conference preview

THE CHANGING BUSINESS CLIMATE

How global modeling is affecting our world.

BY JAMES STEVER, JAMES SCHWARTZ, ANDREW RUFFIN, PE, AND JOHN OTTINGER

MODEL-BASED DESIGN IS NOTHING NEW, but it's perpetually evolving.

Four industry experts from different areas of the steel design and construction industry share their experience with model-based workflows and offer their advice on how it can and should be used moving forward.

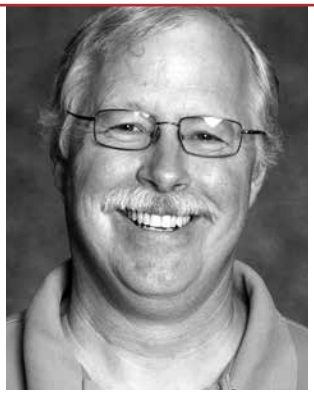
James Stever, Detailer

In the 1990s, it was "electronic data interchange" or EDI. In early 2000s, the new buzz phrase was the now-familiar "building information modeling" or BIM. Each concept was based upon the best technologies of the day and promised big productivity gains that would lower project costs and make steel the building material of choice.

While it was an improvement in terms of project communication—which is always a good thing—in my opinion, it was still a digital flavor applied to a historical process and did not deliver the significant cost savings expected. Manufacturers and detailers were still reviewing information and models that were static snapshots in time, transmitted via historical communication channels. This process shifted some of the coordination liability and cost to downstream players. On the manufacturing side, modern technologies such as high-speed internet connections for video conferencing and large file transfer protocols had to be implemented, along with an exponential increase in electronic file storage. Additional software support such as Revit, Navisworks, FabSuite, Procore and other applications were required to deal with design-side electronic information and downstream BIM collaboration. As a detailing firm, our costs went up along with our deliverables, with very little compensation to show for it.

Today, we are hearing the term "global modeling." How is it different and what are its implications? From a manufacturing perspective, global modeling can be defined as: sharing design and fabrication models for collaborative purposes to the complete integration of design models and associated information with the manufacturing models for dissemination across all construction disciplines through erection. (Got it?) This integration is being brought together in cloud-based technological solutions that allow for real-time review and collaboration in lieu of the historical static 2D evaluation.

The implications of global modeling from the manufacturing side are yielding profound results. The approval process, for example, can now be done in real time, with the comments from the architect and structural engineer applied to elements in the consolidated models in lieu of the 2D PDF abstract markups we have been accustomed to. This allows the detailer to visualize, isolate and focus on those elements with comments for evaluation. Elements with no comments can typically be released for fabrication that same day without the need to sift through hundreds of 2D drawings. In many situations, minor structural changes can be facilitated with no cost impact. And even if there are costs involved due to size changes, etc., pixels are much cheaper than

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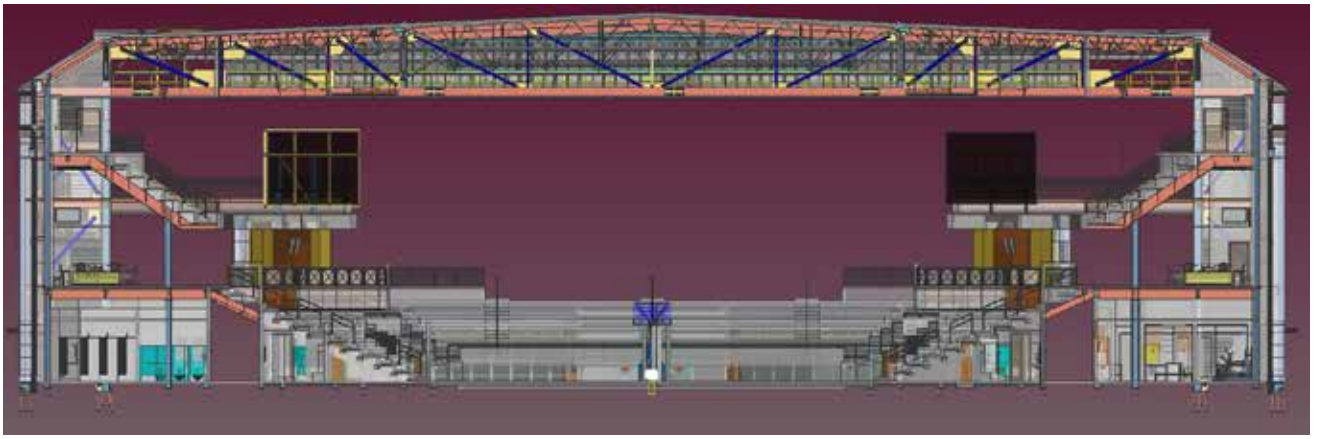


A 3D model of Jerry Richardson Indoor Stadium at Wofford College. The engineer was able to take advantage of cloud computing and log in to a remote desktop provided by the steel detailer to open the live detailing model.

physical concrete and steel. Typically, we are realizing a one-half to two-thirds decrease in approval cycle times, not to mention a reduction in or even elimination of RFIs that can translate into costly change orders. This is a significant factor to an owner and can be the difference between using steel verses concrete.

