Bridging the Design Gap

Integrated design and engineering software for each phase of the workflow

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You Have Probably
Heard That Old Saying,
"We'll Cross that Bridge when we get to it."

In other words, they will deal with a problem when and if it arises. Such simplified thinking can be harmful in business. When it comes to bridge design and construction, you do not have that luxury. From engineering to fabrication to steel and concrete construction, there are plenty of opportunities for error, misinterpretation, and other mishaps.

BIM for bridges enables a better strategy that allows you to see potential problems and resolve them in advance, when project changes are easy and cost efficient, so you can cross that bridge early and enjoy the view.

The BIM for Bridges Difference

Advanced methodology for the bridge design and construction industry has evolved from being a catchphrase to a critical reality. Stakeholders are demanding more intelligent 3D models — models that are a perfect graphical and functional representation of a bridge and its design results, helping to improve design quality, constructability, and collaboration.

Changing bridge expectations means changing how they are designed and engineered.

Integrate Design and Engineering Disciplines

In traditional workflows, bridge, roadway, and other civil designers work in silos with very little information sharing or data reuse. For example, terrain data and roadway geometry are generated by roadway engineers and surveyors. Then this data is shared with bridge engineers via paper copies or methods that require manual data entry or exporting it into a new format. This method introduces unnecessary project risk with the potential for inaccurate or outdated data entry, resulting in delays to the project schedule and cost overruns.

Leading departments of transportation (DoTs) and progressive engineering firms are taking advantage of innovative collaborative software applications that enable the support and integration of design and engineering disciplines.

Collaborate Throughout the Project Lifecycle

Hundreds of potential information exchanges take place over the lifecycle of any bridge – spanning the design, construction, and management phases, and presenting just as many opportunities for error. As BIM practices become mainstream, the intelligent 3D model becomes the single source of information for the project, allowing different engineering disciplines and subdisciplines to retrieve specific data and update the 3D model.

BIM for bridges establishes an environment where all required applications are interoperable and efficiently exchange information.

Support for Efficient, Accurate, and Fast Bridge Design

Consider the amount of time spent on having to create 2D plans before your 3D model – then consider how much that time really costs. OpenBridge provides the ability to create 2D drawings directly from the 3D model and enables full interoperability with reinforcing rebar detailing applications. This unique approach provides the bridge industry with automated 2D plan sheet production and rebar detailing with a direct reference to the 3D model, with the option to generate rebar quantity calculations and automatically detect rebar conflicts.

The real value of BIM for bridges is the 3D model digital deliverable that can produce 2D plans automatically.

Minimize Errors and Costly On-site Changes

The old way of planning the construction of a bridge project is fraught with the potential for major errors, leading to costly revisions. Sharing intelligent 3D models with contractors allows them to plan effectively and add any information to the model, such as manufacturer specifications, spreadsheets, PDF documents, or field data.

Intelligent 3D models can be used to create the construction schedule and plan how the structure will be built in a fully collaborative environment with the engineering disciplines.

Taking advantage of a BIM workflow is not as costly, difficult, or time consuming as you might think. In fact, the cost and risk of not being an innovator is far greater. Learn how to get there.

Lead the Way - Scope, Process, Results

As a bridge engineer, we know you wear many hats. Your scope of work includes an array of responsibilities across many phases, and with a diverse group of stakeholders. Your digital solution needs to support an efficient, comprehensive, and collaborative workflow from start to finish. That is why Bentley created a complete set of bridge design and engineering solutions.

Plan
- Collect field data
- Generate conceptual design
- Create types, spans, location reports

Design
- Design, analyze, and maintain bridge structures
- Minimize environmental impact

Analyze
- Complete site investigations
- Analyze and design
- Analyze bridge hydraulics

Construct
- Manage the fabrication process
- Supervise construction

Operate
- Streamline the maintenance, rehabilitation, and decommissioning of bridge assets

Bridge Modeling

OpenBridge Modeler®

Create Physical Bridge Models Easily and Accurately

Gone are the days of needing scripting and visualization specialists. OpenBridge Modeler produces intelligent models with engineering content properties for various bridge components. They include concrete compressive strength, structural steel grade, standard beam designations, and rebar details.

