

# Built to last, built to adapt

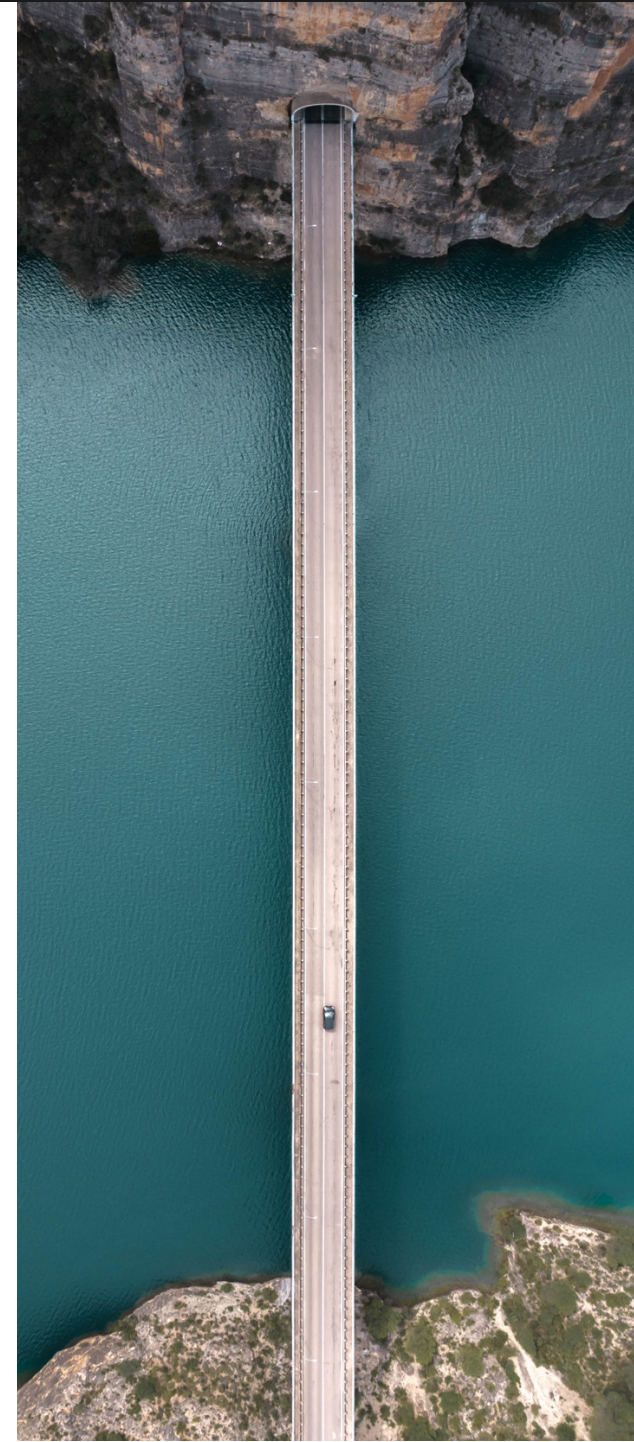
How digital integration is transforming bridge  
and tunnel infrastructure



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## Bridges and tunnels today

Infrastructure owners and stakeholders face unprecedented challenges in developing, maintaining, and operating bridge and tunnel assets. From aging infrastructure and climate change to urbanization and limited budgets, the demand for resilient, sustainable, and long-lasting infrastructure has never been more urgent.

Bridges and tunnels serve as critical lifelines—supporting mobility, connecting regions, and fueling economic growth. Designing and maintaining these assets safely and efficiently requires deep domain expertise and specialized technology tailored to the unique complexities of bridge and tunnel engineering.

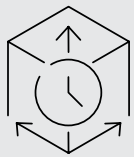
This e-book explores how Bentley's discipline-specific software—purpose-built for bridge and tunnel design—empowers infrastructure professionals across the asset lifecycle. These solutions are not generic tools, but deeply integrated capabilities that support structural modeling, geotechnical simulation, construction sequencing, and asset performance management. They are developed in close collaboration with engineers who work on bridge and tunnel projects every day.

