conference preview

BIM FOR BRIDGES AND STRUCTURES

Bridging the information exchange chasm.

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WE ARE ARGUABLY living the greatest age of information and technology.

In the past decade, there has been an explosion of information-producing technology and software. Even more so, we are witnessing mass use of that information. Google's and Facebook's—two of the largest companies in the world by market capitalization—greatest asset is their ability to own, manage and maintain information. And we are experiencing the same evolution in the architecture, engineering, construction and operations industries, with the maturity of building information modeling (BIM) and the development of smart cities.

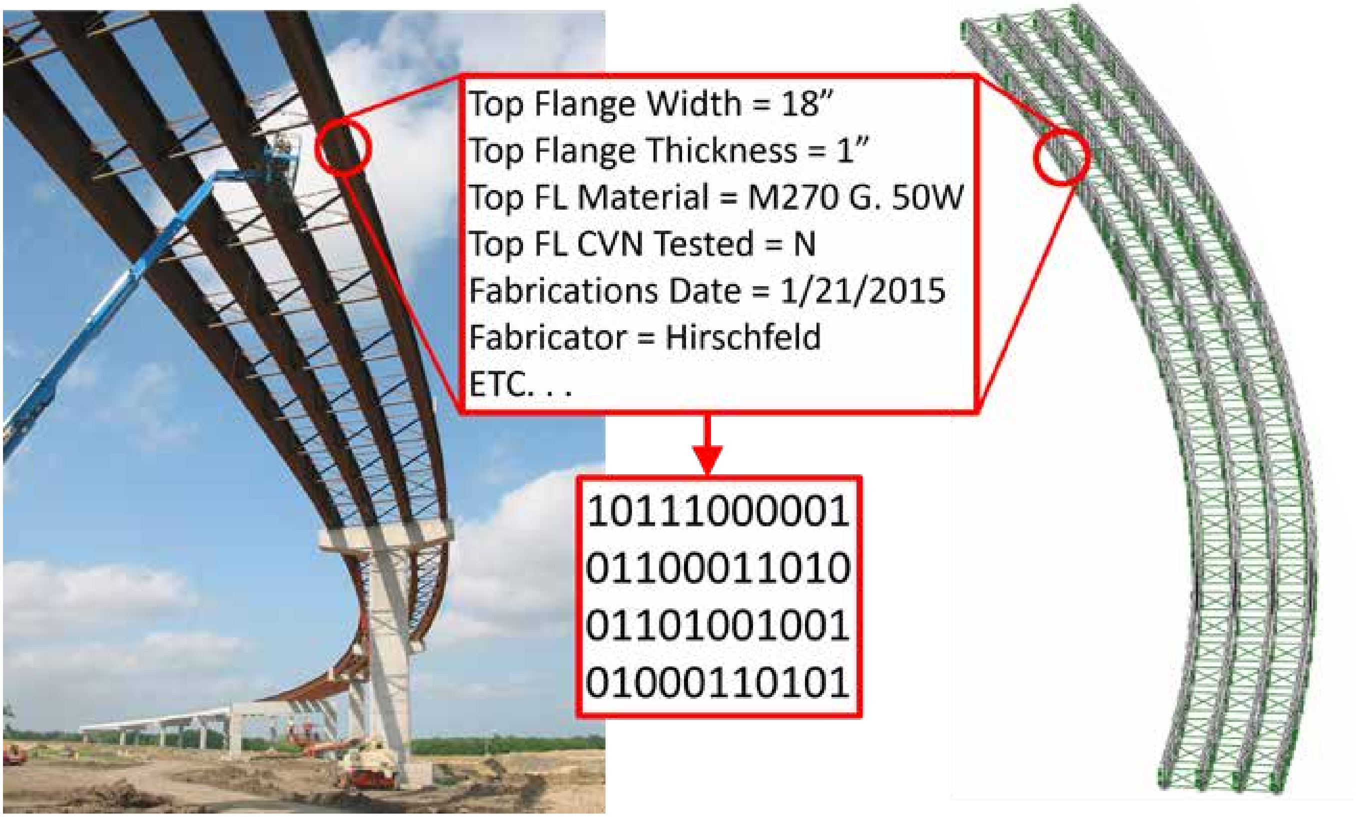
However, the transportation infrastructure has been slow to adopt these technologies, mainly due to the non-interoperability (e.g., sharing capabilities) of the various software options. There is a great need to bridge the chasm of non-interoperable software in order to reap the full benefits of information production, use and sharing for the life cycle of bridges and other transportation structures. To meet that need, we must look to adopt the proven means and methods of BIM seen in the building domain.

