Roadways Reimagined

Innovative Solutions for More Resilient Infrastructure

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Roads and highways today

Roads and highways are essential to our communities, connecting us to people and places with routes for drivers, dedicated lanes for cyclists, corridors for public transportation, and safe walkways for pedestrians. More than that, they drive our economies forward. By facilitating trade, creating jobs, and promoting regional growth, roadways help businesses flourish and societies thrive.

But our road infrastructure is deteriorating, more people are using it than ever, and natural disasters and extreme weather events are beginning to take their toll. Combined, these factors are creating greater demand for safer and more resilient roads, including both new construction and rehabilitation.

And if that wasn't enough, not only is there a shortage of infrastructure professionals, but also the asset lifecycle is full of disconnected data and inefficient workflows, making it difficult to keep up with current and future road infrastructure demands.

There's no denying that these are significant challenges to overcome, but it is possible if you rethink how you design, build, and maintain the world's roadways.

Main drivers for change

There are five major challenges driving the need to change the way you design, build, and maintain roadways.

Rising demands on aging roadways

Our existing road networks were designed and constructed decades ago. Now, stretched beyond their limits, they are expected to handle more traffic, function more efficiently, and meet broader accessibility, equity, and safety goals. At the same time, these aging roadways are also becoming more vulnerable to natural disasters, extreme weather, and everyday wear and tear, resulting in greater safety risks and economic concerns.

Disconnected data and workflows

The project delivery process is still largely achieved through disconnected systems and static file handovers. This method creates data silos across the asset lifecycle and a significant loss of information at each handover point. As a result, problems such as misinterpreted design intent, construction misalignment, late-stage changes and rework, schedule delays, and project cost overruns are not uncommon.

Workforce gaps and shortages

From planning and designing to building and maintaining roadways, workforce gaps and shortages are a major challenge for everyone involved, often leading to significant impacts, such as project delays and higher costs. Despite this challenge, the sector is still expected to meet current and future road infrastructure demands, making it more important than ever to work in the most efficient and productive ways possible.

Unknown ground conditions

It's common for unknown ground conditions to cause issues during projects, but that doesn't make them any less troublesome. These subsurface surprises often happen at the most critical stages of construction, causing delays, increased costs, and safety hazards. Even a small problem underground can turn into a major headache aboveground. Without the right tools, these problems are nearly impossible to avoid.

Budget pressures for future roads

Adapting road infrastructure to withstand extreme weather, comply with new standards, and support sustainable travel modes is essential for maintaining the safety and functionality of our road systems. However, these adaptations often lead to increased costs in design, construction, and maintenance. By utilizing the right tools and technologies, you can develop smarter, more cost-effective, and durable road networks.

Transform challenges into opportunities

Transform your road and highway industry challenges into opportunities with Bentley, the software company for infrastructure engineers.

Maintain safe and reliable roadways

Bentley's asset analytics makes it easier to evaluate roadway conditions, reducing manual work. By continuously assessing your roads, you can predict failures and perform proactive maintenance. And with real-time data analysis, you can detect issues automatically, improving the reliability of aging infrastructure. Additionally, you can rapidly assess damage after natural disasters, enabling communities to rebuild faster.

Connect people and data across the lifecycle

Our open data ecosystem enables you to connect, combine, manage, and share data from various sources, no matter the format. This ecosystem not only prevents information loss across the asset lifecycle, but also ensures data accuracy and integrity, empowering engineers and infrastructure professionals to easily collaborate, accelerate workflows, and leverage data for faster insights and better-informed decisions.

Boost productivity and efficiency

Many infrastructure professionals are turning to advanced technologies to close their capacity and skills gap, and for good reason. For example, Bentley's automated workflows, AI-driven capabilities, and generative design tools can be used across the infrastructure lifecycle to help you reduce tedious, manual, and repeatable work, resulting in empowered teams who can achieve more, all while reducing errors.