By adopting Bentley's iTwin-powered digital twin approach, stakeholders can make better decisions, improve asset reliability, reduce environmental impact, and extend the life of their infrastructure.

With an end-to-end ecosystem designed specifically for bridge and tunnel delivery, teams are equipped to deliver high-performing infrastructure—on time, on budget, and built to last.

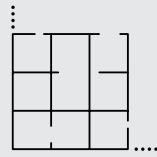


# Five major challenges driving the need for smarter bridge and tunnel infrastructure



## Aging infrastructure under rising demand

Most bridges were built over 50 years ago and are functionally obsolete. They're handling more traffic, heavier loads, and new requirements for safety, accessibility, and resilience. In the U.S. alone, over 220,000 bridges need major work. Meanwhile, tunnel systems face similar issues, with outdated ventilation, aging lighting, and safety systems struggling to meet modern standards.



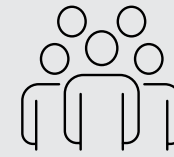
## Disconnected design and construction

Bridge and tunnel projects still rely on disconnected workflows where geometry gets rebuilt multiple times, design intent is lost, and data doesn't flow between disciplines. Road alignments, structural spans, and foundation models often exist in separate systems, creating misalignment that leads to costly rework, schedule delays, and budget overruns during construction.



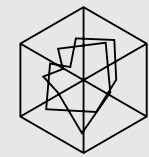
## Complex subsurface uncertainty

Tunnel projects frequently encounter unexpected ground conditions that derail budgets and schedules. Limited visibility into soil conditions, water tables, and geological risks means construction teams face costly surprises. Even bridge foundations can hit unexpected subsurface challenges that require expensive design changes and construction modifications.



## Skills shortages and capacity gaps

The infrastructure sector faces a growing talent shortage just when bridge and tunnel needs are highest. Experienced engineers are retiring faster than new talent joins the field. Teams are stretched thin across multiple projects, making it crucial to work as efficiently as possible with automated workflows and intelligent design tools.



## Climate resilience and budget pressure

New bridges and tunnels must withstand extreme weather, flooding, seismic events, and temperature variations while meeting sustainability goals. These requirements increase design complexity and construction costs. At the same time, budgets are tight and accountability for carbon emissions and lifecycle performance is higher than ever.



# Transform your bridge and tunnel challenges into opportunities with Bentley's connected infrastructure platform



## Build resilient infrastructure faster

Bentley's integrated modeling environment lets you design bridges and tunnels together with road corridors in a single shared model. This eliminates geometry rebuilding and preserves design intent from concept through construction. You can rapidly iterate on complex curved spans, variable tunnel profiles, and challenging foundation conditions while ensuring that everything stays coordinated.



## Connect disciplines across the lifecycle

Our platform breaks down silos between road, bridge, tunnel, and rail teams. Soil profiles inform both bridge foundations and tunnel linings. Rail alignments feed directly into bridge and tunnel models. Construction simulation spans all elements without data conversion. This integration reduces errors, speeds delivery, and improves project outcomes.



## Minimize subsurface risk

The sole focus and deepest expertise of Seequent, the Bentley Subsurface Company, is understanding subsurface conditions. Geotechnical data, such as borehole logs, geological surveys, and ground investigation results, are seamlessly integrated into design models—enabling more informed decisions and reducing risk across the project lifecycle.



## Maximize team productivity

Automated design workflows, AI-driven condition assessment, and generative design capabilities help smaller teams accomplish more. Smart components accelerate routine tasks while powerful analysis tools handle complex scenarios. This lets your experienced engineers focus on high-value design decisions instead of repetitive modeling work.



## Ensure long-term performance

Digital twins connect design models with real-world performance data throughout the asset lifecycle. Inspection data flows back into the original design model, enabling predictive maintenance, condition forecasting, and data-driven renewal strategies. This extends asset life while reducing long-term costs and improving safety.

