

COMPANY

Cole Engineering

LOCATION

Ontario, Canada

SOFTWARE

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

A winning alternative for civil infrastructure design

InfraWorks helps Cole Engineering visualize and expedite its detailed Civil 3D infrastructure designs

Seeing our design against the municipal backdrop simplified, and therefore expedited, our design investigations and helped us shorten the delivery of our design. We were able to quickly identify and resolve design issues in this virtual environment—identifying potential utility conflicts, right-of-way concerns, and constructability issues.

—Alan Winter

General Manager, Greater Toronto Area West office
Cole Engineering Group, Ltd.



The project involves the design and construction of approximately 40 kilometers of pipeline. Image courtesy of Cole Engineering.

The firm

Based in Ontario, Cole Engineering Group is a multidisciplinary consulting engineering firm serving clients in the public and private sectors. In 2009, the Canadian firm adopted 3D modeling techniques and Building Information Modeling (BIM) workflows. They started using Autodesk® AutoCAD® Civil 3D software to generate proposals and detailed designs for its land development, transportation, water resources, and municipal infrastructure projects. In 2012, the firm also began using Autodesk® InfraWorks™ software to develop pre-engineering design proposals and support 3D project visualization throughout the design process.

“Unfortunately, the widespread use of design-time visualization does not extend to civil engineering and infrastructure projects,” says Jeff Lyons, AEC solutions business unit leader at Cole Engineering. “At Cole Engineering, we’re changing that and using project visualizations to improve the design and delivery of our infrastructure projects.”

The project

The firm’s first InfraWorks project is a C\$150-million water distribution project for the Region of Peel, a southern Ontario regional municipality. The project involves the design and construction of approximately 40 kilometers of pipeline between Brampton (a large urban municipality) and the more rural town of Caledon. New water mains are being installed to meet water demands for future development in the area by connecting several water storage facilities.

Most of the water mains will be constructed in open trenches alongside existing roads. In some cases, the pipes will run underneath highways, busy intersections, railway beds, and creeks, which will require jack and bore tunnel construction techniques. The project features four different construction contracts and four matching detailed design phases. Cole Engineering was awarded the contract for detailed design and contract administration of the project in October 2012.

Use InfraWorks to visualize infrastructure projects throughout the design process



For its detailed design, the firm is using Civil 3D and InfraWorks in combination to design, visualize, and communicate the project. Image courtesy of Cole Engineering.

The challenge

“At our first post-award meeting, the client handed us a massive schedule change,” recalls Alan Winter, the firm’s general manager for its Greater Toronto Area West (GTA West) office. “They chopped a year off the schedule for the first design segment, leaving us just seven months to complete the first construction contract.” The Region of Peel had an urgent need to supplement its existing water supply, as future developments were already well underway, with some homes built, sold, and anxiously awaiting water hookups.

In addition to the time crunch, the accelerated project schedule produced another design challenge. The regional municipality had no time to acquire extra property beyond its own right-of-way. As a result, all the new mains had to fit into existing municipal properties and compete for space with existing buried utilities.