Know the subsurface at every project phase

With earth modeling, analysis, data management, and collaboration software, you can unlock a common understanding of ground conditions. This enables seamless collaboration with transportation engineers and construction teams across the infrastructure lifecycle, so you can optimize resources, improve environmental benefits, and deliver projects with greater certainty, achieving better all-around outcomes.

Adopt smart systems for better roadways

By integrating 3D geospatial data into Bentley's digital twins, you can deliver safer and more resilient road projects, faster. Using a continuously updated digital twin lets you visualize, monitor, and manage assets in real-time, improving decision-making across the lifecycle. And applying AI allows quick data analysis to predict maintenance needs and detect issues early, reducing downtime, cutting costs, and improving road safety and reliability.

Solutions made specifically for roads and highways – above and below ground

Put these opportunities into action at your organization with Bentley's solutions made specifically for roads and highways—from planning and design to construction and maintenance.

Design
Go from complex requirements to optimized designs and better project outcomes, faster.

Construction
Safely deliver more sustainable projects on schedule and within budget, every time.

Maintenance
Proactively manage and maintain safer roadways faster and cost-effectively.

Lifecycle management
Create sustainable and resilient systems that adapt to the changing needs of society.

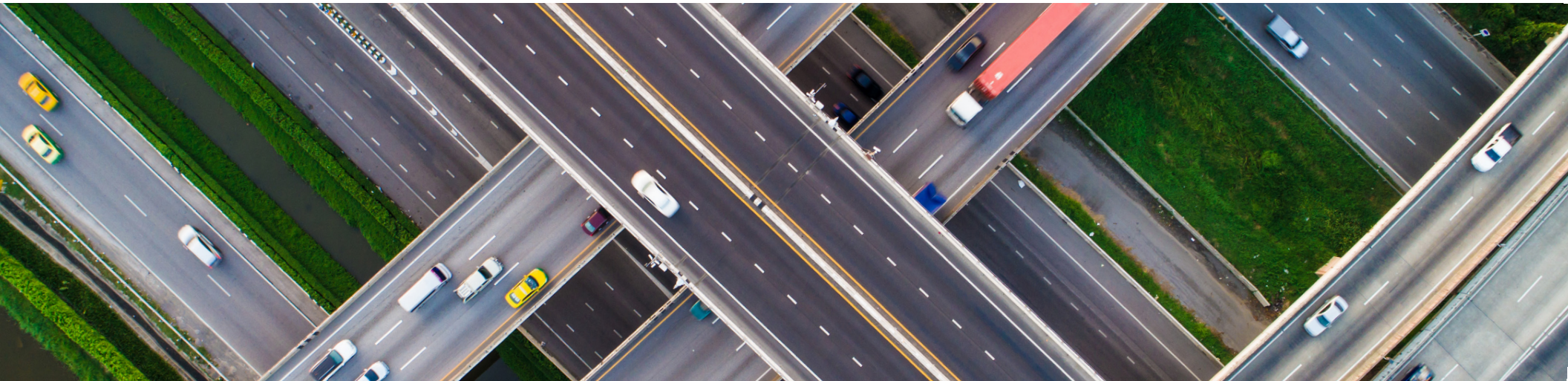
Design solutions

With our comprehensive and dynamic road and highway design solutions, you can foster a transparent, collaborative, and insight-driven project delivery process that continues to add value through construction and into maintenance. As a result, you'll be able to boost design productivity and efficiency, create optimized and resilient road designs faster, and deliver better, more sustainable project and asset outcomes – above and below ground.

- **Improve design collaboration –** Make better-informed decisions by collaborating across design disciplines within a unified model that incorporates data from multiple sources.
- **Accelerate design and documentation –** Streamline and automate your design processes and leverage AI-driven capabilities to ensure designs meet requirements from the start.
- **Simplify data handovers –** Access, share, and reuse trusted and secure design data across the lifecycle to enhance construction and optimize roadway maintenance.