Work with Civil Geometry, No Data Translations Required

The application has direct access to Bentley's civil design data. This access allows you to visualize and evaluate bridge geometry and how it interacts with the alignment, terrain, drainage, and surrounding structures from the start of your project. The multidiscipline, consolidated project view makes it possible to identify constructability issues and conflicts prior to construction.

Reduce Tedious Manual Work with Dynamic Change Management

OpenBridge Modeler's built-in relationship between bridge components enables dynamic change management, saving time and preventing frustration. Have an alignment or profile change? Watch as it automatically updates the entire bridge geometry. Make a deck cross-slopes change? Watch as the beam and elevations update automatically.

Automate Documentation and Reports

OpenBridge Modeler generates a variety of reports, including deck elevations, beam-seat elevations, material quantities, cost estimates, and Input Echo reports to facilitate the evaluation of multiple bridge alternatives, construction sequences, costs, and other elements.

When your needs expand, your solution set needs to expand to support it. OpenBridge® Designer enables you to perform analysis – and includes the capabilities of OpenBridge Modeler. Let us expand on that.

Bridge Modeling, Design, and Analysis

 OpenBridge™ Designer

Create a True BIM Model (Physical and Analytical Models)

What if you had the ability to combine modeling, analysis, and design into one comprehensive affordable bridge product? With OpenBridge Designer you can evaluate multiple bridge options, material types, and span arrangements, ultimately optimizing each bridge to make it as economical and safe as possible.

Produce Detailed Design Check and Analysis Reports

Perform full 4D analysis with no limitations – you can involve geometry, boundaries, loading and combinations, construction stages, dynamic analysis, and nonlinear material behavior. Work on any structural model and all bridge types to perform complex analysis, such as hydrodynamic analysis, wind buffeting, and high-speed rail. Streamline your global projects as you choose from over 20 international design codes.

Accelerate Bridge Efficiency Using One Application

You can connect and enhance workflow processes by leveraging a rich data asset for as-built documentation, maintenance, and operations. OpenBridge Designer enables you to perform analysis, design, and load rating all in one environment to directly exchange project information, including bridge geometry, materials, loads, pre-stressing strand patterns, shear reinforcement, cross-frames, diaphragms, and stiffeners to improve decision-making.

Create Intelligent Models and Perform Construction Sequence Inspections

Rapidly verify bridge geometry as the bridge is displayed in plan, elevation, and cross-section views. You can evaluate multiple bridge alternatives, construction sequences, analysis and design reports, and cost reports. As a result, you can solve problems related to creep and shrinkage, camber, and other issues before construction.

OpenBridge Designer is the industry-leading solution for bridge engineers – and the only solution you need. Check out the capabilities list.

OpenBridge Capabilities At-A-Glance

- *Capabilities provided in both OpenBridge Modeler and OpenBridge Designer*
- *Additional capabilities provided exclusively in OpenBridge Designer*

Bridge Types

- Prestressed girder
- Steel I-girder
- Cable stayed
- Suspension
- Spliced girder
- Concrete slab or box
- Floating bridge
- Segmental – balanced cantilever and span by span
- Incremental launching
- Steel box or tub
- Truss
- Arch

Design Codes

- U.S. customary units
- Metric (SI) units
- AASHTO LRFD and LFD for design
- AASHTO LFR and LRFR codes for load rating
- Canadian CHBDC
- Indian WSD and LSD
- Eurocode, China, South Korea, Australia, Brazil, Austria, Malaysia, Hong Kong, Japan, New Zealand, Russia, and South Africa

Design

- Prestressed concrete
- Steel frame
- Plate girder
- Concrete frame
- Optimization for steel plates and field splices
- Irregular section
- Moving load
- Creep/shrinkage
- Strut-tie modeling
- Seismic-response spectra, pushover, and time history
- Bridge load rating

