COMPANY
**New Mexico Department of Transportation (NMDOT)**

LOCATION
**New Mexico**

SOFTWARE
**AutoCAD® Civil 3D®**
**AutoCAD® InfraWorks™**

# A new road

## NMDOT adopts Autodesk BIM solutions for the design and construction of transportation network
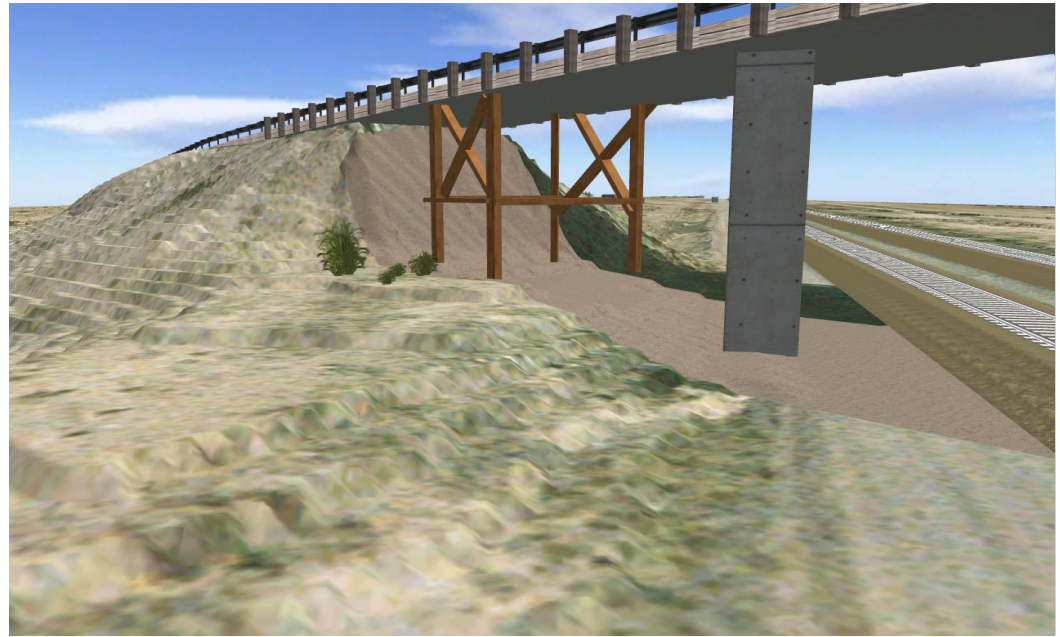
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> —**Jessica Hunter**
>   Project Development Engineer
>   New Mexico Department of Transportation



Cambray Bridge designed by intern, Matthew Oakeley who had only spent a few hours on the Autodesk InfraWorks. Image courtesy of NMDOT.

## Overview

In early 2013, the New Mexico Department of Transportation (NMDOT) continued down a path to 3D model–based design processes by adopting Autodesk® BIM solutions for the design and construction of its roads, highways and bridges. NMDOT's strategic decision was prompted by a range of anticipated benefits, including cost savings due to reduced change orders, improved public input using model-based visualizations, and improved construction using BIM solutions to support virtual construction planning and sequencing. While finishing projects started on its former design platform, NMDOT staff began training on Autodesk® AutoCAD® Civil 3D® and Autodesk® InfraWorks™ software, and the Department is now embarking on its full-scale deployment of these Autodesk solutions—using them for production on most new projects starting in 2014. Designers have already begun using Civil 3D on the design of two bridge replacement projects: Berrendo Creek Bridge in Roswell and two sets of bridges on Interstate 10 (I-10) in Las Cruces. "The original survey and preliminary design phase of these projects were carried out using our former design platform. We imported that preliminary design data into Civil 3D and are now using the software for the detailed

design and documentation of these projects." says Scott May, IT Application Developer, NMDOT.

## Water over the bridge

In September 2013, multiple days of record rainfall in New Mexico led to widespread flooding of the rivers and creeks in Roswell, including the usually dry Berrendo Creek. Over four inches of rain caused the creek to flood, and water and debris to nearly overtopped a steel bridge on US 285 that spans the creek. Built in 1963, the bridge was already in poor condition and had experienced a number of flooding events. In addition, the older structure does not meet today's design standards and is not compliant with the 1990 American with Disabilities Act (ADA).

As a result, NMDOT is replacing the bridge's deck and steel girders, and rehabilitating the existing substructure. In addition, the new design will ensure that the bridge can withstand being overtopped by water, with debris collectors added to keep the driving lanes clear of obstructions and enable emergency personnel to use the bridge during flooding. The new girder and deck design will raise the bridge deck several inches and will provide pedestrian ADA sidewalks on both sides of the bridge.