Solutions

- Survey data management
- Geotechnical design and analysis
- Drafting and detailing
- Road design and analysis
- Signaling and signage design
- Drainage and hydraulic design and analysis
- Structural design and analysis
- Building and architecture design
- Constructability review
- Carbon analysis



Design solutions in action

Beca uses 3D design and a collaborative environment on Takitimu North Link.

The project:
The Takitimu North Link project aims to improve safety, access, and travel options in the rapidly growing western Bay of Plenty region in New Zealand via a 14-kilometer corridor connecting Tauranga and Ōmokoroa. The project, led by the Fulton Hogan/HEB joint venture with Beca as the lead design consultant, faces geological challenges requiring careful design and construction.

The challenges:
The development area was a very constrained corridor running through productive horticulture and farmland, limiting development options. As the design teams gathered and incorporated data, project needs and details greatly changed, requiring quick adaptation. In addition, Beca also prioritized sustainability and construction efficiency, aiming to reduce the project's impact.

The results:

- Streamlined digital workflows allowed teams to consider more options, which reduced tender costs and **improved design efficiencies by 20%.**
- Collaboration and interoperability helped Beca realize significant savings during the design phase.
- Detailed geological insight in the design will help builders to reuse all excavated material, eliminating the need to use heavy equipment to remove material or import fill to the site.