# Solutions made specifically for bridges and tunnels— aboveground and belowground

Put these opportunities into action with Bentley's infrastructure engineering software, designed for the unique challenges of bridge and tunnel infrastructure from initial concept through decades of operation.



## Design

Create integrated bridge and tunnel designs that coordinate with road and rail corridors from a single source of truth.



## Construction

Deliver complex projects safely and on schedule with 4D sequencing and real-time progress tracking.



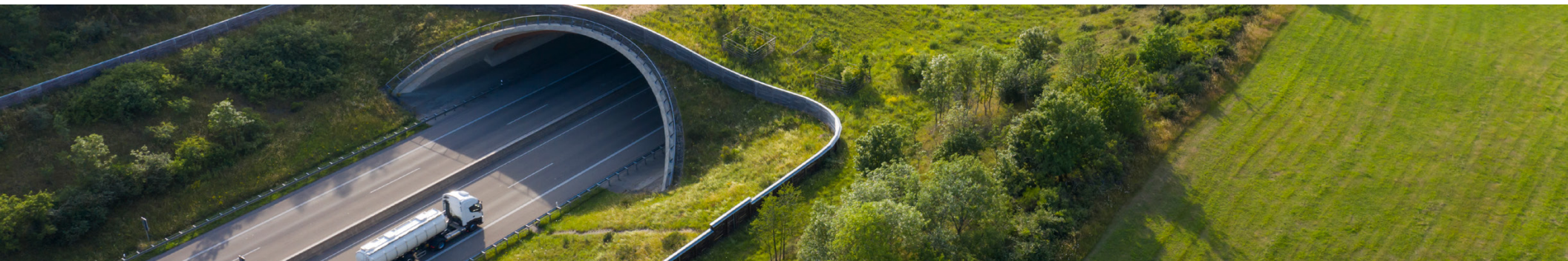
## Operations

Monitor performance and manage maintenance with intelligent asset management and condition assessment.



## Lifecycle management

Extend asset life and optimize performance with predictive analytics and digital twins.