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# Realize significant cost savings through reduction in change orders

**Dynamic design coordination**

On the Berrendo Creek bridge project, NMDOT is responsible for the road design, but an outside consultant is responsible for the bridge design. Like many of NMDOT's consultants, the consultant is already using the Civil 3D design platform. "Prior to our adoption of Autodesk BIM solutions, the design workflow between these consultants was cumbersome and involved a lot of manual effort and adjustment to combine design information for the bridge, road, and surrounding topography. In addition—even before this Department wide transition to the new platform—some disciplines within NMDOT have used Autodesk Land Development for many years, which complicated the internal exchange of project information," said May.

With NMDOT's transition to BIM, the bridge designers and the NMDOT road and survey teams on this project are all using Civil 3D software, helping NMDOT and the consultant to more easily share their road and bridge models for coordination. In addition, all teams can use the survey data of existing conditions (the bridge substructure and the topography around it) without the need for conversion or translation. "We can create road alignments and profiles using

underlying model geometry of the bridge. We can check critical elevations between the 3D road corridor, the bridge, and existing terrain," says Kelley Riha, Engineer Coordinator, NMDOT. "Any minor changes to the bridge design—raising the bridge deck an extra inch, for example—will affect the vertical alignment of our road design. But with Civil 3D, it will be simple to make the change and all the elevations will update automatically. This automatic, model-based coordination is certainly more efficient and definitely makes us more productive."

Even though the design of this bridge project is still in progress (design completion is expected in the summer of 2014), Civil 3D is already providing benefits to the NMDOT team. "With Civil 3D, we have an automatically adjusting 3D project model, where our survey and road alignments, profiles, and grading mesh seamlessly with the bridge design," stated Jessica Hunter, Project Development Engineer at NMDOT. The Civil 3D software uses an intelligent, model-centric approach to connect design and documentation, with project models and design elements that are dynamically related to each other—keeping all of the design elements, as well as the documentation, coordinated.

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Berrendo Creek Bridge during the flooding of September 2013, Image courtesy of NMDOT.



Berrendo Creek Bridge in the aftermath of the 2013 flood. Image courtesy of NMDOT.

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"For example, this section of US 283 was recently transferred to the City of Roswell. But all the mileposts on our drawings were labeled for US 285. In the past, this change would have caused a lot of manual updating of drawings. With Civil 3D, all we had to was change 'US 285' to ' FL-4685-P in one place, and all the design documents with all the milepost notations updated automatically. Both productivity and quality increases because there is no time-consuming, error-ridden manual update of drawings," explained Hunter.

## Keeping all roads open

NMDOT is also using Civil 3D for the redesign of two sets of bridges on I-10 in Las Cruces, adjacent to New Mexico State University. The redesign of one of the bridges is particularly complicated because it is the juncture point of a tapered acceleration lane entering I-10 eastbound. The length and configuration of the current acceleration lane is causing vehicles to merge onto the road at speeds considerably lower than the interstate traffic—making for a dangerous situation. To remedy that situation, the project includes the extension of the acceleration lane.

Complicating matters further, this section of I-10 splits the university from a large residential student housing area. "With student housing on one side of the bridge and access to the University via the road below, there are



I-10 Union Bridge in Las Cruces is very with pedestrian traffic. Image courtesy of NMDOT.

> The InfraWorks project animations enable viewers to virtually fly-over and drive through the redesigned interchange, which gives everyone a much better understanding of the new construction.
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a lot of students who bike or walk under the bridge throughout the day to their classes. Our goal is to minimize the project's impact on the daily users of these roads," stated Arthur Romero, a Project Development Engineer at NMDOT.

NMDOT is using Civil 3D to develop a project model that will be used for design and documentation, as well as calculating quantities for earthworks, asphalt and subgrade, guardrail, and so forth. In addition, the software's corridor modeling features are being used to develop various design options for the configuration of the acceleration lane to minimize the amount of borrow or excavation material for the project. "As we iterate through the design alternatives, we are getting immediate feedback regarding earthwork quantities. For example, as we raise or lower the vertical profile of the roadway, Civil 3D automatically updates all the quantities, helping us understand the impact of the design change and helping us balance the earthwork," stated Joseph Volpato, Engineer Coordinator, NMDOT.

Traffic control is another important aspect of this project. By safely altering the routes of pedestrians and local traffic on the street below the bridge, NMDOT plans on keeping that street open (without a lane drop) and ADA-compliant

throughout all phases of construction. The design team will plan to use Civil 3D to model each phase of construction, which will help team members to visualize the construction and its impacts. "This virtual construction will give us a better understanding of the project and help us plan the optimal order of the phased construction to minimize its impact on the road below," said Romero.

**Infrastructure visualization**

In early 2013, shortly after NMDOT's decision to adopt the Autodesk platform and while most of the NMDOT staff was training on Autodesk software, May and his team began piloting InfraWorks to develop project animations for the visualization of a complicated roadway rehabilitation project on the verge of completion: the I-10/I-25 Interchange Improvements Project was designed by Molzen-Corbin & Associates.

This newly built interchange is located at the intersection of Interstates 10 and 25 in Las Cruces. The project features the replacement of two ramps (one with a new fly-over bridge), the reconstruction of two bridges to current standards, the realignment of several frontage roads, and expanded ramp entrance and exit lanes.