Analysis

- Static
- Dynamic (linear and nonlinear)
- Soil structure interaction
- Section definitions
- Heat of hydration
- Material nonlinear
- Construction stages (linear and nonlinear)
- Higher order: P-Delta and large displacements
- Rail track/structure interaction

- Finite element
- Cable sagging
- Wind dynamics: CFD, frequency, and time domain
- Hydrodynamics
- Nonlinear springs, dampers, and isolators

Plan Production and Documentation

- Plan, profile, and cross-section sheet generation
- Construction documentation
- BIM deliverables
- Steel and rebar detailing drawings
- Camber diagrams for steel bridges
- Analysis reports: forces, stresses, displacements
- Design code checks reports
- Report customization

Integrated Design and Data for Every Project Phase

With a comprehensive set of capabilities, engineers can stop stressing about technology inefficiencies and focus more on engineering optimum solutions. Whether your team works directly on every portion of the workflow or you need to work with other organizations, Bentley has a software solution for you and your partners that easily shares, consumes, and references data for a seamless and collaborative experience.

Plan
- OpenBridge Modeler
- OpenTunnel® Designer

Design
- OpenBridge Designer
- OpenRoads™ Designer, OpenRail™ Designer, OpenTunnel Designer
- ProStructures™

Analyze
- OpenBridge Designer
- ProStructures
- OpenFlows™

Construct
- OpenBridge Designer
- OpenTunnel Designer
- Use the applications to reference models and documents to verify the accuracy of construction

Operate
- OpenBridge Designer
- OpenTunnel Designer
- Use the applications to hand off the digital model for future maintenance

Read on to discover the capabilities you should be looking for across the project lifecycle, and how the right applications working together seamlessly enable an effective workflow.

Modeling and Reinforcement Detailing

 ProStructures™

Perform Detailing with ProStructures

ProStructures is a comprehensive steel and concrete design detailing application used to increase productivity and profitability. With ProStructures you can create and automatically update 3D models that include structural steel and reinforced concrete structures. OpenBridge integrates with ProStructures, giving you a full view of the project to easily identify clashes and streamline your workflow to include physical modeling, analysis, and plan production.

Produce High-quality Steel Detailing and Fabrication Designs with ProSteel™

With ProSteel you can confidently deliver an intuitive 3D modeling system that is perfectly suited to lay out complex steel structures and extract engineering, fabrication, and erection drawings with automatic updates whenever the 3D model is changed. The software enables you to produce drawings for every steel shape, connection, and plate work from the 3D model and update the generated drawings in external reports and bills of material.

Intuitively Model Parametric Concrete Structures with ProConcrete™

ProConcrete enables you to model objects of any shape, with any combination of reinforcing. You can reduce documentation production time and eliminate errors and design flaws. The software enables you to quickly create accurate 3D rebar models, placement drawings, fabrication details, bar bending schedules, concrete quantity, and material reports with automatic updates to reflect model changes.

* ProStructures includes ProSteel and ProConcrete.
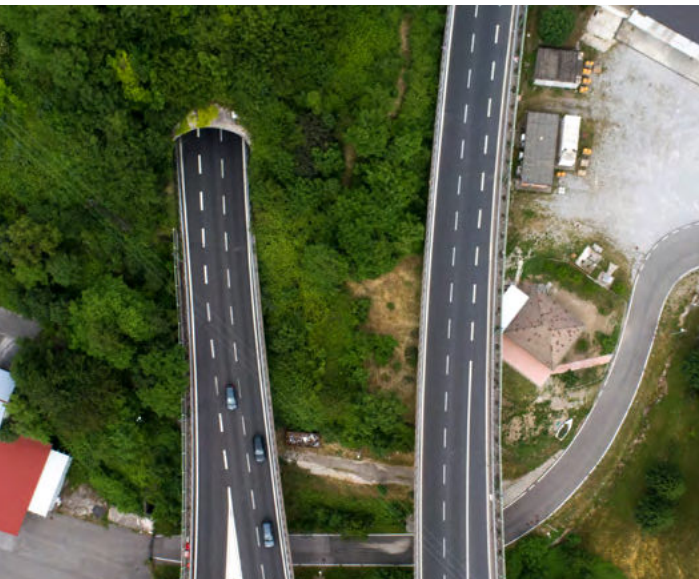
Multidiscipline Civil Design

