



WSB Increases Access to Greater Minnesota with TH 169 Roadway Expansion Design

Organization Saves USD 12 Million on Freeway Conversion Using Bentley's Digital Workflows

INCREASING MOBILITY TO GREATER MINNESOTA

Highway 169 (TH 169) is a major corridor that runs nearly 360 miles north to south through Minnesota, cutting through its capital, Minneapolis. The Minnesota Department of Transportation (MnDOT) was tasked with converting a three-mile stretch of TH 169 into a freeway system. Spanning from the Mississippi River to 197th Avenue in the city of Elk River, this roadway section required safety upgrades to reduce traffic accidents on the heavily trafficked route. Meant to enhance the overall infrastructure and improve vehicle and pedestrian movement, the TH 169 Redefine Elk River Project includes transforming four traffic intersections into interchanges and adjusting the entrance to the TH 169/TH 10 interchange. Additionally, the northbound bridge on TH 169 that spans Highway 10 will be replaced. All underground infrastructure and utilities will be upgraded, and pedestrian walkways will be added to the connecting local roadways. The project is anticipated to be complete in 2024.

MnDOT contracted engineering firm WSB to deliver the final designs of the TH 169 roadway expansion. The project was specially funded through Minnesota's Corridors of Commerce program, and, therefore, could not exceed a construction budget of USD 130 million, labeled the guaranteed maximum price (GMP). "There were specific challenges with the project based on not being able to exceed the GMP cap, which meant that our design had to be iterative and flexible, and we needed to provide real-time quantities," said WSB's Chief Operations Officer Jon Chiglo.

OVERCOMING SEVERAL PROJECT-WIDE CHALLENGES

WSB was required to deliver the project under the construction manager/general contractor (CMGC)

delivery method, which enabled MnDOT to retain a construction manager during design to offer input on construction processes. The addition of a constructability review throughout the design phase eliminates inaccuracies that could cause delays or unexpected costs. In addition, WSB sought to advance its processes for creating and employing 3D models of road, bridge, drainage, and utility elements on the TH 169 expansion, which required complicated earthworks calculations. They also wanted to supply MnDOT with their first paperless project delivery to enhance sustainability and cut costs.

To overcome these challenges, WSB sought robust digital twin technology and coordinated workflows to tackle the collaborative, budget, and engineering requirements and to advance their 3D modeling capabilities. They knew that digital twin and 3D modeling applications would allow them to establish a connected data environment, providing seamless, real-time updates.

USING DIGITAL WORKFLOWS TO AMPLIFY ACCURACY

After considering their options, WSB chose to work with Bentley to find the right solution for this complex project. "We worked with Bentley to develop the workspaces, standards, and templates for the 3D elements," Chiglo said. "We utilized the clash detection software as a check for our design with each stage and the final configurations to check our plans for conflicts."

To provide up-to-date coordination with MnDOT and the CMGC, WSB used Bentley's web-based, integrated platform to review the latest 3D design iterations of the roadway project with both stakeholders weekly. Revising design elements on the digital twin ensured that no components were overlooked, and clash detection and measurement

PROJECT SUMMARY ORGANIZATION

WSB

SOLUTION

Roads and Highways

LOCATION

Elk River, Minnesota, United States

PROJECT OBJECTIVES

- ◆ To convert 2.8 miles of TH 169 into an expanded freeway with upgraded interchanges, bridge, and underground utilities.
- ◆ To deliver a paperless design to MnDOT in collaboration with a construction manager/general contractor (CMGC) under USD 130 million.

PROJECT PLAYBOOK

Bentley Infrastructure Cloud™, iTwin® Capture, iTwin Design Insights, MicroStation®, OpenBridge® Designer, OpenBridge Modeler®, OpenRoads™ Designer, ProjectWise®, SYNCHRO™ 4D, SYNCHRO Control

FAST FACTS

- ◆ The TH 169 expansion will increase capacity to reduce traffic congestion and improve safety and freight transportation.
- ◆ WSB used the TH 169 Redefine Elk River project to advance their 3D modeling capabilities with Bentley's support.