The concept of BIM for bridges and structures will be integral to the management of bridge projects in the future, and state departments of transportation (DOTs) and other owners are already beginning to see the potential asset management advantages of using BIM. BIM is not just a pretty 3D picture of a structure that one can fly through and use for marketing purposes. Rather, it encompasses the information that describes a structure, from conception through operation and beyond. Essentially, BIM *is* information. Behind the scenes of the representations of the model is data. To a computer, data is just bits and bytes—1s and 0s. Importance is placed on the *data that describes* the geometry, material properties, section properties, fabricator changes, coating systems, field changes, etc. Being able to use the information in a stand-alone fashion (e.g., structural design) can be useful.

However, an enormous potential exists to link that information to other stakeholders, such as designers to fabricators to contractors to maintenance/asset management tools. This sharing of information is known as information exchange, and the free and effortless exchange of information from one software to another is called interoperability. For the bridge industry to capitalize on interoperability to enhance asset management systems, a standardized scheme and method needs to be developed and adopted. As the National BIM Standard and the industry foundation classes (IFC) (**www.nationalbimstandard.org/**) provide the standards and methods for information exchanges in the building domain, so too must such standards and methods be developed for bridges. In order adopt a neutral format like IFC, the bridge industry must first develop standardized exchange requirements.

AASHTO/NSBA Efforts

The National Steel Bridge Alliance (NSBA) is leading the way for standardization of steel bridges by developing exchange requirements for these structures. The effort to develop a standard has been going on for over a decade. Several years ago, AASHTO/NSBA began a task group (TG15) formed to focus on Data Modeling for Interoperability, headed by Dr. Stuart Chen. This group started to build a data set library and develop a graphical representation of the bridge life-cycle (process map). Formed as a pilot study, the TG10/TG15 subcommittee worked with erection engineers to determine a model for this standardization process. Over the course of two years, the authors of this article led the subcommittee of dedicated volunteers, including Ron Crockett, Steve Percassi, Jon Stratton, Rob McKenna, Jon Gast, Ronnie Medlock, Hanjin Hu and others. The group developed an information delivery manual for steel bridge erection engineering that identified the erection engineering exchanges needed for interoperability. Currently, the AASHTO/NSBA database has grown to more than 2,000 unique entities that can be specified for any given exchange. This bottom-up approach to BIM standardization is an important distinction that uses bridge industry experts rather than BIM experts to define the necessary information to be exchanged. Several lessons were identified, including detailed assumption and standardized formats, which would enable future work to be completed faster and



Bridge as binary data.

more purposefully. Currently, TG15, chaired by Samy El-sayed, is modifying final deliverables per comments provided by AASHTO/NSBA members.

Latest FHWA Push

Since standardization of the data scheme needs to be at the national level, and not state DOT-specific, the Federal Highway Administration (FHWA) has an integral role to play. One of the most notable voices in the realm of BIM for bridges and structures is Brian M. Kozy, principal bridge engineer at FHWA. Kozy has been a staunch advocate in moving the industry toward a BIM-based project development and asset management approach. In a recent discussion with Kozy, he stated that there are two global benefits in adopting BIM for bridges and structures:

1. “When engineers produce and maintain a BIM model, this is fundamentally providing a product that has much greater value to the owner and other stakeholders downstream. Anyone who has need of information about the bridge can benefit when a 3D model has been used, from engineer to fabricator to contractor to owner to inspector and beyond.”
2. “BIM-based workflow fundamentally advances the way that engineering is done for the bridge. Engineers and other stakeholders can invest more of their time on developing the optimal solution for the project rather than wasting time on the data management and other bookkeeping aspects of the project.”