# Communicating with 3D visualization tools

roads, and expanded ramp entrance and exit lanes. "We used InfraWorks software to create a 3D visualization model of the project, including the new interchange as well as imported aerial photography, digital terrain models, and survey data of the surrounding terrain," explains May. Next, the group used InfraWorks in conjunction with the 3D model to create an animated movie of the new interchange—set in the context of the existing surroundings. "The InfraWorks project animations enable viewers to virtually fly over and drive through the redesigned interchange, which gives everyone a much better understanding of the new construction," said May.

### Historic effort

NMDOT also used InfraWorks to help communicate design proposals for the replacement of a historic railroad overpass. The Cambray Bridge is on NM-549, a two-lane rural highway, approximately 30 miles west of Las Cruces. The steel and timber bridge straddles railroad tracks and is the oldest remaining railroad overpass in New Mexico, but its age poses a range of safety-related concerns.

NMDOT is challenged with upgrading the bridge to current standards without making substantial changes to the structure's aesthetics that will adversely affect the surrounding historic district. NMDOT used InfraWorks to model its proposal for a new bridge and the surrounding terrain, creating project visualizations that were used for public outreach and during presentations to the New Mexico Historic Preservation Division.

## The result

NMDOT expects that its adoption of BIM processes and Autodesk BIM solutions will provide many benefits. Benefits include ease of performing what-if analysis, the dynamic link between design models and materials quantities, along with automatic updating of drawings and other documentation when design changes are made.

"Our survey crews have already automated a lot of their processes, enabling their survey data to map directly into Civil 3D. Using data capture and field coding, the survey data comes into Civil 3D with less need for post-processing—saving us valuable project time and increasing our quality," said May.  NMDOT also expects to employ Autodesk BIM solutions to support Automated Machine Guidance (AMG) site preparation, which will help accelerate overall construction by minimizing survey labor time and machine fuel consumption costs.

"We have always struggled with combining different design data and file types. For example, several years ago we lost a lot of time on one project trying to merge right-of-way parcel maps with a road design. This really set the project back, and we almost lost our funding. The use of Autodesk solutions throughout NMDOT will help streamline our workflows and make it much easier to collaborate with different disciplines throughout the Department and with our many outside consultants who already use Civil 3D," said Romero.

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"The advantages of using Autodesk software go beyond just a common platform," says Jessica Hunter. "Civil 3D provides significant time savings. Its model-based design approach speeds up everything from the creation of alignments and surfaces to volume and earthwork calculations. And since the design model is dynamically linked to the quantities and documentation, we save considerable time when making design changes," explains Hunter. "In fact," adds retired New Mexico Transportation Secretary Alvin Dominguez, "when the Department first announced its decision to adopt Autodesk solutions, it anticipated that the software would pay for itself within two years of full implementation through cost savings realized in the reduction of change orders."

For more information on civil infrastructure solutions from Autodesk, visit www.autodesk.com/ids or www.autodesk.com/civil3d.
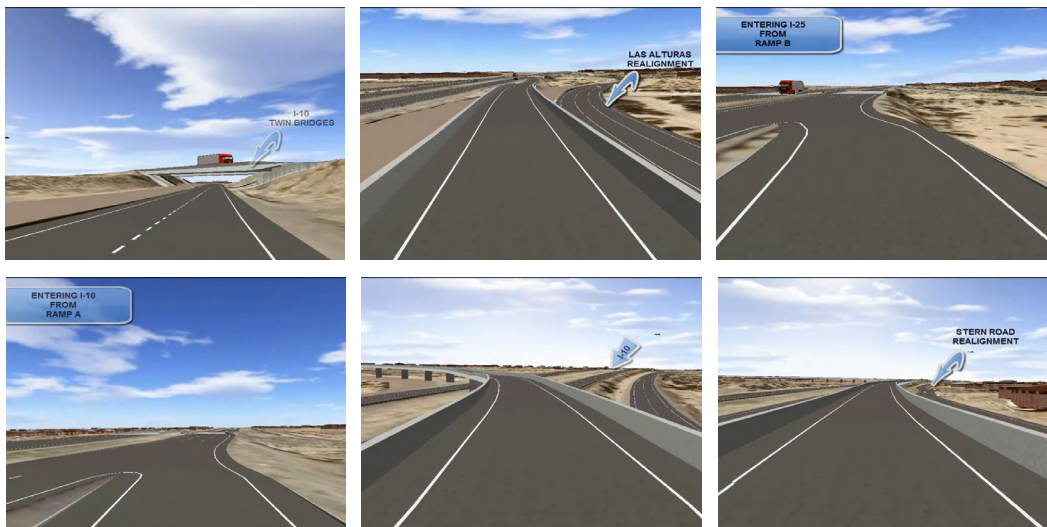
Imagery captured from Autodesk InfraWorks model shows rebuilding of twin bridges and realignment of some of the frontage roads. Images courtesy of NMDOT.

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