NYSDOT Pilot Project Tests Digital Terrain Model-Enabled Construction

Integrating Bentley Software with Machine-Control Technology Allows Creighton Manning to Expedite Bypass Extension Project Delivery

Project Summary

Organization
Creighton Manning Engineering

Solution
Roads

Location
Bethlehem, N.Y.

Project Objectives

- Relieve traffic congestion and improve vehicle capacity and safety
- Provide levels of service for a 20-year traffic forecast
- Facilitate sustainable economic development while mitigating impacts

Products Used
Design Engineers: MicroStation®, InRoads®, and InRoads Storm & Sanitary

NYSDOT: Bentley OnSite

Fast Facts

- Project team constructed a four-lane highway and converted a two-lane highway to a four-lane highway
- Three two-lane roundabouts replaced signalized intersections to improve safety
- InRoads was used to model context-sensitive alignments, minimize environmental impacts, and produce DTMs
- InRoads supported the use of machine-control technology for accurate stakeless grading

ROI

- 3D modeling integration and machine-control technology facilitated movement of over 200,000 cubic meters of earth in relatively short time
- Stakeless grading improved accuracy and efficiency to deliver a higher quality project in less time
- Expedited construction met schedule despite five-month delay
- Roundabout designs reduced accident frequency and severity, and decreased peak-hour traffic delays by 7-15 minutes per vehicle

DOT Improves Capacity for Sustainable Development

Creighton Manning Engineering (CME), a professional engineering and surveying firm in Albany, N.Y., has been recognized for its expertise in local and regional transportation planning and traffic engineering. The New York State Department of Transportation (NYSDOT) retained CME to design the $15.2 million Route 85 Slingerlands Bypass Extension project, which addressed capacity and service-level issues along a 3.25-mile highway section near Bethlehem, N.Y. CME used Bentley's InRoads software to expedite design and construction so that the bypass could open on schedule despite delays.

Bypass highways may not be the most glamorous of engineering projects, but they do have a profound effect on communities. Since divided highways control foot and vehicular traffic, planners use them to expand or limit access as needed to enliven centers of interest or protect them from excess flow. This requires more components than most observers realize, with multiple sections that work together to achieve project goals. CME performs 3D modeling to not only preview how the highway infrastructure will come together, but also guide construction of the many parts.

For the Slingerlands Bypass, state and town planners wanted to improve vehicle capacity, relieve congestion, improve safety, and provide sufficient lane capacity to meet 20-year traffic projections. They also wanted to enhance current land use, provide for projected land use changes, and facilitate economic development—all while minimizing or mitigating environmental impacts and improving bicycle and pedestrian accommodations. In addition, this was to be done while maintaining traffic during construction—16,000 vehicles each day traveling about 60 miles per hour.

"The location and the environmental constraints were the primary factors contributing to the complexity of this project," said Jeffrey Pangburn, an associate and senior project manager at CME. "The newly constructed parts of the bypass were designed in a context-sensitive alignment to avoid and minimize impacts to ravines, wetlands, and historic properties."

In all, the Slingerlands Bypass involved construction of 1.5 miles of new, four-lane divided highway and reconstruction of 1.75 miles of two-lane highway into a four-lane divided highway. Also, an existing bridge was modified and widened, and four two-lane roundabouts were built. The project was not only successful, but also an award winner: CME won the 2009 "Transportation Project of the Year Award" from the American Public Works Association and the 2009 "Gold Award" from the American Council of Engineering Companies.

3D Modeling Minimizes Environmental Impacts

Models were useful in most phases of the project, particularly environmental aspects, according to CME CADD Manager Karl Detrick. "The 3D model and the digital terrain models were instrumental in designing and constructing the project to minimize environmental impacts. For example, with the models we were able to compare several different alternative alignments during the design phase and find the best ways to avoid wetlands and historic properties."

