Bentley®
Advancing Infrastructure

CASE STUDY

Collins Engineers Sets New Bridge Inspection Standard with Iconic Robert Street Bridge

Bentley's iTwin® Capture and iTwin Experience Creates Digital Twin to Cut Down Site Time by 20%

REIMAGINING AN IMPORTANT CONNECTION

Located in St. Paul, Minnesota, the rainbow arch of the Robert Street Bridge has been an iconic landmark for nearly 100 years. The eight-span reinforced concrete arch bridge is on the National Register of Historic places, and serves as an important connection for both vehicles and pedestrians. It spans 1,429 feet, crossing of the Mississippi River, two railways, and a local roadway. "It is an important vehicular and pedestrian connection crossing the Mississippi," said Barritt Lovelace, vice president of UAS, AI, and reality modeling for Collins Engineers, Inc.

Although the bridge was rehabilitated in 1989, it has seen continuing deterioration. Therefore, to ensure that the historic bridge will last another 50 years, the Minnesota Department of Transportation (MnDOT) is planning a significant renovation to secure the future of this piece of St. Paul's history while modeling technological advancements that will become benchmarks for the bridge industry. "[This] is the largest leap forward in bridge inspection since formal bridge inspections started in the United States in 1971," said Lovelace. MnDOT contracted with Collins Engineers to inspect the Robert Street Bridge ahead of this major rehabilitation as part of a project team with Michael Baker International, Inc.

CHALLENGING TRADITIONAL WORKFLOWS

Collins Engineers had three main objectives for this rehabilitation project. The first was to ensure that they collected detailed information about the bridge's condition. This data would be collected both through inspection and testing the bridge's materials. The second objective was to calculate the bridge's load rating based on the condition information to determine its current load carrying capacity. Lastly, the team needed to create a bridge management plan and conduct service life analysis to inform future rehabilitation efforts.

To meet all these goals, Collins Engineers' inspection team augmented traditional methods, which involved hand-measuring cracks and spalls and relying on pencil-drawn sketches and notes, along with photographs, when making critical assessments. "The main challenge of this project was the difficulty in efficiently and accurately collecting detailed inspection information for such a large structure with so many defects and deficiencies," said Lovelace. "Using traditional inspection data collection methods would be very tedious and expensive so our team had to find innovative ways to not only be more efficient but also to provide a higher quality deliverable for MnDOT."

VISUALIZING UPDATES WITH A DIGITAL TWIN

Collins Engineers began by using drones to capture over 57,000 images of the bridge. Then, after other solutions fell short of what the project needed, they chose Bentley's iTwin Capture to process the drone-captured images that, along with iTwin Experience, created a detailed digital twin of the bridge. This capability allowed senior engineers on the project to pre-inspect the bridge, study its condition, and document defects before going to the site in person. "One of the largest breakthroughs of our team approach included the ability to pre-inspect the bridge by using the digital twin in the office prior to starting field work," said Lovelace. "This method allows engineers to validate defects instead of recording detailed information in the field."

PROJECT SUMMARY

ORGANIZATION
Collins Engineers, Inc.

SOLUTION
Bridges and Tunnels

LOCATION
St. Paul, Minnesota, United States

PROJECT OBJECTIVES

- To collect detailed bridge condition information to determine the current load carrying capacity of the bridge.
- To develop a bridge management plan and service life analysis that will inform the rehabilitation efforts.

PROJECT PLAYBOOK
AssetWise®, iTwin, iTwin Capture, iTwin Experience, MicroStation®, ProjectWise®

FAST FACTS

- The Robert Street Bridge is an eight-span reinforced concrete arch bridge in St. Paul, Minnesota.
- Collins Engineers used iTwin Capture to process over 57,000 images and, with iTwin Experience, created a detailed digital twin of the bridge.
- Project engineers could pre-inspect the bridge, study its condition, and document defects before going to the site.

ROI

- By being able to pre-inspect bridges and implement digital delivery methods, Collins Engineers was able to cut down time spent on site by at least 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.