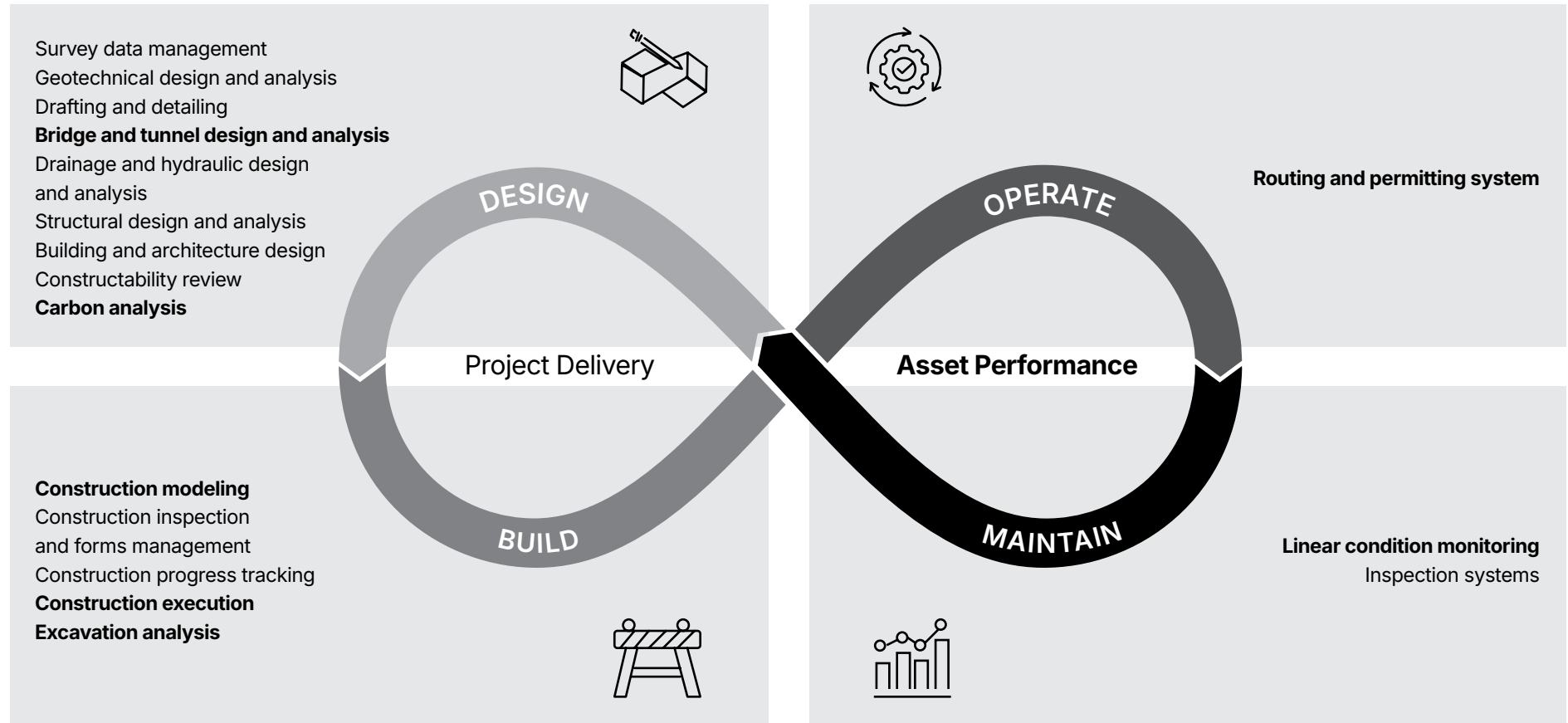
# Bridge and tunnel solutions

## Full lifecycle

Document management system  
**Connected data environment**  
 Geographic information systems (GIS)  
 Engineering geological modeling

Mobility simulation  
 Geotechnical data management  
 Requirements/compliance management  
**Condition monitoring system (IoT)**

Enterprise data management  
 Reporting and dashboarding system  
**Imagery and field data collection management**





# Design solutions made for bridge and tunnel infrastructure

With Bentley's comprehensive bridge and tunnel design platform, you can create coordinated designs that integrate seamlessly with transportation corridors. Our geometry-driven approach handles complex curved alignments, variable cross-sections, and challenging subsurface conditions while keeping all disciplines synchronized throughout the design process.

**Accelerate complex geometry** – Rapidly model curved bridge spans, complex tunnel profiles, and variable girder depths with parametric design tools that automatically update connected elements when changes are made.

**Integrate subsurface intelligence** – Bring geotechnical data directly into structural models so foundation designs, tunnel support systems, and earth retention work from accurate ground conditions.

**Ensure code compliance** – Automated code checking and analysis ensure designs meet requirements from the start, reducing review cycles and late-stage changes.

## Solutions:

- Survey data management
- Geotechnical design and analysis
- Structural design and analysis
- Bridge design and analysis
- Tunnel design and analysis
- Drainage and hydraulic design
- Building design and constructability review
- Carbon analysis





## Design solutions in action

### JMT untangles a long-congested river crossing with 3D modeling and a digital twin

Bentley applications helped to deliver models with a high level of detail and keep numerous stakeholders informed.

- Previous attempts at solving traffic problems on I-95 above the Rappahannock River failed due to stakeholder concerns.
- JMT used Bentley applications to create a digital twin of the project reaching the high level of detail required.
- The connected data environment and the intuitive digital twin eased concerns and ensured the project met the deadline.

[Read the case study](#)

### Arcadis leverages digital modeling and analysis to deliver iconic lifting footbridge in London

Bentley and Seequent software helped create a functional yet aesthetically striking design within a bustling financial district.

