

The Future of Civil Engineering: Design for the Lifecycle of the Asset

MicroStation Connections

By Lauren Browne, ConnectPress Editor

“The trouble with our times is the future is not what it used to be.” - P. Valery

With infrastructure, particularly with regards to civil engineering, there is a focus on problem solving as the world experiences major changes like globalization, resource scarcity, population increases, political shifts, and cultural evolution. As the profession of civil engineering has always been vital to shaping how things get from point A to point B, this article aims to shed light on how civil engineers are adapting to trends like information modeling and sustainability, and predicts where the profession is headed over the next twenty years as it spearheads the aforementioned changes.

Whether you call it model-based design, information modeling, building information modeling (BIM), or for bridges Bridge Information Modeling (BrIM), this trend in the process of design and construction isn't just being seen in the architectural industry. It's becoming more important to the civil engineering profession as the economy has brought to the surface things that have always been on the minds of civil engineers – like tighter timelines and tighter budgets, which both lead back to the question of how would it be possible to make this process more efficient with less design errors in the field.

“Building better, faster, cheaper is the mantra of the day. Bentley BrIM can help a lot in this regard,” said Shri Bhide, director of product management, BrIM team, Bentley Systems.

This is where model-based design has really proven itself to spearhead these challenges. Information modeling coupled with better project delivery options, allows engineers and contractors to “automate much of the design to construction workflow, dramatically improving productivity and accuracy, and completing heavy construction projects faster and more profitably,” explained Terry Bennett, Senior Industry Manager, Civil Engineering & Construction at Autodesk.



Image courtesy of Autodesk.

A screen shot of Autodesk's Infrastructure Modeler 2012, which assists GIS, planning and civil engineers professionals with conceptual design by creating, evaluating and communicating project proposals.

Adam Strafaci, senior industry marketing manager, Infrastructure at Autodesk, said that while civil engineers might not necessarily call it a BIM approach, they are absolutely doing a BIM type of workflow, one in which is a model-centric

approach. “We started to see it with land development engineers as a way to better coordinate the architect and other disciplines on a project. But what we’ve seen lately is this idea that BIM is extending into road and highway projects where you’re able to build a very rich model and use it for things like driving visualization, simulation, analysis, and quantity take off.”

In the case of bridge design, Bhide said he’s seen the bridge industry change in the last five years to include more BrIM: “Demand for improved modeling, true-to-life details, constructability, and better integration of the real-time data between the multiple disciplines involved in a bridge project has been steadily increasing for a number of reasons:

1. reduced construction costs with economical designs
2. improved quantity take-offs
3. realistic visualization for selling the project
4. virtual drive-thru.”

As Bhide explained, Bentley’s BrIM approach that they developed was in response to more of the industry needing to provide a virtual data model for all of the bridge lifecycle.

Another reason why model-based design is being used more often is because of government organizations like the GSA and U.S. Army Corps of Engineers mandating the process of their projects. With government support, others are following suit, like transportation agencies. In addition, in one example, “there’s a large land owner in Texas that mandated BIM not only for building projects but for any associated land development projects,” said Strafaci.

While model-based design is a newer process that is catching on in the civil engineering industry, sustainability and green engineering is not. With sustainable design and construction getting so much attention these days, it’s interesting to examine where civil engineering stands with this green uptake.

Strafaci said sustainable design is definitely prevalent in the civil realm, but it’s nothing new because it’s something the civil engineer has been doing for a long time – the only difference is now it is labeled as sustainable design. “So for example, there are requirements around a land development project or a transportation project. The civil engineer does an analysis before the development to figure out how much stormwater run-off is going to come off that site. And then they need to demonstrate that as a result of the development, they’re not increasing the amount of run-off coming off and they’re not negatively impacting the water quality,” explained Strafaci.

In the simplest form of sustainability every project could be more or less green, just depending on how much energy, water and materials are used for the design, construction and operation. Bhide explained there has been a “renewed awareness” in the choices made to need to build bridges more efficiently and less expensively, and that sustainability is being sewn into projects to help meet these needs while not compromising the resources of future generations. “Increased consumption of recoverable industrial wastes and byproducts in bridges, accelerated bridge construction, and design using high performance materials for long service lives of 75 or 100 years are a few sustainable strategies that are becoming very popular,” said Bhide.