The solution

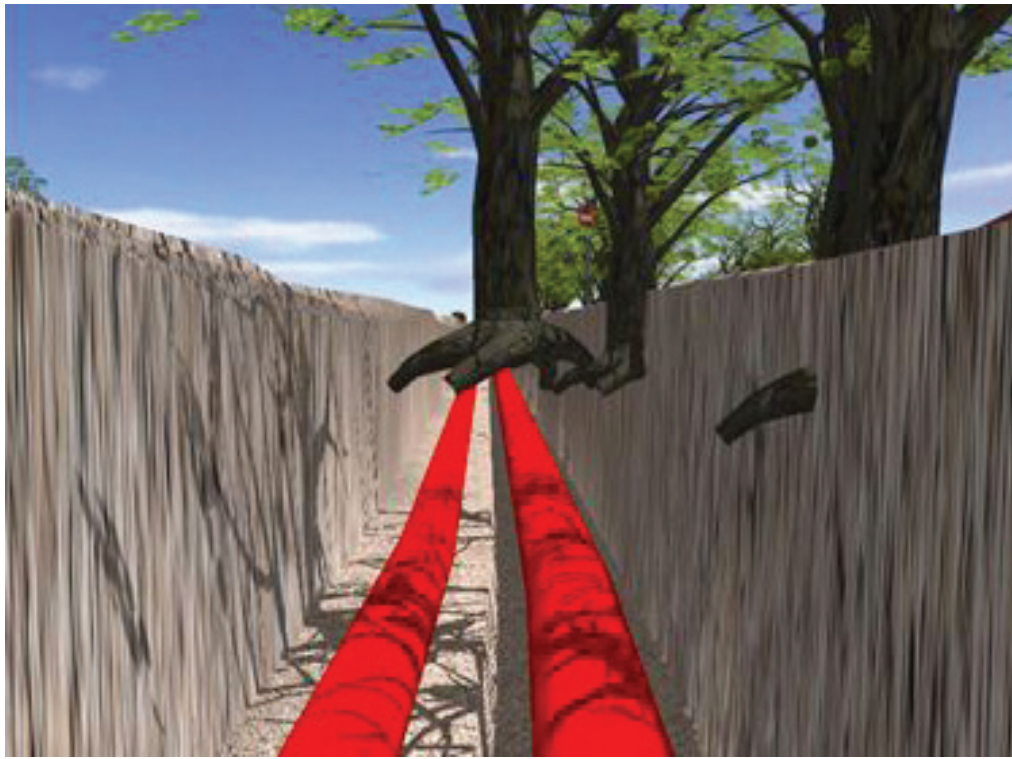
In the proposal stage, Cole Engineering used InfraWorks to consolidate different data files (such as 2D CAD, GIS, raster, and 3D models) to create an existing conditions model. Then the team developed its pre-engineering design with Civil 3D software and imported that design into InfraWorks to create project visualizations and simulations in the context of the surrounding neighborhoods—helping the firm distinguish its proposal from its competitors’ and secure the contract.

For its detailed design, Cole Engineering is using Civil 3D and InfraWorks in combination to develop, visualize, and communicate the project in the context of the existing environment. “Most engineering firms still rely on traditional 2D plans and profiles to communicate design alternatives and concepts for civil infrastructure projects,” says Lyons. “But with our transition to BIM, we now use visual communication tools to inform decision making during the design process and to convey those designs—helping clients, municipal agencies, and public stakeholders better understand the design and the impact of that design on the surrounding environment.”

Conceptualize designs in context

To develop the project proposal, Cole Engineering combined a variety of publicly available datasets to create a model of the existing project area in InfraWorks. These datasets included: orthophotography and a digital elevation model (DEM) of the existing terrain from airborne survey; GIS information that contained property, right-of-way, and utility data; and digitized features such as trees, poles, lights, building pads, railway lines, and roads. The firm added other existing features that would influence the design (such as water towers and bridges) to complete the model of the surrounding area.

Using Civil 3D, the firm developed a design proposal for the water mains, trenches, shafts, and tunnels, and imported that design data into InfraWorks for project visualization. “When it comes to design communication, there’s no question that 3D project visualizations are far superior to 2D drawings,” says Winter. “They help clients and other project stakeholders quickly grasp the entire scope of a complex design, regardless of their engineering background.”



Cole Engineering could identify which trees located on private property might be impacted by the trenching. Image courtesy of Cole Engineering.

Unfortunately, the widespread use of design-time visualization does not extend to civil engineering and infrastructure projects. At Cole Engineering, we're changing that and using project visualizations to improve the design and delivery of our infrastructure projects.

—**Jeff Lyons**
Business Unit Leader for AEC Solutions
Cole Engineering Group, Ltd.

Cole Engineering relied on the IMX file format to transfer data between Civil 3D and InfraWorks. "InfraWorks software maintained a live link to the IMX file containing all relevant Civil 3D design information," explains Lyons. "When there were changes to the Civil 3D model, all we had to do was click 'Refresh' to update our InfraWorks model and visualizations."

When the concept-level design was complete, Cole Engineering created a series of high-level concept images and animation sequences of its virtual design model that were included in its proposal package for the client. "Our InfraWorks model was developed over just a two-week period," says Winter. "After we got the project contract, the only concern the client had was that our use of the InfraWorks project visualizations set the bar too high for other firms bidding on future projects."

Visualize infrastructure designs

On winning the contract, Cole Engineering commissioned a high-definition, truck mounted mobile LiDAR survey, replacing the airborne DEM used during the proposal phase with a very precise ground survey. The survey data included documented survey codes that, when imported into Civil 3D and InfraWorks, enabled the applications to automatically generate the appropriate 3D model objects such as trees, telephone poles, hydrants, and so forth. "The new schedule didn't allow us time to perform a conventional ground survey," says Winter. "This truck mounted mobile LiDAR gave us the same information with the same quality and accuracy, but much faster."

