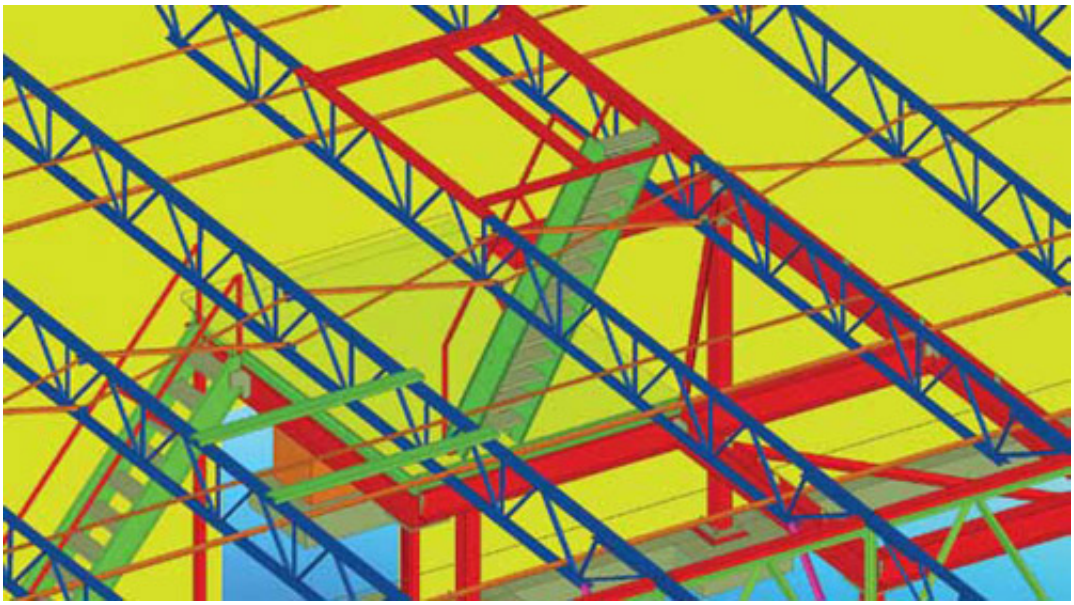
BIM at work

EXPERIENCES IN BIM-BASED DIGITAL STEEL JOIST DESIGN

By Ricky Gillenwater, Carl Pugh, P.E.



Digital joist design supports early collaboration on BIM-based steel joist design integration. Shown here is a screen capture taken from New Millennium's Dynamic Joist steel joist modeling program, a component plug-in to Tekla Structures.

Many people think 3D and BIM are the same thing. This is because there have been different approaches to digital planning at different phases of structural steel projects. In a true BIM approach, where joist design collaboration occurs early in the development process, the BIM team does not seek final documentation approval until they have completed the digital design and detailing of the steel joists within the as-built structural 3D steel model. However, sometimes the joist provider is asked to participate in projects in 2D initially; then later follow with the 3D model containing as-built joists. Other times, a company may be asked to send the 3D model along with a 2D plan to get approval; then it receives any changes and completes the as-built model. These hybrid approaches can be redundant and less efficient, but they seem to address a comfort factor around traditional design.

Early steps in the right direction

Another tendency is the use of digital models for purposes that are somewhat outside of BIM. Oftentimes, customers will come back to the joist provider regarding older jobs that they fabricated, asking for 3D models of the joists. The joist provider can do this; however, these are finished jobs with all the coordination completed, and any rerouting or adjustments made in the field were done post design. The BIM process starts way upstream in the development of the structural package. Customers may take the traditional design approach and then at the end request 3D models of their joists. This is a step closer toward BIM, but is not what most would say is the ultimate goal of BIM.

So why would a project manager ask for a 3D joist model after the fact? Some project managers seem to be trying to improve collaboration at the tail end of projects by using a 3D joist plan to review mechanical, electrical, and plumbing (MEP) integration, for example. They are not getting the benefit that one sees

when the coordination is done upstream. That's where the customer sees the biggest benefit.

It also may be that a building owner or management team wants to have a 3D model for future maintenance and space planning. But think how much more useful that model would be if it was a BIM-based project from the start, accurately representing the final integrated and refined design?

BIM fosters significant timeline reductions. For example, a recent BIM-based Target store project resulted in a remarkable reduction in the timeline for shop drawings. Based on the use of its digital steel joist design component, the design team reduced the typical eight- to 10-week timeline to just three-and-half weeks, compressing the timeline typically taken between the award of the steel joist package to the approval of shop drawings sent back to the joist provider for fabrication – including calculations and integrated 3D geometry. Another obvious advantage is the more rapid and accurate integration of MEP designs. Other important advantages have included such objectives as reducing building height, maximizing space, and minimizing the amount of structure.

Greater potential savings to the project

People conceptually understand that if you remove a single MEP clash during the 3D joist modeling phase, then you just prevented costs in new materials, production, shipping, onsite crane time, and erection labor. But what is the real savings? For example, on another BIM project, a stabilizer plate needing a bottom chord extension could have easily been missed during a traditional 2D approach, but it was quickly identified in the 3D approach. After receiving the joists in the 3D model, the structural engineer saw that a stabilizer was not planned for the joist girder. The engineer designed a special stabilizer hanger for the bottom chord extension, thus preventing a field erection problem. If missed, a field adjustment and back charge would have been applied. These scenarios are often seen using BIM. They are all real, prevented costs.

Integration into a building model eliminates a lot of time and costs that cannot be gained from a 2D approach. Seeing how a 3D product fits within the structural framework eliminates potential errors that one will never see from a 2D approach or realize from a human visual perspective.

But there still aren't statistics to back it all up, and that's why project owners and developers can't evaluate BIM as they do other ROI decisions. Prevented costs are not typically measured well in the AEC industry; a project ends and there is no full post-mortem. Unless you are the owner of a series of similar projects, like a major retailer, then you don't have the opportunity to measure as you go to see just how significant the BIM process can be by way of costs prevented and revenues gained. Similarly, the trades have yet to put numbers to their contributed value. It's not enough to promise value engineering and then not to show ROI to the project owner. The industry is just beginning to document the value that can come from a BIM-based format.

Familiar design impediments still hold true

Despite all the perks surrounding BIM adoption, there are downfalls as well. The structural design process has always depended on communication throughout. On a BIM project, however, everyone participating knows the process is based openly on information sharing, or file sharing. Missing information doesn't stay missing for very long, and you can visualize what needs to be completed or corrected. Errors are exposed, get noticed, and fixed. But this higher level of ongoing scrutiny and information sharing can make the BIM process very challenging because the digital model is being updated constantly between the trades.

If the project is not clearly defined up front, BIM will not overcome these obstacles any better than a traditional approach. It might eventually help the back-end, but it is most effective when the scope is well defined early. New Millennium recently developed a 3D joist model for a large project, only to learn that

the dimensional data it used for the model was inaccurate. Metric dimensions initially imported into the plan had not been converted correctly into U.S. units. Had the team built according to the model, the building would have had an exterior dimension that was wrong by several feet. For everyone on the BIM coordination team, this was a humbling reminder that the BIM process facilitates fact checking and communication – but it doesn't replace it.

Ricky Gillenwater *is information technology director for New Millennium.* ***Carl Pugh, P.E.****, is an engineering manager for New Millennium. They can be contacted at* ricky.gillenwater@newmill.com *and* carl.pugh@newmill.com*, respectively.*