improving design quality and efficiency and shortening the design cycle by 68 days to save CNY 20 million. Bentley applications facilitated dynamic comparative analysis of the current environment and design scheme, industrializing project delivery.

**Project Playbook:** ContextCapture, LumenRT, MicroStation, OpenCities™ Map, OpenRoads, ProjectWise, SYNCHRO®

## Chongqing Communications Planning Survey & Design Institute; Guizhou Communications Construction Group Co., Ltd.

Zunyi, Guizhou, China

### *Integrated Application of BIM in Meitan-Shiqian Expressway*

The Meitan-Shiqian Expressway runs a total length of 112.9 kilometers with almost 55% of the line comprised of bridges and tunnels. A large-scale project featuring numerous existing structures amid complex topography and geology, the CNY 17.88 billion initiative presented engineering design and construction management challenges. The project team needed to create a BIM model to improve construction and full lifecycle management.

Unmanned aerial vehicles were used to survey the existing site while ContextCapture helped develop a 3D reality model to accelerate design optimization, shortening the construction period by 89 days. Using OpenRoads to build a multidiscipline BIM model helped identify more than 100 collisions prior to construction. Integrating LumenRT provided an immersive, virtual experience for builders to better understand design intent. The 3D BIM model helped accumulate 61 gigabytes of digital asset data, establishing a digital twin for future operations and maintenance.

**Project Playbook:** ContextCapture, LumenRT, MicroStation, OpenBridge, OpenRoads, ProStructures





## Christopher B. Burke Engineering, Ltd.

Kane County, Illinois, United States

*Christopher B. Burke Engineering, Ltd.  
Delivers \$650K in Savings to Kane County  
Using Bentley Innovations*

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The Illinois Kane County Division of Transportation initiated a USD 5.3 million project to improve two high-volume roadway intersections. Christopher B. Burke Engineering (CBBE) sought to produce a cost-effective design proposal. The project required that traffic flow be maintained and that alternative modes of nonvehicular transport be addressed and ADA compliant. CBBE also needed to obtain community and stakeholder approval and create an accurate 3D representation of the existing site.

ContextCapture, LumenRT, OpenRoads, and MicroStation helped design an optimal engineering solution within 10 days, ultimately saving approximately USD 650,000. Leveraging Bentley applications, CBBE generated various 3D model iterations for real-time effective evaluation. The team delivered a conceptual design that fit within the project footprint, eliminating the need for land acquisition to save approximately two years and associated costs. Using Bentley applications enabled CBBE to optimize design and visually demonstrate its winning proposal, accelerating consensus among stakeholders and the community by 30%.