James Schwartz, Software Developer

It was around 1996 when the company I worked with first brought a 3D model from a design product into a 3D fabrication product. Though there were a large number of repairs required to achieve the required fabrication level, it was still quite exciting. Since it was a relatively new process, we were quite forgiving, with the belief that things would only get better. Even back then, we were complaining about the quality of contract drawings that we were receiving and hoped this process would improve the drawing issue. The early 2000s brought us from EDI to BIM, and I still have a lot of *Modern Steel* articles expounding the virtues of BIM, EDI and VDC (virtual design and construction). The early adopters were seeing great gains in communication and RFI reductions. But even with all of this progress, I still recall conversations with clients trying to talk them off the ledge due to issues with importing data from one program to another.

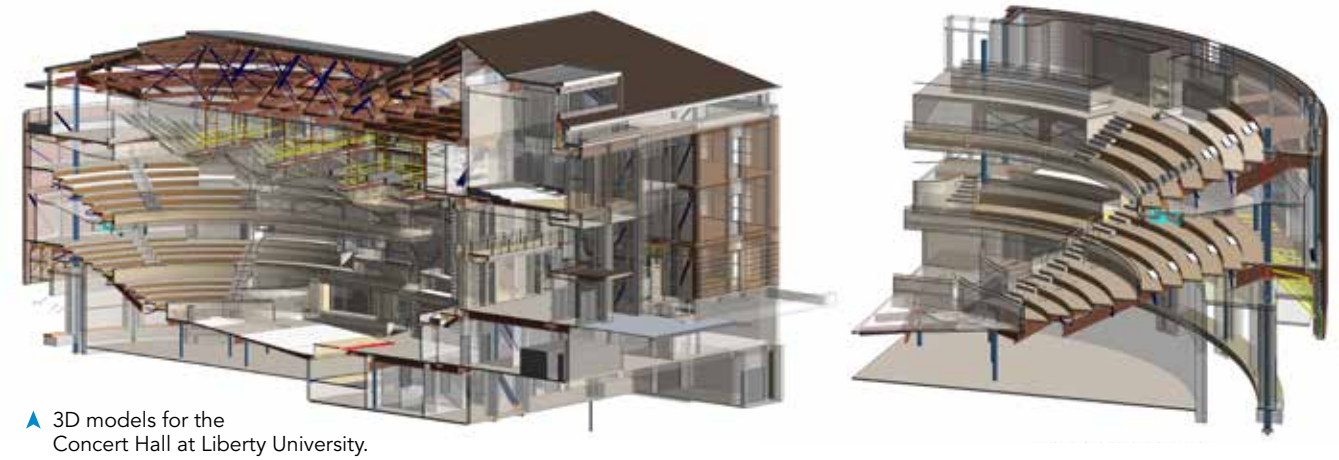
More than two decades later (no flying cars yet!) we are progressing—and yet still struggling in the transition stages. With new technologies come new problems. We have seen great gains between architectural and engineering modeling, as well as with data-rich federated or collaborative models used for coordinating the various trades. But we still struggle with the delivery between the design model and the fabrication model. With all the advancements, software companies still have not completely bridged this gap—to the point that some larger companies have taken this upon themselves to improve this process by creating their own software or plug-ins. We all know the effect of revisions and trying to communicate across the secondary steel. On the fabrication, detailer and erector side, we are seeing a new struggle with what governs: the drawings or the model (even though the *Code of Standard Practice* says that either can). Though the contract states that the drawings govern, in a number of cases that I have consulted with, this is not what is reflected. At best, it can be a hodgepodge of the two. At this point, I want to express that data is just data, and for some purposes, 3D may be the best form of communication—other times, 2D or Excel files suffice. Also, software does not create communication, it only facilitates it! We tend to become too dependent on software, trying to replace communication with software instead of using software as a bridge. Due to this, we find ourselves in this resolvable dilemma. In my experience and from some research, it all begins at the beginning.

