

# TECHNOLOGY

information and updates on the impact of technology on structural engineering

## Bringing It All In-House

### The Future of "Single-Source" Structural Engineering

By Joshua Gionfriddo, E.I.T.

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Structural engineering design firms looking for opportunities to increase revenue, which today should include most everybody, should consider looking to our close neighbors on the construction side of the industry for inspiration. Based on the construction business model and the ever-increasing interoperability of today's Building Information Modeling (BIM) software, today's structural engineering workflows can be reshaped to take advantage of technology to improve project returns.

Consider the current workflow. Structural engineering firms currently leverage BIM technology to model, analyze and document their designs. These designs are then passed on to the fabricators via 2D construction documents. The project is then remodeled by the fabricator who adds the connections, possibly designed by a third party engineer, to the fabrication model. From this fabrication model, shop drawings are then created and returned to the Engineer of Record (EOR) for approval. Once approved, fabrication can begin.

This workflow is severely outdated, given that current technologies provide the tools to enable EORs

to leverage their BIM models to add structural steel connections, analyze them and detail these connections into a set of shop drawings. With this functionality at the ready, how can your structural engineering firm become a "Single-Source" EOR of the future, generating the extra income from the increased scope of work?

Let's explore these evolving work practices and how your firm can fit into this new reality.

## Staying Competitive in Today's Market

If EORs can begin to more effectively leverage all available BIM resources, they can put themselves in the advantageous position of being able offer the lowest cost while maximizing the firm's profits due to the interoperability of BIM software and the collaboration available within. For example, by managing tasks such as structural detailing, any changes to designs could be made all at once, significantly minimizing the cost of those changes, an efficiency not achievable when this process is outsourced.

Thornton Tomasetti (TT) is one well-known engineering firm that offers these Single-Source construction services. When asked to describe the efficiencies that being a Single-Source EOR provides to their clients, Josh Bradshaw, Tekla BIM Manager for TT offered this: "Using the internally developed interoperability, we are able translate our models directly to Tekla Structures. Our Construction Support Services team can deliver a Tekla model of base geometry for mill

order, include a few conceptual connections, or include all connections, and even produce the fabrication drawings. The connection design team can leverage the BIM to study complex conditions and to communicate directly to the detailing team. This level of collaboration between the design and detailing phases allows those two tasks in the construction timeline to overlap, decreasing the overall schedule of the project."

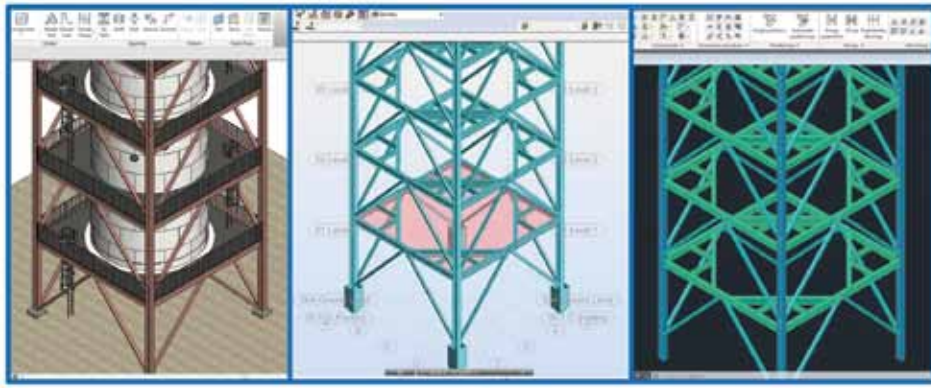
## The Realities of This New Contractual Relationship

Currently, any added efficiencies that structural engineers bring to a project via BIM are not being reflected in the structural engineering firm's bottom line. In some cases it is just the opposite, as owners increasingly shrink deadlines and fight for reduced fees, falsely believing that BIM saves the designer time. The time savings BIM affords is manifested mostly on the construction side of the project. Although it's the owners that need to understand this, it's the design community's job to educate them.