Photo courtesy of La DOTD

A perfect example of designing with the lifecycle in mind: The I-10 Twin Span over Lake Pontchartrain in Louisiana was designed for a 100-year service life. The project is one of Bentley's 2011 Be Inspired Finalists and is the largest public works project.

Bennett brings up the good point that through software tools that make it easy for model-based design, it encourages smarter choices with these sustainability factors and engineers can “greatly increase the odds of a sustainable outcome... It enables civil engineers and designers to understand the environmental impact of every design element early in the design process—long before they make critical design decisions about site location, stormwater management or material movement.”

Even though the concept of sustainability isn't new to civil engineers, the incentives to design civil aspects of a project as green is more a focus now than ever with the popularity of the LEED rating system. Many of the credits in LEED are civil-focused with credits in water resources and stormwater management.

In addition, Strafaci notes that there's been an emergence of new rating systems that support sustainable practices in civil engineering. He has heard of a green highway initiative, not a formal rating system yet, in which “a number of engineering teams and DOTs have gotten together to try and put together guidelines on designing green highways with things like the pavement you use (for example permeable pavement), how you manage drainage, and reducing the impacts of transportation systems.”

And so with systems like model-based design and concepts like sustainability paving the future, what lies ahead in the future for civil engineering? It can be a little daunting to think about the future of infrastructure, but in general it seems only natural to predict that more cost-effect, high quality, more sustainable designs in less time with less mistakes is a safe bet.

Bennett noted that over the next 20-25 years, \$41 trillion dollars will be spent on infrastructure projects globally, with a heavy focus on Asia. This includes:

- \$22.61 trillion in water with \$9 trillion alone of that to be spent in Asia
- \$9 trillion in electricity with \$4.23 trillion to be spent in Asia
- \$7.8 trillion in road and rail with \$2.11 trillion to be spent in Asia
- \$1.59 trillion in airports and seaports with \$.5 trillion to be spent in Asia

With all of this money that will be spent and sustainability on the minds of everyone, both Strafaci and Bhide agree that it will be critical for civil engineers and project owners to start thinking more about the lifecycle of the project and how to

design the project for the cost of the entire life. “What you’re starting to see with some of these larger projects, these public-private partnerships, these design-build-operate types of contracts, is that companies aren’t just building the highway, but they are building it and then signing on to manage it as a for-profit business for say, twenty to thirty years,” said Strafaci.

Strafaci also believes that to complement this bigger interest in designing for the long term, it’s going to require the technology to change in order to facilitate this handling vastly more amounts of information. The models will be much richer because they won’t just be used for design and driving construction, but also for operating the project in the future, said Strafaci.

In addition, Bhide said the for bridge design, “increased use of pre-fabricated bridge elements and systems, and accelerated bridge construction will continue to be main strategies for delivering bridge projects in the U.S. for the long haul.”

With a design’s lifecycle on the forefront, the process of model-based design and BrIM can make this transition of designing for the lifecycle easier. Simply stated, Bentley explains the cornerstone of BrIM is data reuse. Bentley considers the bridge information model to have the capability to be the information source of the bridge asset, making BrIM applicable to the entire bridge lifecycle.

Civil engineers, as all infrastructure professionals do, have their work cut out for them: these are changing times where bridges can no longer be built without construction waste being a factor, roads can no longer be built without factoring in sustainability aspects like permeable pavement, and successful projects are focused on model-based design from concept all the way through operations.

Autodesk and Bentley echo each other’s ideas on the future of the civil engineering industry lying in the adoption of model-based design, which will clear the way for designing for the lifecycle of projects. And the rest, as they (will) say, (will be) history.

Lauren Browne is a graduate from Northern Arizona University where she received a Bachelor of Arts in English and a minor in journalism. Other than wordsmithing, Lauren enjoys running, hiking, biking, climbing, and really anything outdoors.