- Using Bentley's solutions as a single source of truth improved productivity by 20%.
- Producing an accurate digital representation of the site's subsurface reduced the ground investigation scope by around 30%, saving more than GBP 70,000.
- Digital connectivity increased data efficiencies for design cost savings of about 1,000 hours.

[Read the case study](#)

### Tecne Systra improves safety and sustainability of Italy's Autostrade tunnels

Bentley's OpenTunnel® Designer helped reduce project delivery time by 21.5%, saving EUR 26,600.

- Leveraging Bentley's advanced modeling tools reduced design time by 21.5%, significantly cutting costs.
- Bentley's solution improved data interpretation efficiency by 35%, enabling faster and more accurate project execution.
- Digital workflows optimized structural interventions, extended infrastructure life, and reduced waste, contributing to more sustainable engineering practices.

[Read the case study](#)

[Watch the video](#)

# Construction solutions

Bridge and tunnel construction demands precise sequencing, safety coordination, and real-time progress tracking. Bentley's 4D construction modeling and project delivery platform helps you plan complex builds virtually first, coordinate across multiple contractors, and track progress in real-time to keep projects on schedule and within budget.

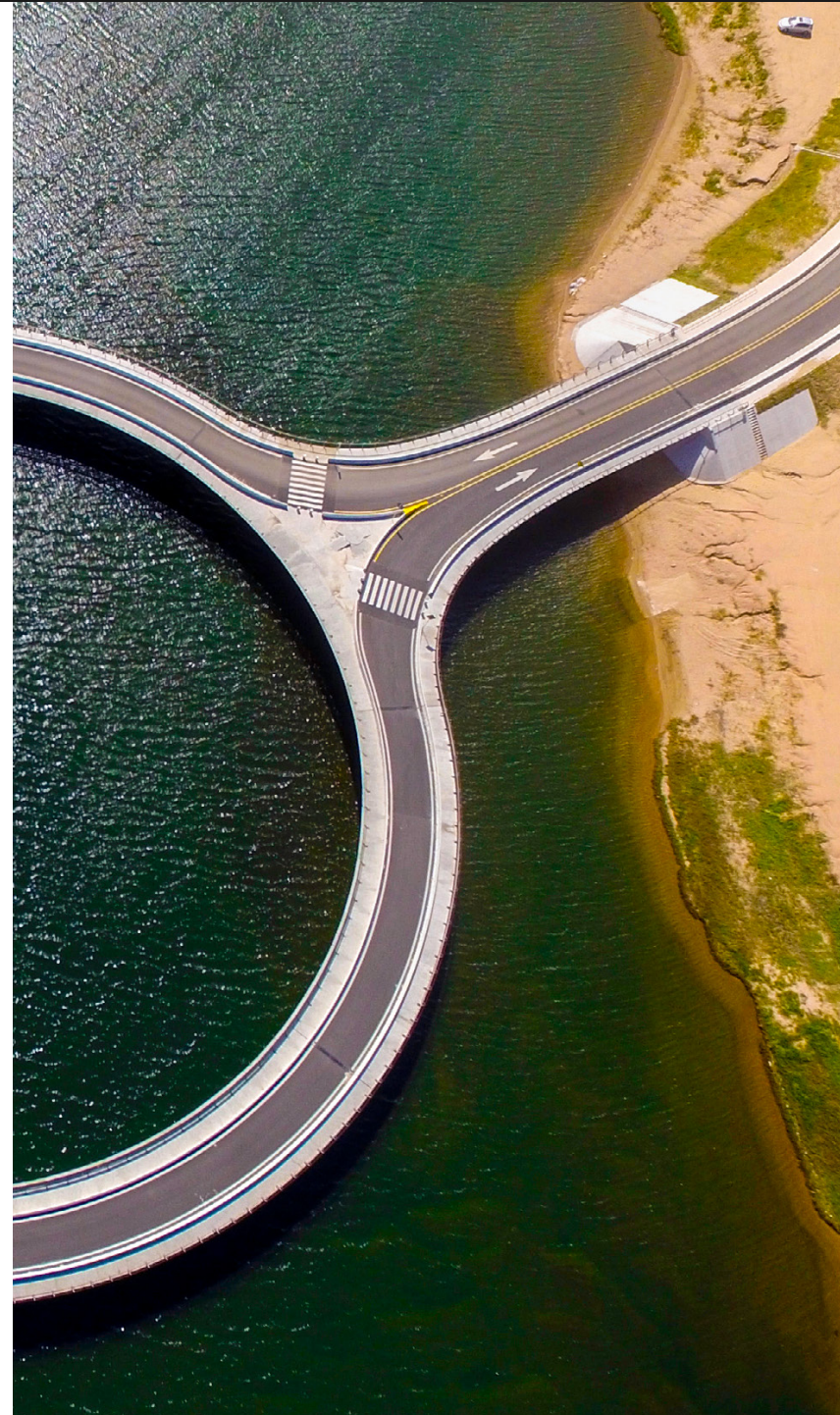
**Plan complex sequences** – Model bridge deck pours, tunnel segment installation, and utility coordination in 4D to identify conflicts before they happen on site.