There are groups of architects and groups of engineers but there is no all-encompassing group of owners, so this education must take place on a project-by-project basis. Designers must show owners how they would benefit from this new level of coordination. Not only would the project costs be reduced due to elimination of duplication of design work but, by extending the benefits of BIM to the construction side of the project, substantial savings can be realized. A steel connection that must be modified in the field costs 10 to 20 times the original shop fabricated version. Eliminating the need for these types of costly field repairs offers tremendous cost saving opportunities to all parties. Contractual relationships change for Single-Source firms. When this process is applied to typical design-bid-build projects the structural engineer would have two contracts, one with the owner/architect for traditional design services and one with the construction manager/fabricator for the connection design and detailing services. This dual services contract can be executed directly with the owner or contractor for a design-build project, making this the optimal project type for Single-Source firms.

## Where This New Workflow is Most Efficient

A Single-Source workflow alleviates many of the traditional project pain points, reducing RFIs, eliminating third party shop drawing review and optimizing connection design. The interoperability of design and detailing software allows for a seamless transition from design model to fabrication model to the built structure. When asked to describe their workflow advantages, Ken Murphy, BIM Director



*Design, Analyze and Detail, above are screen images from Autodesk Building Design Suite showing a single model in all three phases.*

for TT offered this: “We explore multiple design and analysis iterations using internally developed interoperability, design computation and automation. This allows extremely fast generation of models not only in analysis, but also on the BIM side. By using many different platforms in our project delivery, we can choose the best tools for the complex jobs and maximize not only our efficiency but also the quality of the deliverable BIM.”

## Getting the Tools to Get Started

Firms that wish to take on this increased work scope will have some hurdles to overcome. Additional training will be needed to get a design staff BIM-ready. Firms too often don't take this seriously, and for years projects using new technology can flounder because a proper understanding of the technology was never had. The level of accuracy in the design model will need to be detail ready, but BIM software is inherently accurate. With proper use, BIM software wants to be accurate. However, improper modeling techniques can lead to accuracy errors, so additional training of traditional CAD staff will be necessary when implementing this Single-Source workflow. Design staff must have an understanding, before a project kicks off, that this BIM model will be used for fabrication so they can model with appropriate accuracy. Additionally, as detailing work is best done by specialists, additional staff may need to be hired. However, these workers should be skilled and ready to contribute to the organization on day one. Another of the roadblocks to implementing Single-Source engineering for medium and small-sized firms has been the prohibitive upfront cost of detailing software packages such as Tekla or SDS/2. As noted by Josh from TT, these traditional detailing software packages don't work seamlessly with BIM software. But as

more software providers enhance their offerings with interoperable suites of products, such as Autodesk's Building Design Suite, the barrier to the average firm is being eroded. Now, within a single software purchase, you get all the tools to design, analyze and document full building design. Structural engineering firms that begin to integrate these tools and adopt a Single-Source workflow will be well positioned to differentiate themselves from the competition and effectively capture more business.

Impediments for Engineers to take on this scope of work include:

- 1) Real or perceived increase in liability.
- 2) Added training.

- 3) Added staff.
- 4) Added interoperability systems are needed.

At this point in time, the average engineering firm is still trying to figure out how to implement BIM into their practice without incurring too much additional cost. BIM software is just not yet up to the level of versatility and ease of use of CAD software, so that most firms still incur more cost in developing drawings in BIM. So, the move to include detailing is likely yet a ways off.

Moving forward, it needs to be determined at the very start of the engagement if the model will be used for follow-on detailing in order to ensure that the proper level of accuracy is used.

Providing the accuracy level in the initial engineers' BIM model required for shop detailing will take some additional effort. Engineering CAD drawings, and to some degree current BIM practices, do not require the level of dimensional accuracy needed to get down to the 1/16 inch accuracy needed for detailing.

Adding the shop drawing detailing to the engineer's scope of work will greatly increase the revenue to be gained by the engineer, but it should be an overall savings to the owner by elimination of work duplication. ■

# Providing the building blocks to BIM-ready.



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