Years ago, I read a series of *Modern Steel* articles ("It Doesn't Have to Be That Way! Parts 1-3," January-March 2003, available at **www.modernsteel.com**) on communication and bringing all involved parties together early as possible to create a clear plan of expectations, which are to be documented—a concept I fully support. As the saying goes, "Good fences make good neighbors." A good BIM execution plan needs to be negotiated, one that carries all the way through to the fabrication and erection level. If the engineer is required to provide and maintain a model with LOD 300 elements, there is a cost that is associated with this. Concerning LOD (level of development), there is no such thing as an LOD model, only LOD elements within the model. (See **www.bimforum.org/lod**, as well as the article "BIM Execution Plans" on page 52, for more on this.) In short, clear processes are required to be set—e.g., which elements in a model are accurate and what is to be done when the model is deviated from, not forgetting the erectors that may not have 3D model access.

Andrew Ruffin, Structural Engineer

Most readers of this magazine are familiar with the process of steel shop drawing review and have likely had nightmares about receiving multiple copies of huge sets of steel shop drawings. The process of flipping through pages of erection drawings and piece marks—and possibly a connection calculation package that's hundreds of pages—has been a dreaded task in many engineering offices across the country. Transferring, by hand, each and every comment to the duplicate sets to be sent to the rest of the team was not only an act of tedium, but also an opportunity for human error or omission.

The advent of electronic shop drawing review provided a welcome relief from the task of transferring comments to additional sets, but still requires flipping between multiple pages to find all the information of a connection. When connection calculations are submitted, the structural engineer of record (EOR) is also left flipping through hundreds of pages, looking for a specific connection to verify that the detailer has met the



3D models for the Concert Hall at Liberty University.

design criteria. Think of all the time spent during this process simply looking for information in drawings before that information can even be processed and reviewed.

As our industry continues to make advances in 3D modeling, clash detection and cloud computing, it only makes sense that the steel shop drawing review process should evolve as well. Many architects and structural engineers have already made the switch to BIM and are building intelligent 3D models that are accurate enough for most coordination. While many steel detailers have been building and using their own 3D models for years, they rarely have the luxury of starting from the structural model. The process of representing the 3D structural model in 2D drawings, then having the steel detailer turn 2D drawings into a 3D model—to then put back into 2D drawings for shop drawing review—creates a duplication of work that does not make sense in today's fast-paced environment.

So how do we leverage the advent of cloud computing and 3D modeling to take the steel shop drawing review process to the next level? At a minimum, I would suggest providing the steel detailer with structural, architectural and any other relevant models. Even if you want the 2D construction drawings to govern instead of the 3D model, it makes sense to provide the detailer with the same information that the designers have. With this information in hand, many questions that may typically be pushed through the RFI process can be answered using the models. The detailer can also link in BIM from other subcontractors to aid in dimensional coordination and connection locations (e.g., precast seating). Having the information contained within the model can significantly reduce administrative time for processing RFIs, for both the detailer and EOR, and minimize delays for the detailer.

Once the model is ready for review and approval by the design team, the virtual review process has many benefits for the team. When we used this project on a basketball arena project, for example, we were able to take advantage of cloud computing and log in to a remote desktop provided by the steel detailer to open the live detailing model. Within this model, segments were released for review as the detailing was finished, and we were immediately able to begin the review process. We were provided with traditional erection plans and details, but instead of flipping through pages and pages of 2D piece drawings, we had a 3D model to see exactly how all the steel was framed. Selecting a member provides all the data associated, including a piece drawing, access to the specific connection calculations and any comments or questions made by team members. The model can easily be filtered to display members that have detailer or EOR questions so that they can quickly be addressed. As segments of framing are approved by the design team, they can be put into fabrication much faster than with the traditional shop drawing approval process.

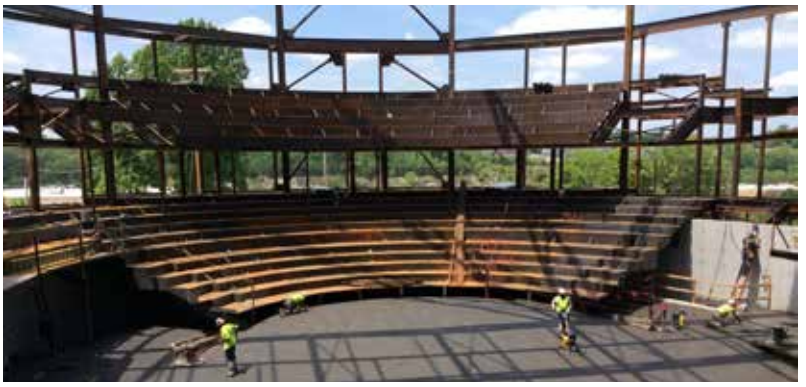
Using the structural 3D model and a virtual steel approval process has many advantages for the project team. The reduction of administrative tasks allows each team member to spend more time focused on critical items and enables the entire process from RFIs to approval to move significantly faster than traditional steel delivery methods.

