Bentley
Advancing Infrastructure

Project Summary

Organization
Foth Infrastructure & Environment, LLC

Solution
Roads and Highways

Location
Cedar Falls, Iowa, United States

Project Objectives
- To implement collaborative digital engineering solutions to optimize design and meet aggressive timelines.
- To develop a comprehensive visual plan to engage the public and stakeholders.

Products Used
Descartes, gINT®, Haestad™, iModel.js™, LEAP®, ContextCapture™, LumenRT, MicroStation®, OpenFlow™ SewerGEMS®, OpenFlow™ WaterGEMS®, OpenRoads™, ProjectWise®, RAM®, STAAD®

Fast Facts

- Foth developed an innovative roadway design solution that transformed and revitalized University Avenue.
- The organization used Bentley's open applications and digital twins to deliver a 3D BIM model that met city and stakeholder criteria.
- Dynamic visualizations supported by Bentley technology were critical to achieving public buy-in and accelerating decision-making.

ROI

- Bentley's integrated modeling applications reduced the design phase by 50%.
- The BIM model optimized data accessibility and increased efficiency of Foth's interaction with the pubic and stakeholders by 50%.
- Bentley's collaborative digital engineering solution met the city's priorities to transform the corridor and save USD 32 million over the next 25 years.

Foth Uses Digital Engineering to Deliver Large Infrastructure Project in Cedar Falls, Iowa

Bentley Applications Facilitated an Innovative Design Solution Estimated to Save USD 32 Million over 25 Years

A Massive Modernization Initiative

Located in the busy community of Cedar Falls, Iowa, University Avenue is a critical two-mile, six-lane divided highway that supports more than 20,000 vehicles per day. The corridor is more than 60 years old with deteriorated pavement and experiences a crash rate 20% higher than the state average. The thoroughfare lacks pedestrian and bicycle accommodations, and has exceeded its expected lifespan. With increasing public pressure to improve roadway conditions, as well as to provide nonvehicular access and spur economic growth, the city of Cedar Falls initiated a USD 38.9 million modernization initiative to transform and revitalize the corridor. The project criteria included improving traffic flow and safety, ensuring bicycle and pedestrian access and mobility, providing a "living street" compatible with existing networks, facilitating commercial access, and minimizing capital investment and operational costs.

Foth Infrastructure and Environment was retained to develop a comprehensive transportation plan from preliminary engineering through final design and construction. To best address the city's priorities, Foth introduced innovative design elements rarely seen in the state, including roundabouts, a lane reduction, and a complete streets approach to accommodate multimodal travelers, all of which were met with strong public scrutiny. "Our concept development and design processes had to be accurate, defendable, and stand up to public scrutiny," explained Aaron Moniza, senior client manager at Foth. Faced with intense public involvement and aggressive timelines, compounded by technical and engineering challenges that required coordinating multiple phases and teams, the organization required integrated digital applications to meet city and stakeholder demands.

Coordinated Digital Workflows

With 100 members in seven offices working together for over five years, it was important that Foth have the right communication and design applications. Working closely with the city, Foth set out to help it realize their goals using Bentley's open BIM and reality modeling applications. The team used multiple data acquisition capabilities, including drone and mobile scanning for fast accurate data collection. The team put that engineering data to work by establishing 3D models and an open, connected data environment based on ProjectWise. Bentley's ProjectWise helped manage, store, and share over 21,000 files and 122 gigabytes of data among the geographically dispersed offices and engineering teams throughout all phases. Foth used OpenRoads, OpenFlows, and STAAD to create multidiscipline 3D models for roadway, grading, and utilities, as well as to support right-of-way acquisitions and construction estimates. These component models were then imported into OpenRoads for assembly into a coordinated BIM model of the entire roadway conceptual design. Bentley's civil, utility, and structural applications were used for traffic modeling, corridor simulations, utility coordination, and comparing using signaled intersections versus roundabouts, which facilitated collaborative engineering processes. These processes enabled quick analysis of numerous design alternatives to determine an optimal roadway solution.

Collaboration and effective sharing of the models and engineering data were critical to meeting the aggressive schedule and developing a cost-effective design. Bentley's open applications streamlined workflows and facilitated coordinated design to meet these timelines. The integrated digital platform helped teams remotely manage data and bring consistency in document management and engineering processes, while also providing traceability for design change management to diagnose and remediate issues within hours instead of weeks. Access to project data and models on site through mobile devices enabled field personnel to quickly answer questions and remotely develop solutions. Leveraging a connected data environment enabled real-time access to all project data and streamlined digital workflows, accelerating design, optimizing client review and decision-making, and facilitating effective public relations.