 OpenRoads™ Designer

 OpenRail™ Designer

 OpenTunnel® Designer

No Project Lives by Itself

Every bridge is connected to a road, rail network, or tunnel, involving thousands of decisions and changes for design, aesthetics, structural integrity, material choices, and safety. Bentley's civil design software allows you to manage all bridge and connection data, from concept through construction, in a single composite model. Easily collaborate with multidiscipline teams to understand how all project elements work together to prevent conflicts early in the design phase. With Bentley technology, there are no more data transfers, no more communication lags, and no more cost overruns – just straight collaboration improving efficiency, quality, and confidence across all project stakeholders.

Tailor-made Software for You and Your Project Partners

Whether your company is working directly on the infrastructure connecting to a bridge, or you are partnering with another firm to get the job done, Bentley has tailor-made software for the work you do. OpenRoads Designer, OpenRail Designer, and OpenTunnel Designer provide capabilities to automate the production of those specific infrastructure elements and streamline the production of construction documentation. With a design-driven approach that connects your designs to plan set production, this connected workflow supports the production of high-quality drawings, including multidiscipline documentation sets, which are consistent across the entire project. You can say goodbye to outdated paper plans and last-minute on-site change orders.

Hydraulics and Hydrology

 OpenFlows™

Hydraulic Tools for All Bridge Sizes, No Matter the Complexity

The hydraulic analysis of a bridge can be a complex undertaking. You need to determine model computational methods, topographic data, flow impact, scour, and site flooding. Is your team working on a project involving hydraulics design? Look no further and use OpenFlows for drainage and hydraulic analysis and calculations to plan intelligently with interoperable hydraulics capabilities. OpenFlows ensures design accuracy and environmental impact.

User-friendly Calculators and a Hydraulic Toolbox for Your Engineering Needs

Analyze cross-drain systems and bridge and roadway overtoppings with OpenFlows CulvertMaster® by selecting from a library of standard culvert shapes, materials, and entrance conditions. Provide reliable calculations on a wide variety of hydraulic elements such as pressure pipes, open channels, weirs, orifices, and inlets with OpenFlows FlowMaster®.

Engineering Software to Streamline Your Modeling Process

Analyze, design, and operate complex stormwater systems with OpenFlows CivilStorm® using built-in hydraulic and hydrology capabilities and a variety of wet weather calibration methods.

Capabilities At-A-Glance

ProStructures

- Support for multiple national and international codes
- Use standard parametric and easily modified reinforced concrete objects
- Model rebar of any shape and complexity
- Face-based rebar modeling updates user reinforcement when concrete shapes change
- Standard parametric connections
- Element modification capabilities
- Structural parametric objects for quick modeling
- Extract fabrication, placing, and general arrangement drawings
- Generate bar bending schedules and bills of material (BOM) in single or batch process
- Output file formats: IFC, ISM, iModels, and 3D PDF

OpenRoads Designer

- Download, create, analyze, and adjust survey data
- Use purpose-built tools for advanced alignment, profile geometry design, and editing tools
- Create a best-fit alignment based on existing road centerline or road edge survey data
- Automate intersection and roundabout design based on road geometry defined by alignment, profile, and superelevations
- Design and edit roadway cross-sections
- Create 3D models for utilities, storm, and sanitary drainage
- Build utility models directly from survey data and identify conflicts
- Automate the production of high-quality drawings, including multidiscipline documentation sets
- Integrate with LumenRT™ to create models as well as high-impact visuals and animations

