In-Model Review

The Next Step in Construction Administration

By Adam Azofeifa, P.E.

Building Information Modeling (BIM) has become progressively more popular as a drawing production tool in the last decade, to the point that engineers can now use software such as Revit® and Tekla® to not only create a set of drawings, but also develop a comprehensive model that can be combined with models from the architect, MEP, civil engineer, etc. to thoroughly coordinate the construction documents. Even 2D CAD drawings (for those team members not working in BIM) can be imported into BIM software and rendered for the purposes of clash detection and coordination. While the analytical capabilities of BIM software may not yet be where structural engineers would like it, hopes are high that it will be there soon. And we are fast approaching the day when building engineers no longer maintain archives with dusty rolls of (often incomplete or inaccurate) construction drawings, but rather a single comprehensive as-built computer model, where every component of the building is modeled right down to the light switches.

With this ability to develop 3D models for comprehensive coordination and documentation, doesn't it make sense that we also use modeling software as a review tool? The construction industry is currently in a state of transition when it comes to reviewing construction documents. The traditional path, where a sub-contractor submits multiple sets of paper shop drawings to the structural engineer for review, is becoming an exercise of the past. Some sub-contractors are now using BIM software to develop their shop drawings. And with ever more attention being focused on sustainability, the trend has shifted from delivering hard copies of those shop drawings to simply sending electronic versions. More advanced technology and mark-up software (e.g., Bluebeam® Revu®) enable drawings to be reviewed and stamped without plotting a single sheet. But why stop there? If the subcontractor uses a BIM model to develop its shop drawings, and the engineer has comparable modeling software available, we can cut out the shop drawings all together and engineers can simply review the fabricator's model. This idea may seem unrealistic and maybe even implausible, but the fact is that software already exists that enables fabricators to send their 3D models to engineers for a complete review that takes place right in the model. Now the question is: can we and should we take advantage of that capability?

This past year, the AISC Technology Integration Committee performed a survey of approximately 500 structural engineers to gauge their perspective on 3D in-model review. According to the survey, most engineers (roughly 90%) are using some form of paper or electronic (PDF or similar) drawings to review steel submittals, and less than 1% are using a true form of 3D in-model review. The survey also revealed that the majority of engineers felt that they either had the skills or the staff capable of performing an in-model review. At the same time, when asked if they thought an in-model review would save time compared to a paper or electronic drawing review, most engineers thought not. What this implies is that while many engineers feel they are capable of performing a 3D in-model review, given the opportunity, most would not choose that option. This revelation should not be surprising, considering that 24% of engineers surveyed also think that in-model review will never be the prevalent form of submittal review and shop drawings will always be required.

Having recently performed a 3D in-model review of the steel structure for a large hospital project, I have an experienced perspective on the topic. I can say with confidence that the idea is not something to be dismissed. Not only did the in-model review significantly reduce review time compared to traditional shop drawing reviews, but the process also streamlined the communication of comments and revisions back to the fabricator and detailer. A 3D model enables the engineer to evaluate the structure (or subsection of the structure) as a whole, rather than a single member at a time. And the "intelligence" of the software enables an engineer to review and stamp several connections and members at once. This is the essence of Building Information Modeling – the elements in the model are not simply 3D renderings. Each element, from wide flange column to anchor bolt washer, has information embedded in it – the same information that one would see on a shop drawing, except now it can be viewed within the context of the structural assembly. Additionally, RFI's, submittals, contractor notes, and the engineer's comments can all be attached to the elements in the model. All relevant information is contained in one file that is easily stored, shared, and accessible.

There are still several obstacles that stand in the way of 3D in-model review. BIM software has become so advanced that now even concrete reinforcement can be completely modeled, right down to the last stirrup, but the models become far too visually convoluted to be efficiently reviewed. Shop drawings tend to present the information more concisely when it comes to rebar. In addition, depending on the review software being used, an engineer's review stamp cannot be attached to the model. Some software does enable an electronic signature or stamp to be embedded in the model, but sometimes the only evidence of an SEOR review is a report that is generated to summarize the review comments along with a stamped transmittal back to the contractor. A clear outline in the project contract of the expectations from a model review therefore becomes incredibly important.

These issues and others indicate that perhaps, at least for the immediate future until in-model review software has been further developed, the best review methodology is a hybrid form that combines 3D in-model review and electronic shop drawings – the 3D model provides the engineer with all the benefits of BIM, and all the comments and stamps can be transferred to electronic drawings to serve as documentation of the review.

As structural engineers, we have a responsibility to our clients to design safe structures and facilitate an efficient construction administration process. As we continually strive to improve our codes and design methodologies through research and advanced analysis and design tools, so should we aim to improve our construction administration practices with tools that increase efficiency and contribute to better quality control. Ultimately, our goal is to provide our clients with the best possible structures and to ensure that those structures are being constructed as designed. Any tool that helps us achieve that goal should be embraced. The construction industry is in a generation of technological transition. BIM has already exponentially improved our ability to communicate our designs. It's time to take the next step.▪

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