John Ottinger, Architect

In my career as an architect, there has always been a great frustration over the 2D limitations that we seem to place on the shop drawing review process. I see vast quantities of useful information produced in our 3D modeling efforts, which we then consciously dilute into an antiquated format based on pen and paper. I see plans, sections and details extrapolated from a highly detailed fabrication model that tell only a fraction of the story available to the project team. As architects, we are reviewing submittals with the whole building in mind. From finishes to footings, we are analyzing and integrating multiple systems into a whole. Why do we continue to ignore the opportunity to use the entire picture that is presented by the technology we work with? If we changed how we operate just a little, wouldn't we be better able to coordinate and manage the production of the complex buildings of today?

Not only is the current 2D review process more difficult and time consuming compared to an integrated 3D process, but also the chances of missing critical coordination issues are exponential. This is especially true of structural steel fabrication drawings. We have the tools; the next step is to figure out the way. I took a first step down this road on a recent project, the Concert Hall at Liberty University in Lynchburg, Va.

The 1,600-seat concert hall was designed to support a music program that encompasses a dynamic spectrum of musical styles. Conceived as a finely tuned, wood-lined chamber for natural acoustic musical performances, the hall can also be configured to



▲ The project was the architect's first experience integrating 3D modeling during the steel fabrication submittal review process.

support a wide range of amplified events through sound dampening measures that can be deployed throughout the chamber. The key concept was flexibility. To increase the degree of difficulty even further, we were faced with a fast-track schedule that required multiple early packages, including structural steel. Steel fabrication drawings were being prepared simultaneously with the full interior package of the concert hall. There was not much room for error. This confluence of factors placed even more emphasis on trying to figure out ways to save time at any possible point while maintaining our ability to provide a quality review of submittals.

It was obvious early on that a good deal of work was going to be required in the submittal review phase and that trying to do this using the standard 2D document review process would be a huge challenge. I would like to say that we had a strong clear plan in place, but the truth is a little different. Much of this process developed organically during the structural steel submittal review process as a conversation with the steel detailer and the structural engineer. As we proceeded through the sequence review of the standard 2D drawings, more and more questions arose that required online meetings to review 3D fabrication model. After many of these meetings, the team realized the necessity of having the steel fabrication model integrated into our Revit model for review. It was going to be the only way we could assure that the decisions we were making did not have adverse effects on all of the construction trades later down the line. It would also help streamline the submittal process. Although we had not reached the stage of cloud-based real-time submittal markup that I am one day hoping for, just having the 3D steel information imported into our Revit model allowed us to turn around submittals and RFIs in an extremely expedited manner. An analysis of our first foray into this process is listed below.

Positives of 3D model integration at the submittal phase:

- The review time for submittals was significantly expedited by integrated online model review
- The ability to overlay the architectural model with the steel fabrication model is the only way some of the areas in this project could have been resolved, as there was very little room for error
- The accuracy of final fabrication drawings was proven through model review. Change orders were minimized due to close coordination of all structural members, steel plate seating tiers and connections with the architectural finishes and concrete
- RFI requests were handled directly through online model review, removing lengthy delay inherent in paperwork and pass-through intermediaries
- "Revise and resubmit" was often replaced with "submit for record copy only," resulting in more time saved
- A reduction in change orders led to a savings in cost; quality increased thanks to increased accuracy in fabrication drawings that were coordinated with the architectural elements in 3D; and the expedited review and RFI process saved time

Issues to work out moving forward/lessons learned:

- The delivery method requires setting up protocols for model sharing and submittal review with the construction manager and steel detailer, preferably in advance
- Having an accurate architectural model is a must—LOD 300 per AIA document E202 at a minimum, with added detail required in some cases
- BIM clash detection of architectural/MEP/structural systems is often performed by the general contractor or construction manager using Navisworks. On this project, the review did not include clash detection between architectural and structural systems. It would seem a logical step in complex projects for contractors to build in this review as part of their protocols
- For the next project, take the next step and use an integrated cloud-based 3D model submittal review

The ultimate goal for any architect is to produce the building that they have envisioned for their client within budget and on schedule. This never happens exactly as you plan, but using 3D modeling during the steel fabrication submittal review process for this project allowed us to overcome many of the issues associated with the complex geometry and connections presented by our design. The concert hall project ended up pushing us beyond the realm of our standard workflow and opened up doors to how we could operate more efficiently as architects moving forward. They were small steps, but at least the door is now open! ■

This article is a preview of Session T2 "The Changing Business Climate: How Global Modeling is Affecting Our World" at NASCC: The Steel Conference, taking place April 11-13 in Baltimore. Learn more about the conference at www.aisc.org/nascc.