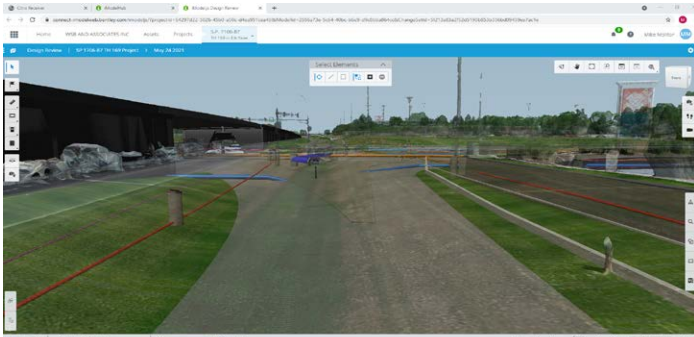
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- ◆ WSB saved MnDOT USD 4.8 million in earthworks costs by using Bentley software to provide the CMGC real-time quantities on site to compare the costs of alternative designs.
- ◆ Clash detection software enabled WSB to relocate 58.7 miles of utilities ahead of schedule.
- ◆ Creating a 4D model in SYNCHRO identified expensive construction conflicts.

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“The innovation 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



The TH 169 Redefine Elk River project will increase roadway capacity to reduce traffic congestion and improve safety and freight transportation on three miles of Highway 169. Image courtesy of WSB.

checks in the modeling software reduced construction errors, eliminating rework. WSB combined the 3D model with the CMGC's construction timeline to establish a 4D model in SYNCHRO that portrayed the excavation, road work, and infrastructure assembly over that period. Together, they identified gaps and overlaps in the timetable, and they determined overlooked tasks that would have increased costs and reduced safety for on-site workers.

WSB had to use a civil design application that could model more than cross-sections of earthworks to accurately quantify earthworks volumes in complicated areas, such as near bridges where materials intersect near the abutments and retaining walls. Therefore, they used OpenRoads Designer to calculate and validate earthwork quantities with 3D modeling technology. To ensure that the project did not exceed the budget, WSB tasked the CMGC contractor with appraising all design changes based on the quantity outputs supplied by the modeling software. Seamlessly transferring all quantities to the CMGC from each design iteration kept the project on schedule.

GOING DIGITAL TO COORDINATE INPUT TO CUT COSTS AND TIME

Using Bentley applications, WSB saved over USD 12 million to date and anticipate their savings to grow to USD 15 million to 18 million in early 2022. Clash detection applications enabled WSB to relocate 58.7 miles of utilities ahead of schedule, advancing the timeline of other utility relocations and the construction of two interchanges, which saved almost USD 500,000. Additionally, the CMGC evaluated the costs of alternative design scenarios by pricing out earthwork costs based on 3D modeling and quantity outputs. Using the software's "version compare" functionality saved more than USD 4.8 million in earthwork balancing, bridge beams, and retaining walls.

Without Bentley's web-based applications as the foundation for the coordination with MnDOT and the CMGC, visual review would have been much slower and less defined. ProjectWise's easily accessible 3D environment made collaboration with MnDOT's right of way team more efficient than in the past. "Bentley has allowed for a more cooperative and collaborative process between the project team and all the project stakeholders," Chiglo said. "We leverage these tools to communicate challenging design constraints at our internal and external meetings to ensure this culture of collaboration and sharing encompasses the entire team."

Establishing a digital workflow in a connected data environment from design through construction provided real-time design updates to create a safer, more efficient roadway expansion. Making design changes through Bentley's open modeling solution saved WSB time and money during the design process to meet the deliverable deadline. WSB also trimmed down their timetable by creating a reality mesh of the roadway's real-world conditions from unmanned aerial vehicle imagery. This enabled WSB to supply construction limits to MnDOT sooner than expected. Furthermore, identifying potential construction conflicts with the 4D model allowed WSB to find cost-effective solutions that can be executed three months sooner than anticipated.

CREATING A DIGITAL TWIN FOR FUTURE ASSET MANAGEMENT

WSB integrated design data with scheduling, price estimation, and inspection for streamlined project delivery using Bentley technology. Creating a digital twin eliminated a paper-based review cycle accelerating their timeline. This was also the first time WSB delivered a paperless roadway construction plan to a client.

The design models were transitioned into construction and asset management models, and the digital twin will be used throughout construction and operations. MnDOT will use the models within its enterprise asset management system to support operations of the asset throughout its lifecycle. Combining the design model with the asset management system delivered reliable information to operations staff, streamlining maintenance and management tasks.

Construction is slated to begin in spring 2022 and last through 2024. Once complete, the expanded roadway and new infrastructure will support freight transport to benefit the local economy. Additionally, the new freeway will increase capacity to eliminate bottlenecks to improve traffic congestion and enhance motorist safety.