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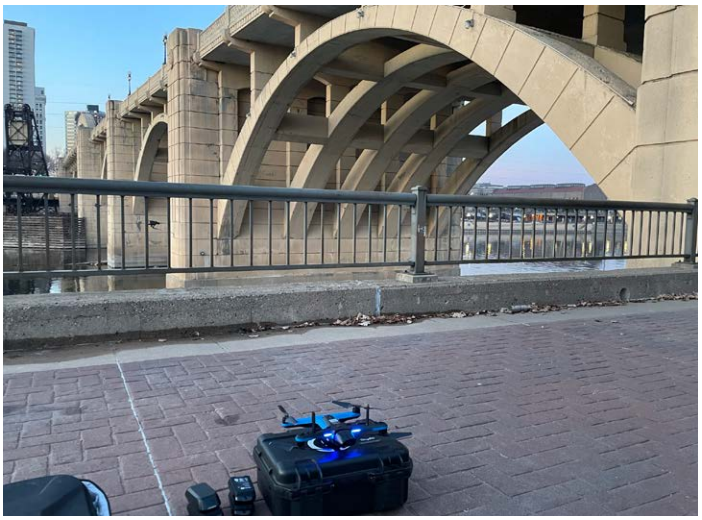
– Barritt Lovelace, Vice President of UAS, AI, and Reality Modeling, Collins Engineers, Inc.

Once in the field, engineers could reference the 3D digital replica on internet-enabled tablet computers to verify pre-inspection data and annotate the model with additional findings. The team was able to gather at least 70% of the project's total inspection information before ever visiting the bridge. "We're still relying on our inspectors and their experience, but we've changed from discovering a lot of these defects in the field to just verifying that they're there and that pre-inspection information and the artificial intelligence correctly [identified] the defects," said Lovelace.



By being able to pre-inspect bridges and implement digital delivery methods, Collins Engineers was able to cut down time spent on site by at least 20%.

These digital innovations also helped the engineering team mitigate a workforce shortage across the bridge industry. "Not enough new engineers are entering the workforce to keep up with the rapidly growing demand for their skills, as a slew of American bridges and other infrastructure age past the 50-year mark," said Lovelace. "[American] infrastructure is in the second generation of needing repairs."

The benefits of relying on digital delivery methods also extended beyond the engineering team to other partners on the Robert Street Bridge rehabilitation. Inspection and testing data that were incorporated into the digital twin were shared across project collaborators, including the design and construction teams, providing a seamless method of double-checking the inspection team's work. Traditionally, the only way to verify an inspector's work and see if any bridge defects were overlooked was to commission another independent inspection. However, by using a digital twin to organize and display data, an additional layer of accountability was built in from the beginning. "There's less of a chance for error, so we're lowering risk—not only for ourselves, but [for] our client as well," Lovelace said.

STREAMLINING WORKFLOWS FOR IMPROVED INSPECTIONS

By being able to pre-inspect bridges and implement digital delivery methods, Collins Engineers was able to cut down time spent on site by at least 20%. This resulted in fewer roadway closures and traffic disruptions for commuters, as well as freed engineers to focus on the project's critical next step: assessing the bridge's load-carrying capacity and developing a bridge management plan to present to project designers. "Engineers were spending their time making decisions versus collecting data," Lovelace said.

Additionally, by making the digital twin available to potential contractors for more detailed insight into the structural condition of the bridge, Collins Engineers expects to save approximately 20% in rehabilitative construction costs. Saving these costs will help the potential contractors to submit more accurate construction bids. "I estimate that this information sharing will result in up to USD 15 million in savings for MnDOT and a 10% reduction in materials used during the construction process," said Lovelace.

The Robert Street Bridge is an eight-span reinforced concrete arch bridge in St. Paul, Minnesota.

Artificial intelligence capabilities also helped compensate for having fewer workers available for fieldwork by cutting down on the overall time and labor required on site, yielding more than USD 90,000 in savings. On future projects, Lovelace also foresees the option of inviting virtual consultations by experienced engineers who are not able to travel to a given site. As a result of these benefits, he expects a digital-first workflow will be the norm for him and his colleagues moving forward. "Even in cases where the client isn't specifically asking us to do this, we're proposing it, because we know we can give them a better product at a reduced cost compared to traditional methods," he said. With this project, they handed over, for the first time, a 100% digital-twin based deliverable to their client. Collins Engineers leveraged Bentley technologies to completely change their process and perform novel ground-breaking tasks on this historical bridge.