What does BIM mean for civil engineers?

Road and highway projects can benefit from design using building information modeling. By Adam Strafaci

A few weeks ago, I was on the phone with a civil engineer who needed help with a question he was asked by an architecture firm: “Are you BIM ready?” The civil engineer had a good understanding of the benefits of building information modeling (BIM) for building design, and had ideas about how those benefits might extend to civil engineers. But he wasn’t sure how to answer the question. Did BIM even apply to civil engineers? And if it did, would he have to use new software to be “BIM ready?” What if he wasn’t working on projects that involved buildings? Could he still do BIM?

As BIM adoption has become more of a standard in architecture and construction, civil engineers have been taking notice and are asking the question: What does BIM mean for me? For civil engineers who regularly work with architects or structural engineers, BIM may already be part of their vocabulary. But for those who spend their days designing roads and highways, BIM represents a whole new world, one that is highly relevant now and will continue to grow in importance.

What is BIM?

Building information modeling — BIM — is not a product or proprietary software program. It is an integrated process built on coordinated, reliable information about a project from design through construction and into operations. BIM is not just for architects. While it has its roots in architecture, the principles of BIM apply to everything that is built, including roads and highways, and the benefits of BIM are being experienced by civil engineers in the same way they are enjoyed by architects.

BIM is not just about 3-D (although that is part of it). BIM allows engineers more easily to predict the performance of projects before they are built; respond to design changes faster; optimize designs with analysis, simulation, and visualization; and deliver higher quality construction documentation. Furthermore, it enables extended teams to extract valuable data from the model to facilitate earlier decision making and more economic project delivery.

Drafting-centric design limitations

To understand how BIM applies to civil engineering, and to road and highway design projects specifically, it is helpful to first take a look at the legacy 2-D drafting-centric design process. This process, which can best be described as “siloued,” starts with preliminary design, moves to detailed design, and then on to construction documentation. Each step is completed before the next one begins, and collaboration is very limited. This process works well until the inevitable design change needs to be made, at which point time-consuming and error-prone manual drafting updates are required. As such, this process has inherent practical limitations.

The graph in Figure 1 maps the level of effort required over the life of a typical road design project from preliminary design all the way through to construction and into operations. As the blue line indicates, the ability of the engineer to impact project performance is declining and the cost of making design changes is increasing. This gets to the heart of the limitations of a drafting-centric workflow. While it is theoretically possible to use this process to perform iterative design for optimizing project performance, realistically, very little of this is done. It is just too costly to make multiple design changes and evaluate impacts on project performance once the documentation is started. As a result, a drafting-centric process typically yields the first design that meets code, and not necessarily the optimal design.

New workflows with BIM

Contrast this legacy approach with one that is becoming a standard across the AEC industry — BIM. Implementing a BIM process for road and highway design starts with creation of coordinated, reliable design information about the project. This results in an intelligent 3-D model of the roadway in which elements of the design are related to each other dynamically — not just points, surfaces, and alignments, but a rich set of information and the attributes associated with it.

For example, perhaps halfway through a roadway design project the profile needs adjustments to a vertical curve and the grades. By adjusting the profile, all of the related design
elements update automatically, allowing the designer instantly to see the impact to cut and fill and right-of-way.

In this way, BIM facilitates evaluation of many more design alternatives. As part of the design process, civil engineers can leverage the information model to conduct simulation and analysis to optimize the design for objectives such as constructability, sustainability, and road safety. Finally, with a BIM process, design deliverables can be created directly from
While it has its roots in architecture, the principles of BIM apply to everything that is built, including roads and highways.

...ing software built for BIM, road design, geotechnical, stormwater, and bridge teams use specialized analysis applications and custom tools to simulate and analyze different aspects of project performance.

However, in most cases, these tools are being used as part of a disconnected workflow. The analysis and simulation is being done outside of the design environment by different parts of the organization, and, as a result, it is difficult to coordinate one type of analysis with another to achieve optimal results.

Autodesk representatives recently shared with WisDOT the value of a BIM process where many types of analysis and simulation would take place as part of the design process, allowing engineers quickly to cycle through iterations and get instant feedback on project performance. Traffic capacity, noise, lighting, drainage, and signage analysis could all be done earlier in a project as part of the design process, well before significant effort is invested in construction documentation. WisDOT engineers acknowledged the benefits and that, if the technology was heading in this direction, they looked forward to experiencing this reality.

From my experience with the WisDOT team and many conversations with civil engineers during the last year, I am convinced of the value of BIM for road and highway design both now and in the future. Organizations such as WisDOT are well on their way to becoming BIM-ready.

Adam Strafaci is senior industry marketing manager, Civil Engineering, for Autodesk, Inc.