

Moving to a model-based process  
for shop drawing review and approval in the structural steel industry.

# A Model Approach

BY CHRIS MOOR

**BIM ADVOCATES HAVE LONG PREACHED** the benefits that electronic modeling brings to designers... but have you ever wondered how is it being used in the shop drawing review process?

According to the respondents of a 2011 survey conducted by AISC (“AISC Basic Technology Survey of Fabricators, Detailers, Erectors,” available at [aisc.org/integration](http://aisc.org/integration)), upwards of 80% of steel fabricators and detailers use highly advanced 3D/BIM tools as their primary tool for producing shop drawings and other information for fabrication.

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Yet less than 1% reported using these models in the review and approval process with the structural engineer.

Engineers, fabricators, detailers and others can save considerable time, money, effort and paper by moving to an electronic shop model review and approval process. However, doing so represents a monumental shift in not only the actual review process, but also in the overall culture of the industry.

## The Review Process

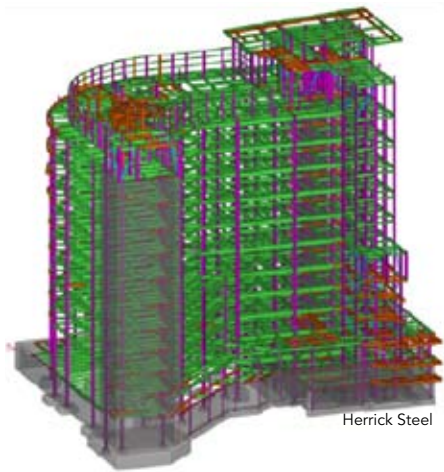
Let’s look at how things are being done today. According to a 2012 survey of structural engineers (“AISC Survey of Structural Engineers Regarding the Shop Drawing Review Process,”

also available at [aisc.org/integration](http://aisc.org/integration)), there are currently six distinct methods for reviewing shop details in practice. They are listed in order of how someone may progress to a full, in-model review process:

1. **Paper-Based (Paper Drawings Only).** This is the traditional method of shop drawing review. Multiple copies of drawings are printed, mailed, reviewed, marked up, distributed and returned. It works but is a bottleneck in the project schedule. More than 20% of the respondents to the survey continue with this method.
2. **“Semi-Electronic.”** This is by far the most common method for shop drawing review used in the industry today. Drawings are transmitted (via PDF or similar format) via email. These drawings are then printed, reviewed, marked up, scanned back to PDF, then returned and distributed. More than half of the respondents use this method.
3. **Electronic Drawings Only.** PDF drawings are transmitted, reviewed and marked up on-screen, then returned via PDF. Less than 10% of respondents use only electronic drawings, even though the benefits (ease of transmission, record keeping and speed) are easy to grasp. Although numerous software programs exist to simplify the review, mark-up and archiving process, respondents still cited difficulty in using these programs and in using computer monitors to view the drawings.
4. **Hybrid, “Model-Assist”—Drawings and Documents with Models as a Reference.** Essentially, the review takes place using drawings (mostly PDF, but sometimes printed copies too), but the model is used as a reference and aid in the approval process. As long as the fabricator/detailer shares the model, this is likely to emerge as the dominant method in the next few years and will act as a stepping stone to a process that occurs only within the detailed fabrication model. The hybrid approach gives the reviewer a much

### Proof in Practice

The Alta Bates Summit Medical Campus, a Sutter Health facility in Oakland, Calif., is a \$298 million, 13-story patient care pavilion that is expected to open in January 2014. Designed by Degenkolb Engineers, the project is coming together via a BIM-based, integrated project delivery method—and a full shop model review application developed by fabricator the Herrick Corporation and detailer Candraft Detailing (both AISC Members). Using this approach has reduced the shop review time by over 50% as compared to a paper-based process—from around nine minutes per piece to just over four minutes per piece. For this project, that's a savings of nearly 10 weeks!



better sense of context and understanding of the project, and allows for easier indexing and referencing.

- 5. Model-Based—Shop Model Review “Lite.”** One step below the ultimate model-only process, the actual review and approval is done within the model, but notes and other records are kept outside of the model. So, the review status of elements may be stored within the model, but RFIs and other documents will be kept separately. This method is easily achievable today and provides significant benefits.
- 6. Model-Only—Shop Model Review.** The whole review and approval process is done within the fabrication model. All comments, “stamps,” review statuses, sketches, additional documents, screenshots, RFIs, etc., are stored within the model. Anyone with access can open the model and review a full history and record by individual piece or assembly from day one. This method is not common and is barely supported, even by modeling software vendors. Additional tools to support this type of process are still needed for the average user, and currently only advanced “power users” of the software have been able to take advantage. These innovators, though, light the way for where the industry is headed.

Beyond what is actually being done today, the survey also asked whether people believed that model review would be dominant in future. Three-quarters of the respondents believe models will be reviewed instead of drawings at some point in the future, with one in five believing this will happen within four years. While it seems that things are moving toward a fully model-based process, it's clear from the numbers (and even clearer from some of the comments received in the survey) that we are actually a long way from model-only emerging as the dominant method.