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>
> *— Karl Detrick, CADD Manager, Creighton Manning Engineering*

Model-based design tools in the InRoads Suite, Bentley's software for civil engineering, were used to develop the roadway's horizontal and vertical alignments to meet the following environmental goals:

- Provide a buffer between the roadway and historic properties
- Minimize the number of ravines crossed, thus diminishing the overall section footprint

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- Minimize the visual impact on existing homes and businesses by depressing the roadway
- Minimize impact on wetlands, and mitigate impact with the creation of new wetlands at a 2:1 ratio
- Design new storm basins and native vegetation buffers to filter project runoff

Pilot Testing Machine-Control Technology

NYSDOT had delayed the award of this contract by five months, so the contractor, Delaney Construction, was working under extreme time pressure from the moment construction began in February 2007. But time was saved during the construction phase through a close collaboration with NYSDOT and the design engineers, and the successful application of machine-control technology.

Slingerlands Bypass was named a NYSDOT pilot project—one of just three statewide in 2008—for the integration of machine-control technology and Bentley's InRoads. The software allowed CME to provide a complete digital terrain model (DTM) to the grading contractors. Demonstrating a commitment to the technology and training required to meet project goals, CME collaborated with NYSDOT during the initial use of the Quantity Manager tools within InRoads and formulated suggestions as to how to best work with the tools.

Three two-lane roundabouts replaced signalized intersections to improve safety

Quantity Manager was used to link the features from InRoads to the project's pay items database. Contractors deployed the tools to grade the project with stakeless technology, while precisely monitoring quantities using Bentley's OnSite. This facilitated the movement of more than 200,000 cubic meters of earth in a relatively short time frame. Grading using this approach was more efficient and was accomplished with improved accuracy, resulting in a higher quality project. InRoads reports were also a big help to state inspectors on the project.

Construction-Stage Design Change

The DTM-enabled construction process was even flexible enough to accommodate a late project addition. During construction, the developer of a new technology park proposed that a fourth roundabout be added in the middle of the bypass to provide access to the park. It made sense and fit the town's business development goals, so NYSDOT was open to the idea. But a change order contract would have meant unacceptable delays.

Instead, the new work was undertaken simultaneously under a highway work permit. NYSDOT, CME, Delaney Construction, and the town of Bethlehem all worked together to execute the work permit, and the Slingerlands Bypass—even with the last-minute roundabout—opened to traffic on schedule in September 2008. The level of cooperation was so extraordinary that team members were presented with an informal "Partnering Award" at the 2008 Associated General Contractors of America/NYSDOT Technical Conference.

Energy, Environment, and Safety Benefits

The four roundabouts built into the Slingerlands Bypass are not the awkward, traffic-slowing circles that many associate with the term. Modern two-lane roundabouts are a very useful tool for traffic engineers, and they have worked well with this project. Because they reduce stopping and starting, the roundabouts reduce fuel consumption and emissions, leading to cleaner air in the region. They are also more efficient: NYSDOT analysts say the average commuter delay per vehicle has been reduced by seven to 15 minutes during peak hours.

Perhaps most importantly, the roundabouts are safer. Before the bypass work, the signalized intersections that were replaced by roundabouts had an accident rate significantly higher than similar intersections statewide. Accident rates have dropped, and state and federal research confirms that roundabouts reduce accident frequency and severity, compared to intersections.

One of the new roundabouts in the Slingerlands Bypass is at Blessing Road, which created a gateway leading into Slingerlands Hamlet. The roundabout slowed traffic entering the hamlet. Together with a new pedestrian network (including a pedestrian bridge, and a main bridge renovation that accommodates bicycling and pedestrians), a canoe launch, and a picnic area on the Normanskill Creek, the bypass has reduced the impact of heavy traffic on the surrounding community.

The bypass project has also facilitated sustainable development of a 1.4-million-square-foot mixed-use commercial space known as Vista Tech Park. This will make a substantial contribution to the town's nonresidential tax base. And for small businesses located along the project corridor, particularly New Scotland Road, more foot-traffic means more business.

Thanks to careful planning, these good effects should be long lived. Projections call for an increase in traffic of up to 25,000 daily users over the next 20 years. The new Slingerlands Bypass is ready to accommodate that increase and will still support community life when traffic reaches that level.

Bentley
Sustaining Infrastructure