**Project Playbook:** ContextCapture, LumenRT, MicroStation, OpenRoads

## PT. Wijaya Karya (Persero) Tbk.

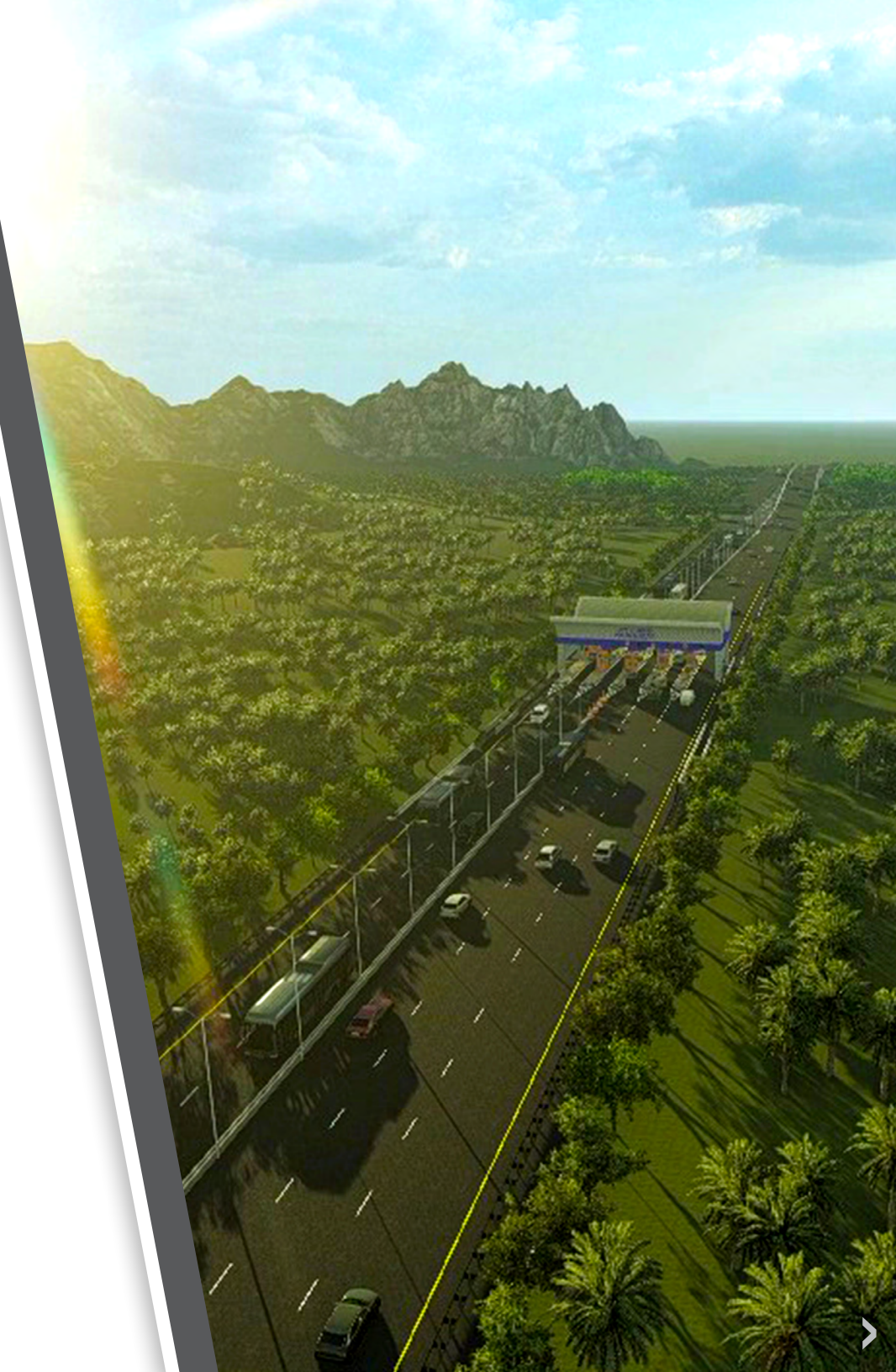
Pekanbaru, Riau, Indonesia

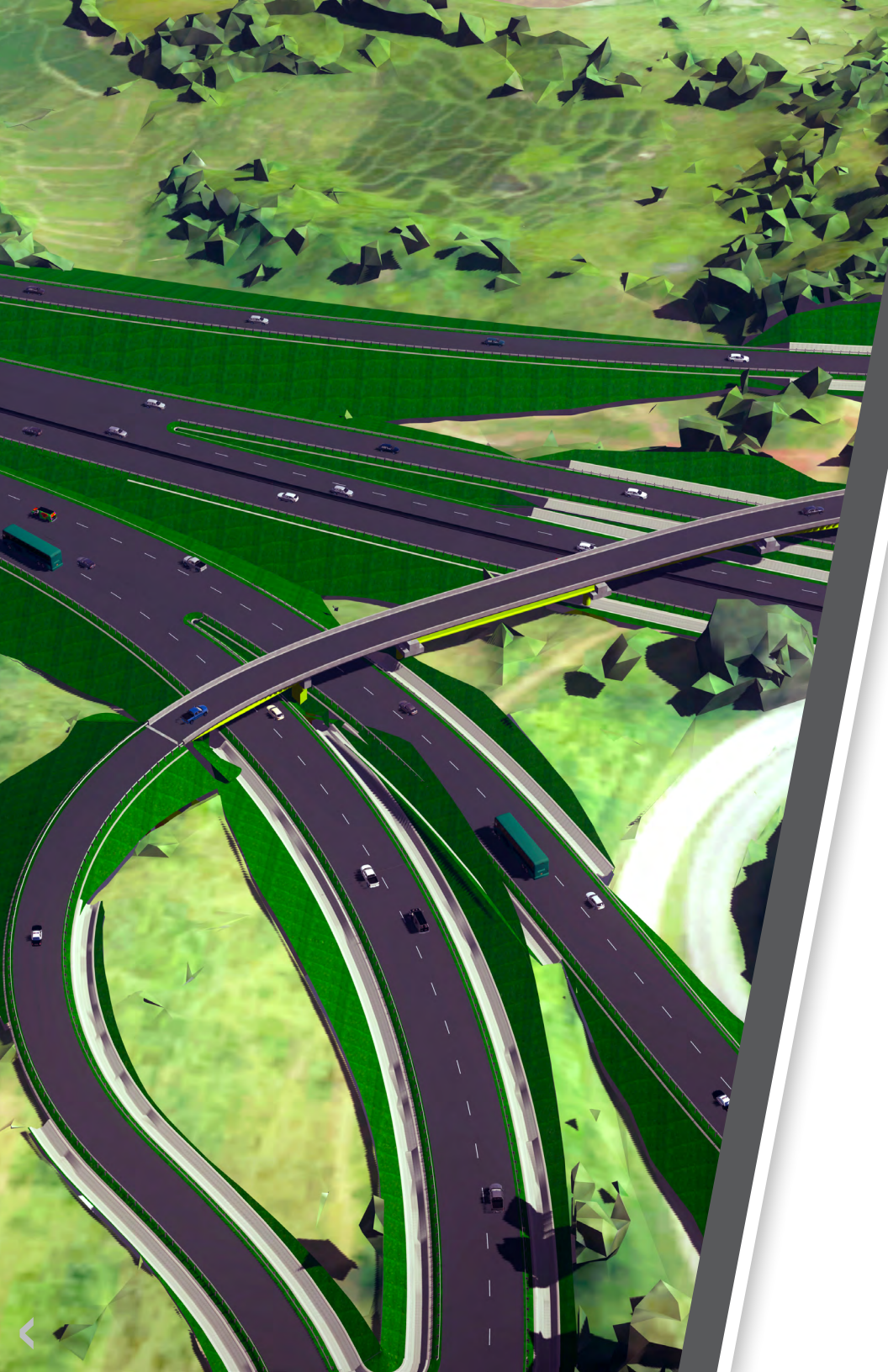
### *Design and Digital Construction of the Padang-Pekanbaru Highways Project Section Bankinang-Padang*