OpenRail Designer

- Includes all OpenRoads Designer capabilities
- Model and design metro, light rail, commuter rail, or high-speed rail projects
- Download, create, analyze, and adjust survey
- Perform regression analysis, horizontal and vertical alignment, cant design, and turnout placement to international standards.
- Create 3D models for utilities, storm, and sanitary drainage
- Build utility models directly from survey data and identify conflicts
- Automate the production of high-quality drawings, including multidiscipline documentation sets
- Integrate with LumenRT to create models as well as high-impact visuals and animations

OpenTunnel Designer

- Comprehensive 3D physical tunnel modeling
- Full excavation shape and excavation tracks modeling
- Tunnel lining modeling for conventional and TBM tunnels
- Parametric, intelligent tunnel components
- Rule-based and constraint-driven modeling
- Solid and transparent views
- Material quantities report, input reports, cost estimate report
- Report formats: PDF, MS Word, MS Excel, HTML
- Direct data exchange with MicroStation®, OpenRoads, OpenRail, OpenBridge, ProStructures, and PLAXIS®
- Connect to PLAXIS 2D and PLAXIS 3D to perform geotechnical analysis
- Import geomodeling data from Seequent's Leapfrog®
- File formats: DGN, XML, LandXML, IFC, and PY
- Automated plan production

OpenFlows

- Water distribution analysis and design
- Transient analysis and modeling in water or sewer systems
- Analyze and design water distribution systems
- Assess and compare any physical design, water demand, network topology, and operational scenarios
- Analyze, design, and operate sanitary and combined conveyance sewer systems
- Model urban sanitary and combined sewer
- Automation of design and rehabilitation
- Model looped networks, flow splits, overflows, and storage capacity
- Full GIS, CAD, and SCADA interoperability
- Analyze, design, and operate stormwater systems
- Calculate pipe sizes and invert elevations

Engineers Like You Use OpenBridge

PT Wijaya Karya

Employs BIM Methodology to Design the Longest Double-decker Bridge in the World

- The BIM methodology of Bentley applications increased the efficiency of bridge modeling by 40% and saved 10% of the construction budget.

- SYNCHRO's 4D visualization detected 85 potential clashes, saving USD 60 million and four months in design time.

- Due to lowered design and construction costs, the project will pay for itself three years ahead of schedule.

NYSDOT

Industrializes East 138th Street Bridge Using a Digital Twin

- Providing the digital twin as the contract document resulted in the winning bid being 15% lower than anticipated.

- SYNCHRO™ 4D and LumenRT facilitated visual construction sequencing, traffic control planning, and public outreach for better project coordination.

- The 4D simulation enhanced understanding of construction, which kept stakeholders from manually sifting through 200 pages of paper plans.

Hatch

Designs a Complex New Bridge to Support Economic Development

- Using OpenBridge, the design team fulfilled all client requirements and delivered a well-designed digital model.

- The client's civil team continually provided major updates and complex redesigns, which would have required many hours to remodel using older design techniques.

- Digital design saved Hatch significant time and money, establishing a new benchmark for future infrastructure projects in the region.

Bridges Have Never Been More Sophisticated

With OpenBridge bridge design and engineering has never been simpler, faster, or more intelligent. We hope this e-book has inspired you to adopt technology solutions that allow you to continue to build and advance your community's infrastructure through innovation.