### Philosophy

Now that we've looked at the various review practices, let's take a step back and address the basic philosophy of how the shop model review (SMR) process works. To be clear, while the idea of reviewing a model might be far removed from the traditional drawing review process, the purpose and end result—as stated in the AISC *Code of Standard Practice*—are exactly the same: “to confirm that the contractor has correctly interpreted the contract documents in the preparation of the submittal.”

In many ways, SMR is no different from a paper-based review, it just *appears* to be. The notion that it is more difficult or takes longer to review a model is actually false, the time needed to get past the learning curve notwithstanding. Similarly, the idea that SMR means reviewing the whole of the project at once, rather than phased work packages, is also false. The ingredients are the same; only the cooking method changes. Where before, the *drawings* were approved for fabrication, now the *model* is approved for fabrication.

This is a fundamental and crucial part of the process that is often misunderstood: It's the *fabrication model* that is to be approved, and it is to be approved within the native software in which it was built and from which it will be fabricated. SMR does not involve the transfer of a model across software platforms, via IFC, CIS/2 or any other method. The model *must* remain in its native software during the review process. Models for fabrication produced in SDS/2 or Tekla cannot be reviewed in Revit or Bentley Structure. Interoperability at this level of detail simply does not exist, nor will it for the foreseeable future—and more to the point, it probably doesn't need to.

Design Data, Tekla and other software vendors who produce detailing software generally also provide software to enable

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viewing and marking up of models. While these modules are primarily geared toward the hybrid review processes noted above, many people have also successfully used them—or the full version of the respective software—for SMR (or at least SMR “Lite”). In addition, many of these tools allow end users to build applications that work directly with their software to meet specific requirements. While perhaps not something every user or firm is capable of, this approach provides a level of flexibility within which most needs can be met.

### Can you say “HI?”

As in most business processes, the most important element in transitioning toward SMR is the human element. Human Interoperability (HI) trumps electronic interoperability every time, and the need to have a motivated team, working together and with shared objectives, cannot be overstated. If this is in place, then any other challenges can be overcome. Collaborative Delivery Methods (CDM) such as design-assist, design-build and integrated project delivery have become more popular in recent years, and at the heart of these methods is technology like BIM, which enables design and construction teams to better share information and collaborate in a more trusting and mutually beneficial environment. The contracts used for CDMs generally deal with the real or perceived legal risks and liability issues that arise from sharing information such as models, and they help provide an environment where teams come together and work more efficiently.

### Stepping Stones

While it’s almost guaranteed that the shop drawing review process will move to become a shop *model* review process in the future, it’s not practical, feasible or realistic to expect it to happen overnight. Project teams need to get comfortable with new technology and new ways of working. The use of models is still new to the majority of project teams, and as such it is wise to move slowly but purposefully toward new ways to use building models. The move from paper-based drawings to electronic drawings is still only in adolescence, and we can’t expect a process at that stage of development to supplant current practice anytime soon. Getting used to performing reviews using drawings on a screen might be the first step, then providing a model as a reference tool might be the second. These steps will take time even though they are quite minor, but the step toward actually reviewing the model, and not the drawings (even if documentation is kept separately), is huge.

No matter the route taken, there will be questions, obstacles, perceptions and misconceptions along the way. While some people will still be wondering how to view and mark up a drawing on a computer screen, or worrying about a perceived liability increase when working with a model, others will be breaking new ground using models to their full extent and adding to their bottom line in the process.

Each stakeholder has a different opportunity for getting people from the former group to the latter. For modeling software companies, it’s a matter of developing the required tools within their software such that model review can completely replace the use of drawings—and making this replacement as easy as possible for the user. They also need to provide training and education on how to use the tools that are already available and any new ones developed. In addition, they must not hinder users with inflexible licensing terms and maintenance fees, a common concern among structural engineers who took the survey.

For those innovators in the design and construction world who are already in full-model mode, it’s a matter of

spreading the word and promoting case studies that demonstrate real savings, as well as sharing experiences on what was difficult and what wasn’t.

As for those of us considering looking to further incorporate models into the review process, it’s a matter of keeping an open mind, making an effort to learn more about the technology, seeking advice from those who are experienced with it, embracing collaborative delivery methods and getting past adversarial relationships. Change isn’t easy, but it is inevitable and, if prepared for, can be very beneficial.

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## When it comes to drawings vs. models, the ingredients are the same; only the cooking method changes.

### Modeling Savings

A quick list of how time, money and effort (and paper) are saved by approving the model as opposed to the drawing:

- ▶ Drawings don’t need to be produced or edited until after approval. In fact, they only need to be produced for the fabrication process. Drawing production and editing can account for up to 35% of drafting time, so shifting this effort and reducing it has considerable benefits.
- ▶ The context of elements being approved is immediately apparent (no thumbing through drawings or looking up piece marks).
- ▶ The audit/data trail stored in a single database.
- ▶ Equipment (copiers/printers) and maintenance needs are reduced.
- ▶ There’s no need for a separate drawing log and management system for approval of drawings.
- ▶ Collaboration for questions/answers or approval comments becomes much simpler.
- ▶ Approvals happen faster, meaning faster progress towards fabrication and erection and in the end, a shorter schedule.