FHWA, along with 13 state DOTs, has pledged to finance a pooled-fund study lead by Ahmad Abu-Hawash of IowaDOT and backed by SCOBS T-19 (chaired by Scot Becker of WisDOT) (**www.pooledfund.org/details/solicitation/1450**). With a current total of $1.24 million pledged, the FHWA and these DOTs are committed to moving the practice forward by taking the recommendation from the recently completed NCHRP 20-07, Task 377, led by Michael Baker International, which outlined the steps to develop and implement BIM within the bridge industry.

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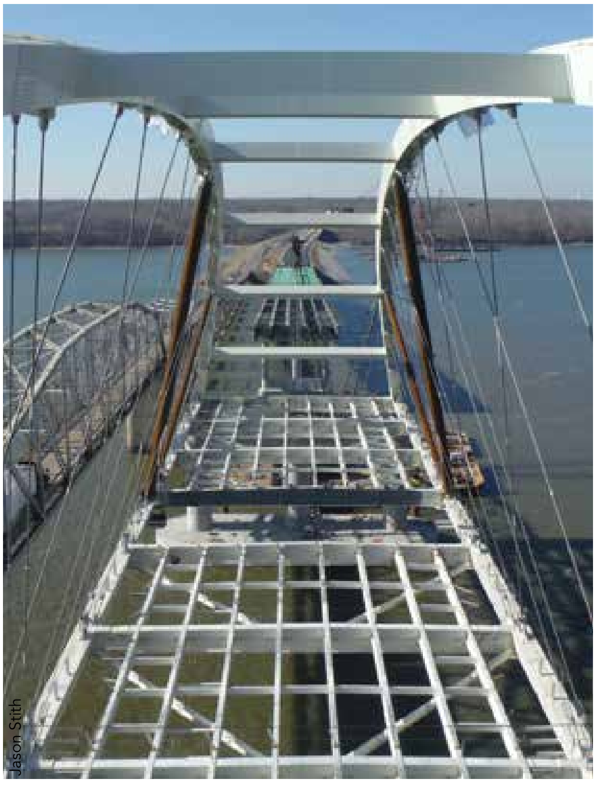
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Looking Toward the Future

As this transition to a digital, model-based workflow transpires, the members of the AASHTO/NSBA committee will be advising and providing recommendations from lessons learned on behalf of the steel bridge industry. In the not-too-distant future, when BIM for bridges and structures is realized to its full potential, much of the information transferred via engineering drawings will be exchanged electronically.

What does this mean for engineers? The designers will provide the camber information, which fabricators will be able to transfer into detailing software without the risk of typos or time-consuming data entry. Another area fabricators have identified where BIM will assist is the bill of material sheet necessary for ordering steel. Identifying and keying in this information takes time and resources and introduces a risk for error. CNC machines need information about the bridge geometry that could originate from the designer and be refined by the detailer. Quick and efficient data exchanges would reduce cost and provide meaningful advancement over current practices. Later, the bridge lifecycle load raters and consideration for overload permits need much of the same information as the original designers, in addition to as-built and bridge inspection conditions, which, if stored electronically in a standardized format, would expedite accurate ratings. The list of possible improvements is vast, but it is fair to say that perpetually scarce transportation funding and resources will necessitate this kind of innovation.

Significantly, tangible benefits via a model-based approach have been proven in the building domain, such as reduced errors, shortened schedules, decreased projects costs and increased profits. However, in order to realize the full potential of BIM for bridges and structures, it's essential for all stakeholders to band together to provide collaboration and alignment. BIM has been successful because it has been driven by the building industry, and those of us in the bridge industry must drive the effort for our projects as well. ■

This article is a preview of Session B8 "Reducing Errors in Bridge Drawings—What You Can do Today and Look to in the Future" at NASCC: The Steel Conference, taking place April 11-13 in Baltimore. Learn more about the conference at www.aisc.org/nascc.


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