Bentley's civil complete solution set provides all the capabilities you need in one place, from one company, designed to work together and to work the way you do.
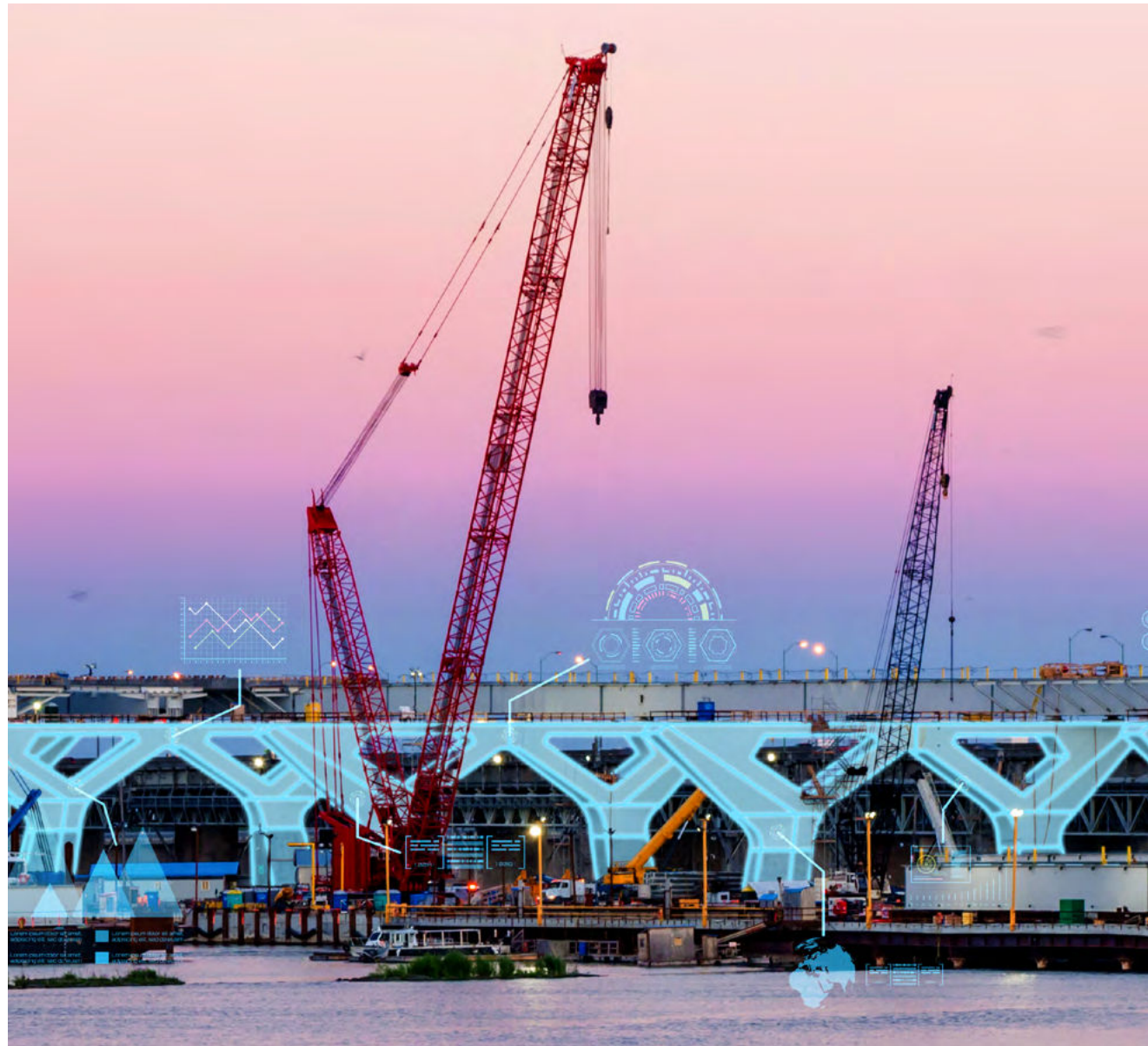
Getting Started

Bentley makes it easy for organizations to find the product license that offers the best options, an affordable price, and the training you need to be successful – through Virtuosity™, Bentley's eStore for practitioner licenses.

Whatever subscription is right for you, you will get access to our expert services, and the ability to leverage one-to-one mentoring by Bentley project experts, personalized training for your team, and on-demand learning. We call this bundle Virtuosity's Virtuoso Subscription, and it ensures your workforce can quickly learn the latest technology and workflows while minimizing downtime and project costs.

Find out how Virtuosity Project-specific Training Helped an Engineering Firm Meet Tight Deadlines.

"I knew we needed specialized software to make this proposal standout, so initially I was simply looking for cost-effective software licensing options. But that search opened the door to new resources as well as training and education opportunities that we had never considered."

– Adrian Troncoso, Vice President, Alliance Group Enterprise

Read the Story   **Shop OpenBridge Now**   **Chat with an Expert**

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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