Maximizing Model Potential

Having a single 3D model improved the accuracy and efficiency of the design process, seamlessly integrating designers and consultants from a global network.

"Our implementation of Bentley applications is a key ingredient to Foth's culture of continually making our clients successful. Using a BIM model, we reduced design time, modernized workflows, enabled the reuse of rich digital deliverables throughout the project lifecycle, and increased our ability to collaborate internally and with our stakeholders. All of these things increase our competitive advantage and allow us to deliver the highest level of service to our clients "

– Blaine Buenger, Senior Technology Manager, Foth Infrastructure & Environment, LLC

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The intelligent reference model facilitated virtual measurements and clash detection, including addressing more than 200 utility conflicts. The model helped the team coordinate with 11 public and private utilities to relocate underground and overhead infrastructure in advance of construction, including adjustments for over 2 miles of major communication facilities. Using the 3D model helped align all parties to identify and visualize clashes while also reducing risk of delays during construction.

Foth also extended its digital engineering model to optimize client review and approval processes, public involvement, and construction bidding. The team used LumenRT and MicroStation to create an animated virtual representation of the corridor model. These representations helped Cedar Falls visualize corridor improvements and traffic patterns, demonstrating design intent to ensure project buy-in and approvals. "The information-rich 3D model and visualizations became irreplaceable presentation features for project meetings, one-on-one interviews, executive summaries, the project website, and public education," explained Moniza. The 3D digital solution successfully diffused the high-profile and political aspects of the project, eventually garnering positive public feedback and saving 1,000 hours in time strengthening public relations.

The 3D model was also provided as part of the project bidding packages, helping secure accurate construction bids for all three phases. Allowing contractors access to the 3D model, along with the high-quality construction documents, resulted in the winning bids coming in under original estimates. Ultimately, the total construction costs were 3% below the contract bid amounts, saving the city more than USD 500,000.

Finally, the 3D model also helped improve the construction phase. Foth established the 3D model as a digital twin, with data flowing to and from the model as field personnel identified and resolved potential issues on site. Beyond construction, the engineering information contained in the digital twin will provide significant value to future operations and asset management as these digital assets can intelligently convey critical information for performance improvements to the city.

Integrated Applications Deliver Benefits

Foth's use of interoperable technology was crucial to accelerating design and streamlining approval processes. For example, design data from OpenRoads drainage modules was exported directly into StormCAD for advanced network modeling. This practice simplified hydraulic calculations, increased design speed, and rationalized decision-making and approval by bringing everything together into one model. The design was able to stay on track over the multiyear design schedule. Bentley's integrated applications facilitated simulating real-world conditions, determining the best design solutions. Using these applications helped Foth meet the deadline for the design phase with full stakeholder approval and reduce the design phase by 50%, from three years to one-and-a-half years, saving 1,600 hours of design time and optimizing efficiency.

Saving time in the design phase dramatically reduced the overall project schedule, allowing Foth to meet construction and city schedules while delivering a high-quality project. Despite the aggressive schedule, construction started a full year earlier, with an estimated total return on investment of USD 650,000. Working in the connected data environment with Bentley's open applications improved project deliverables across all phases, maximizing collaboration and productivity between mobile and dispersed teams, as well as optimizing communication with the city, utility companies, and community stakeholders. Foth now had a connected digital solution, allowing for immediate access to all engineering and project data that helped streamline communication, increase efficiency of Foth's interactions by 50%, and achieve the much-needed public trust.

Digital Solutions Drive Transformation

Foth's innovative design called for six multilane roundabouts in the urban, commercial corridor, one of the first of its kind in Iowa. The city and community had reservations regarding the viability of roundabouts as a transportation solution. To gain buy-in, Foth delivered a digital model and information-rich 3D visuals, providing a successful solution to present the design concept from the community's point of view, accelerating approvals for the new roundabouts, and producing benefits and cost savings to the city and the public. The new design improved safety and reduced injury accidents by 89%, resulting in USD 1.9 million in savings and a decrease in travel time equivalent to more than USD 1 million in savings annually.

"We talked about the technology, but at the end of the day, it's about the people," stated Molly Long, lead civil engineer at Foth. In addition to the roundabouts, the transformative design incorporated sidewalks and bike lanes, as well as benches and landscaping, to achieve higher safety levels for drivers, bicyclists, and pedestrians. The new multimodal network will increase connectivity to employment and services, support workforce development, and contribute to community revitalization. Foth's safe and economical modern design delivered a return on investment estimated at USD 32 million to the public of Cedar Falls to be realized over next 25 years. The improvements made to University Avenue have revitalized economic growth and transformed the community, with 19 properties already redeveloped, and 30% of the corridor poised for future redevelopment.

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