**Coordinate multiple disciplines** – Bring geotechnical data directly into structural models so that foundation designs, tunnel support systems, and earth retention structures are based on accurate ground conditions.

**Track progress in real time** – Monitor construction progress against planned schedules with visual dashboards that highlight delays before they impact critical path activities.

## Solutions:

- Construction modeling
- Construction progress tracking
- Construction inspection and forms management
- Construction execution
- Excavation analysis





## Construction solutions in action

### WSP drives Victoria's transformational and sustainable transport initiatives with Parkdale level crossing removal

Bentley's digital twin technology optimized material usage, reducing resource hours by 15% and the carbon footprint by 30%.

- Working in a connected data environment saved approximately 300 resource hours.
- Integrated digital approach optimized data management and streamlined workflows, reducing modeling time by 60%.
- WSP optimized material usage and reduced carbon footprint by 30%.

[Read the case study](#)

Image courtesy of WSP Australia Pty. Ltd.



# Maintenance and rehabilitation solutions

Managing bridge and tunnel assets requires continuous monitoring, predictive maintenance, and rapid response to changing conditions. Bentley's AI-powered inspection and asset analytics platform helps you shift from reactive maintenance to predictive management, extending asset life while improving safety and reducing costs.

**Predict maintenance needs** – AI analysis of inspection data identifies deterioration patterns and predicts when maintenance will be needed, allowing you to plan and budget more effectively.

**Accelerate condition assessment** – Automated analysis of drone imagery, sensor data, and visual inspections quickly identifies issues across large bridge and tunnel portfolios.

**Optimize resource allocation** – Data-driven insights help prioritize maintenance spending on assets with the highest risk and greatest impact on network performance.

## Solutions:

- Linear condition monitoring
- Inspection systems
- Maintenance management systems
- Asset performance monitoring
- Routing and permitting systems





## Maintenance and rehabilitation solutions in action

### Qk4 revolutionizes bridge survey program, saving Kentucky USD 300 million

OpenRoads and ProjectWise enable 90% reduction in bridge survey time, accelerating critical infrastructure repairs across Kentucky.

- By implementing Bentley applications, Qk4 reduced survey processing time by 50% and overall program costs by USD 380 million.
- The team saved USD 3.5 million in survey costs alone, eliminating approximately 20,000 land survey hours.
- Survey costs per bridge reduced from USD 24,440 to USD 14,220.