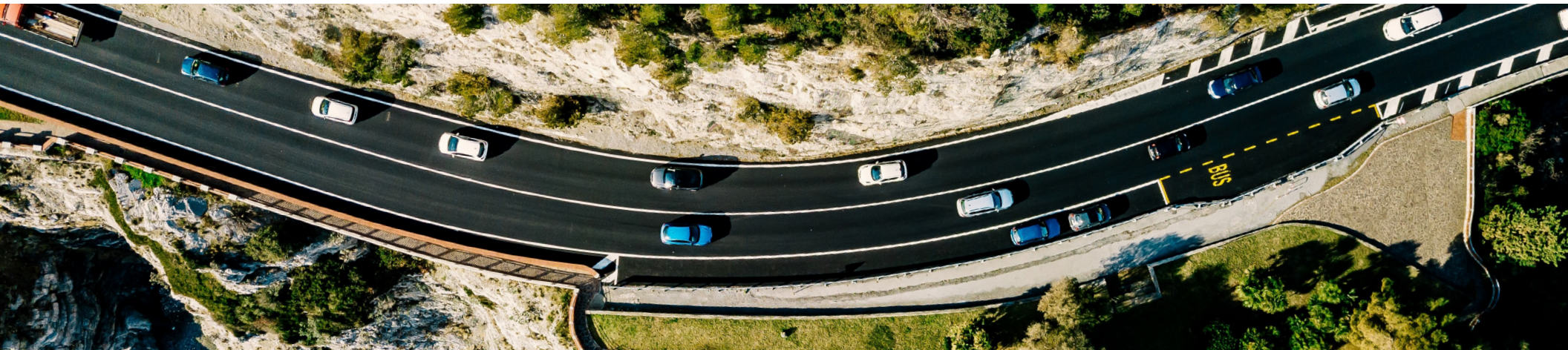
Construction solutions

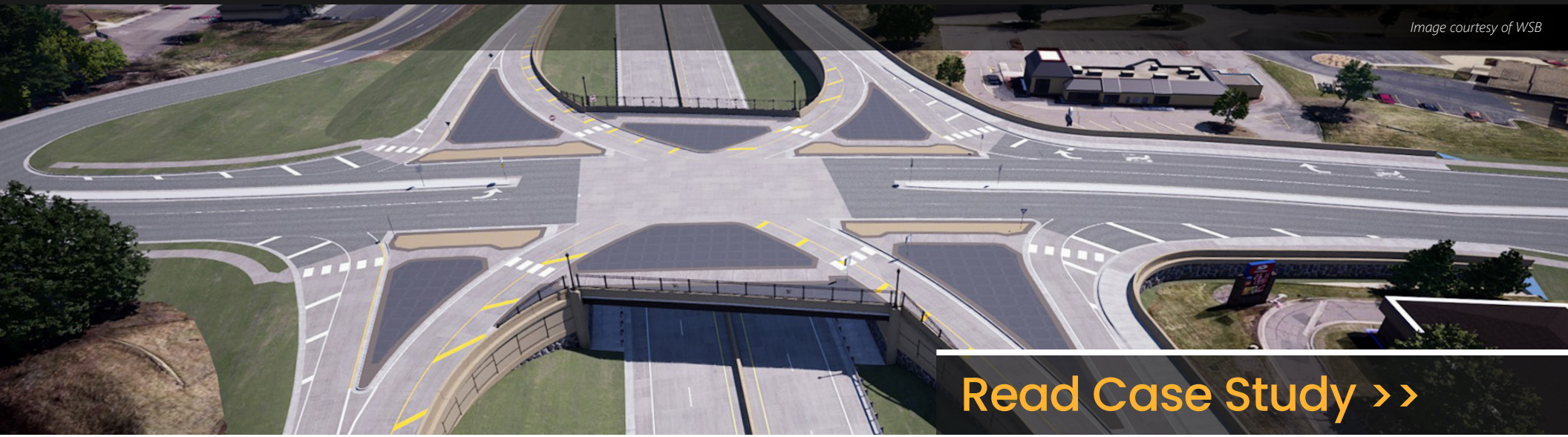
Our road and highway construction solutions offer integrated digital workflows that span preconstruction planning to execution and beyond, significantly enhancing coordination, communication, and transparency across project teams. By adopting this new way of working, including 4D digital workflows and infrastructure digital twins, you can safely deliver more sustainable and resilient projects on time and within budget, every time, ultimately winning more work in the future.

- **Optimize preconstruction planning –** Visually plan and simulate your projects virtually first to identify and resolve issues before breaking ground, maximizing time, money, and resources.
- **Enhance construction execution –** Keep your teams aligned around a single plan with the latest information—from office to field—boosting productivity, efficiency, and safety.
- **Ensure projects stay on schedule –** Track project progress from start to finish in real time, improving project visibility so you can make faster and better-informed decisions.

Solutions

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





Construction solutions in action

WSB increases access to greater Minnesota with TH 169 roadway expansion design

The project:
MnDOT is converting a three-mile stretch of TH-169 into a freeway system to improve safety and traffic flow. The project includes transforming intersections into interchanges, replacing a bridge, upgrading underground infrastructure, and adding pedestrian walkways. The project has a budget cap of USD 130 million, requiring flexible and iterative design solutions from the contracted engineering firm, WSB.

The challenges:
WSB sought to advance its processes for creating and employing 3D models of road, bridge, drainage, and utility elements, which required complicated earthworks calculations. They also wanted to supply MnDOT with their first paperless project delivery to enhance sustainability and cut costs.

The results:
"The innovative and technical creativity of the design team, led by WSB, has raised the bar for the future of 3D modeling, visualization, and cross discipline project coordination in Minnesota. The approach, along with our willingness to coordinate and collaborate with the CMGC, has saved the project significant time and money by providing better meeting presentations, reducing design iterations, and **lowering the need for contingency in the 30% and 60% construction cost estimates."**