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.

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





## PT. Wijaya Karya (Persero) Tbk.

Purwakarta, Jawa Barat, Indonesia

*Jakarta-Cikampek Selatan II Paket 3*

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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.

WIKA used ContextCapture, 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:** ContextCapture, LumenRT, OpenBridge, OpenBuildings Designer, OpenRoads

## Sharjah Road and Transport Authority

Sharjah, United Arab Emirates

### *Khor Fakkan Road R1000*

Khor Fakkan Road is an 89-kilometer highway that will link Sharjah and the eastern region of Khor Fakkan, shortening the drive between the cities from two hours to 45 minutes. The USD 1.65 billion project includes five tunnels and runs through mountainous terrain, requiring 7 million cubic meters of earthworks. Sharjah Road and Transport Authority relied on Bentley's reality modeling and engineering software to deliver the project.

The company used ContextCapture and OpenRoads to survey and design the project, saving time and minimizing risk during construction. Using Bentley's integrated applications optimized design and construction planning, resulting in timely delivery within budget. The 3D and reality modeling solution enabled a 30-kilometer section of the highway to be constructed in a record five-month time period.

**Project Playbook:** ContextCapture, OpenRoads





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## About Bentley Systems

Bentley Systems is a leading global provider of software solutions to engineers, architects, geospatial professionals, constructors, and owner-operators for the design, construction, and operations of infrastructure. Bentley's MicroStation-based engineering and BIM applications, and its digital twin cloud services, advance the project delivery (ProjectWise) and the asset performance (AssetWise) of transportation and other public works, utilities, industrial and resources plants, and commercial and institutional facilities.

Bentley Systems employs more than 3,500 colleagues and generates annual revenues of more than \$700 million in 172 countries. From inception in 1984, the company has remained majority-owned by its five founding Bentley brothers.

For additional information, visit [www.bentley.com](http://www.bentley.com).

## About ContextCapture

ContextCapture is Bentley's reality modeling software that can quickly produce 3D models of existing conditions for infrastructure projects of all types, derived from simple photographs and/or point cloud. Without the need for expensive or specialized equipment, ContextCapture enables users to quickly create and use these highly detailed 3D engineering-ready reality meshes to provide precise real-world context for design, construction, and operations decisions throughout the lifecycle of projects. Project teams can easily and consistently share reality modeling information, consumable and accessible, on desktop and mobile devices, in many formats, including native use within MicroStation for any engineering, operations, maintenance, or GIS workflow.

For additional information, visit [www.bentley.com/ContextCapture](http://www.bentley.com/ContextCapture).