[Read the case study](#)[Watch the video](#)

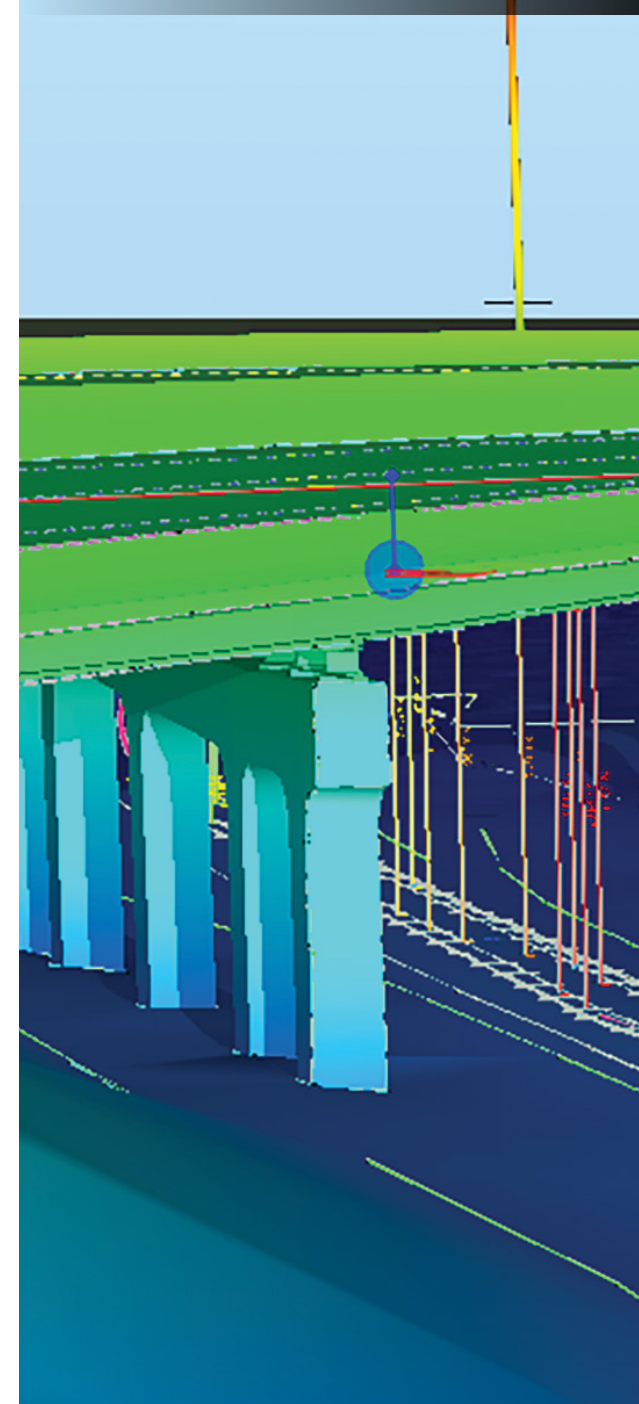
### Collins Engineers sets new bridge inspection standard with iconic Robert Street Bridge

Bentley's iTwin® Capture and iTwin® Experience creates a digital twin to cut down site time by 20%.

- Artificial intelligence compensated for fewer workers in the field by cutting down on the overall time and labor required on site, yielding over USD 90,000 in savings.
- Information sharing via the digital twin will result in up to USD 15 million in savings for MnDOT and a 10% reduction in materials used during the construction process.

[Read the case study](#)[Watch the video](#)

Image courtesy of QK4, Inc.



# Build what's next

## Connecting the future: Smart solutions for bridge and tunnel infrastructure

The challenges facing bridge and tunnel infrastructure today are significant, but they create opportunities for smarter, more connected approaches to design, construction, and operations. With Bentley's integrated platform, you can transform how you deliver infrastructure projects while building assets that adapt to future needs.

Our solutions connect every phase of bridge and tunnel projects—from initial concept through decades of operation. By breaking down silos between disciplines and enabling data to flow throughout the asset lifecycle, you can reduce risk, accelerate delivery, and create more resilient infrastructure.

Whether you're designing complex bridge-tunnel-rail intersections, constructing in challenging urban environments, or managing aging tunnel networks, Bentley provides the tools you need to succeed in today's demanding infrastructure environment.

**The future belongs to an infrastructure that's not just built to last, but built to adapt. Connect with us to see how we can help you build what's next.**

**Contact us today**

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