– Jon Chiglo, COO, WSB

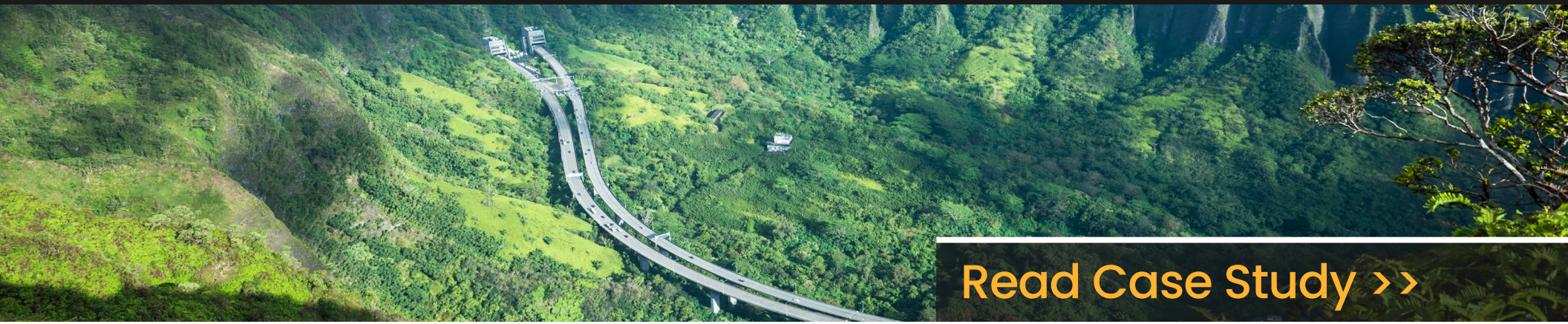
Maintenance solutions

With Bentley's maintenance solutions, you can transform how you manage and maintain your road infrastructure. By applying AI to crowdsourced imagery, you can detect and analyze a multitude of roadway issues—such as potholes, cracked pavement, and damaged signage—enabling you to respond swiftly and efficiently. This approach not only significantly reduces inspection costs, but also enhances safety for drivers, cyclists, and pedestrians alike, ensuring a smoother travel experience.

- **Optimize roadway safety and performance –** Quickly identify and address roadway issues before they turn into safety hazards, preventing accidents, major service disruptions, and costly repairs.
- **Make more-informed decisions faster –** Access real-world data and detailed reports to make better-informed decisions, streamline operations, and improve service delivery.
- **Maximize your maintenance budget –** Save up to 90% on manual inspection costs while maximizing the productivity and efficiency of maintenance teams, allowing them to focus on repairs.

Solutions

- Linear conditioning modeling
- Maintenance management systems
- Inspection systems
- Routing and permitting system



Maintenance solutions in action

Hawaii DOT switched to Blyncsy® (part of Bentley) to automate roadway condition assessment and damage detection.

The project:
From debris and vegetation encroachment to guardrail damage detection, the Hawaii Department of Transportation (DOT) wanted to maintain a safe and pristine road network for its residents, tourists, and the most vulnerable road users.

The challenges:
HDOT faces a number of unique challenges when it comes to road maintenance, including the state's aging infrastructure. Many of Hawaii's roads were built decades ago and are now in need of significant repair and replacement. Additionally, Hawaii's location in the Pacific Ocean makes it vulnerable to extreme weather events, such as hurricanes and flooding, which can damage roadways and make them unsafe for travel, and the separate geography of the four main islands can cause issues as well.

The results:
- **96% potential savings** using Blyncsy compared to manual or LIDAR inspections.
- **Over 23,200 pounds** of carbon emissions saved per vehicle per year.
- **95% reduction** in manual inspections.

Roadways reimagined: Innovative solutions for more resilient infrastructure

At Bentley, we understand the complex road and highway challenges you face. That's why we created solutions specifically for roads and highways—above and below ground.

Our solutions, combined with our innovative technology and open data ecosystem, enable you to easily shift from traditional road project delivery to a data-driven, future-ready approach, empowering you to boost productivity and efficiency by utilizing data throughout the entire lifecycle. The result is optimized outcomes at every phase.

No matter if you're planning and designing roadways, constructing them, or maintaining them, we offer the solutions you need today to deliver more resilient roadways tomorrow.

Explore our solutions in more detail