Cole Engineering used Civil 3D software to model the detailed design, including alignments, profiles, and sections for the pipes and trenches. "We were able to layer in all the different databases, so we knew exactly where the utilities were, where the property lines were, and therefore where we should dig our trenches," says Winter. "We could even identify which trees on private property might be impacted by the digging."

To visualize the detailed design in the context of the surrounding environment, Cole Engineering once again imported its Civil 3D model to InfraWorks and created new still images and animated videos of the detailed design. "We even used InfraWorks to help our client visualize project construction," says Lyons. "We simulated construction staging areas to help them understand space requirements and determine the impact on road and pedestrian traffic, and hazardous intersections and railway crossings."

"Seeing our design against the municipal backdrop simplified, and therefore expedited, our design investigations and helped us shorten the delivery of our design," says Winter. "We were able to quickly identify and resolve design issues in this virtual environment—identifying potential utility conflicts, right-of-way concerns, and constructability issues." In addition, Cole Engineering's images and animations helped the client better understand the design and assess its impact on neighboring businesses and homes.

Improve public outreach

Some of the videos Cole Engineering created for the Region of Peel merge InfraWorks animations with real aerial and ground footage, and include narration that explains the project, the construction techniques in use, and the mitigation and restoration measures in place. As the project progresses, these videos will be shown on the Region of Peel website, helping to communicate the design to the public—informed affected property owners about the work that will be happening outside their door and allaying concerns about the project.

"It's not surprising that 3D models and visualizations are better at conveying designs that are, after all, 3D in nature," says Lyons. "But in the past, producing visualizations of infrastructure projects—particularly those that portrayed the design in the context of the surrounding environment—were very expensive and/or time-consuming to create. With InfraWorks, these visualizations are very easy and inexpensive to create."

Visually enhance design information



The firm brought together various data types to create the model in InfraWorks. Image courtesy of Cole Engineering.

The InfraWorks model even includes InfoTips, a custom application created by Cole Engineering to dynamically display Civil 3D design data within InfraWorks. As a designer reviews the InfraWorks model, there are visual Infotip balloons (pre-calculated Point of Interest Dataset Markers) floating over important design elements. When the InfraWorks user clicks on the balloon, a window pops up providing pertinent design information. For example, there are InfoTips hovering above all pipeline and utility crossings that display the pipe's ID and network name, the type of utility and its ID, the distance between the pipe and the utility, as well as the diameter and elevations of the top and bottom of the pipe and the utility.

"These are more than just static displays of design information," says Lyons. "The InfoTips include real-time links back to the original Civil 3D design models. When the model changes, the information displayed by the InfoTips automatically updates as well—helping to ensure our project team is accessing and visualizing accurate, up-to-date design information."

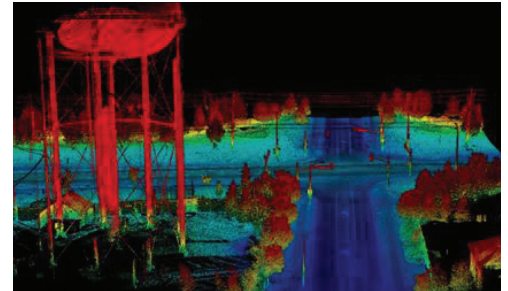
The result

The design of the first phase of the project is complete and the bidding process for construction is underway. Cole Engineering successfully met the project schedule of this first phase and is currently using Civil 3D and InfraWorks on the remaining three phases of its detailed design.

"We pride ourselves on being proactive versus reactive when it comes to design issues," says Winter. "By using InfraWorks to visualize our design as it progresses, we can quickly and easily identify and resolve problems and present proposed solutions to the client. We can show them exactly what the problem is and how to solve it—expediting the entire decision-making process. When time is of the essence, InfraWorks provides invaluable tools."

"BIM and InfraWorks enable us to more fully experiment with and review our concept-level planning, and more accurately build and analyze our detailed designs," says Lyons. "The end result is a more realistic, precise, and valuable digital submission process for our clients."

For more information, visit
www.autodesk.com/infracworks



Data types included truck mounted mobile LiDar which was used to add additional detail to the designs. Image courtesy of Tullock Mapping Solutions..

After we got the project contract, the only concern the client had was that our use of the InfraWorks project visualizations set the bar too high for other firms bidding on future projects.

—Alan Winter

General Manager, Greater Toronto Area
 West office
 Cole Engineering Group, Ltd.