conference preview

BIM, INSIDE AND OUT

BY KEVIN LEA

The pivotal role of the structural engineer in the BIM process.

THE ADOPTION OF BIM (building information modeling) within the construction industry now seems a formality.

A recent survey ("McGraw-Hill Smart Market—The Business value of BIM in North America") suggests the adoption rate for engineers has increased from 42% to 67% in just three years. This, coupled with initiatives from governments worldwide to adopt BIM as part of their procurement procedures, likely means BIM is here to stay.

Despite this, there are facets of our industry that have yet to embrace the concept of BIM. It's fair to say that many engineering firms are still trying to establish "what is in it for them." For many, all they see when they look at BIM is escalating costs rather than the productivity gains it can help them achieve.

The BIM Story Board

Over the years the construction software industry has discussed the merits of sharing BIM data between members of the project team. We have all seen fantastic images and reports of projects benefiting from the collaborative use of BIM, leading to enhanced designed buildings based on accurate information. Sophisticated software solutions such as Autodesk Revit, Tekla Structures and Bentley MicroStation all provide tools to enable true collaborative working.

When BIM processes were initially introduced the benefits of sharing BIM models between the project team was very much the focus. Knowing that the structural column would not interfere with the architectural wall, or that a hole through a web of a beam was in the right place for ducting to pass through it, demonstrated how BIM could offer significant advantages when coordinating a project, reducing errors and therefore reducing costly onsite delays.

As time has progressed, opportunities to expand the use of BIM data are now seen with 4D and 5D applications. This is evident with recent surveys showing a bigger take-up of BIM technology with contractors than with any other discipline.

I have no doubt that structural engineers buy into the "external benefits" the BIM process offers. However, as a keen advocate of BIM—and a structural engineer myself—I cannot help think that the benefits for the structural engineer need to be closer to home for full adoption to be realized.

External BIM

While engineers worldwide are increasingly adopting BIM, how many are doing so because of pressures from architects and contractors? I would suggest that many engineering firms are adopting BIM due to external pressures to ensure they are considered for future projects, and in some cases because BIM is a prerequisite.

This has resulted in many engineering firms purchasing software such as Autodesk Revit to enable them to demonstrate to their peers that they "do BIM." However, they often do not examine the benefits for their own internal processes but rather use BIM only as a means to communicate externally. If engineering firms view BIM as a way to improve their internal design processes, though, they will see an increase in productivity, a reduction in errors and better communication, and will have the "external" part of BIM for free!

Internal BIM

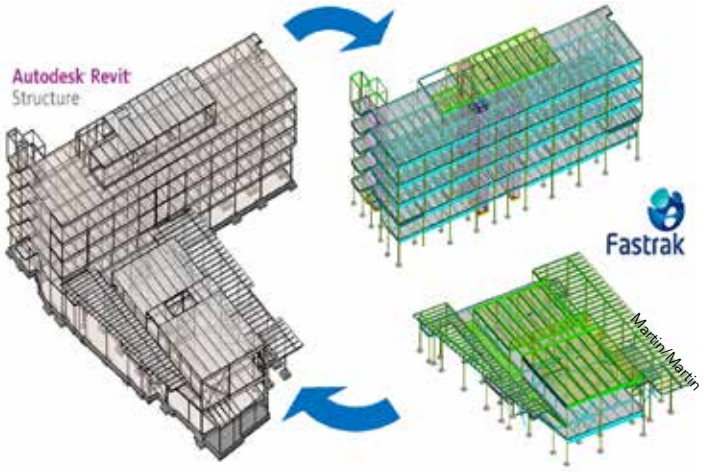
The true spirit of BIM is to use BIM data to maximum effect. With the increasing adoption of external BIM we often see this in practice; however many engineers have not fully embraced the same approach to improving their own internal BIM processes.

Besides producing BIM documentation, such as 2D and 3D drawings, engineers are also responsible for ensuring that the structure is designed to the latest published codes or standards of practice. The internal process of sharing a technician's model with the structural engineer is often still seen as a manual process—even though they often already have the software tools that can communicate BIM data efficiently.

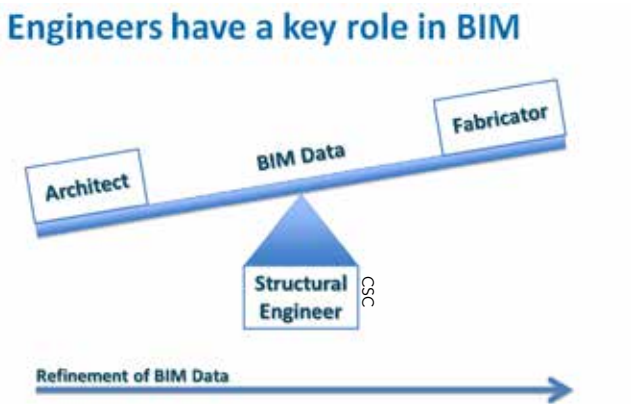
Communicating manually typically leads to the double handling of design data, resulting in inefficiencies and potential errors. As the very nature of the engineer's role involves numerous iterations and refinement of the project data, these inefficiencies can quickly escalate due to the repetitious nature of design.

Improving the internal BIM process can only lead to streamline the engineers design process. For example, the geometry in a Revit or a Tekla model can quickly and efficient be synchronized with design software such as CSC's Fastrak for the code design of steel structures.

Kevin Lea is the BIM business development manager for CSC. You can reach him at **kevin.lea@cscworld.com**.



Autodesk's Revit synchronizing with CSC's Fastrak.



In addition, if models can be synchronized, project amendments can be made in one place, maximizing the use of the BIM data even further—which in turn removes repetition and increases productivity and reduces human error.

Understanding internal BIM (sometimes described as "lonely BIM"), rather than focusing on the bigger picture of external BIM, will be the key for greater adoption of BIM within the structural community. This will naturally lead to greater acceptance and support for external BIM processes.

The Engineer's Pivotal Role

At a higher level, BIM is often described in simple terms. For example, an architectural model can be passed through to the engineer; the engineer can use this BIM data to aid drawing creation, analysis and design; and then the same BIM data can be passed down to a fabricator for manufacture. Although there can be fringe benefits such as better communication through visualization, in reality the process described will not work, as no account for data refinement is being made.

By way of example, an architect would model a column in a building through 20 stories as one element. The structural engineer would need to refine the column into spliced lengths or construction lifts to be able to design the structure correctly. This may mean editing or replacing the column data.

When it comes to refining BIM data is is important that the engineer ensures he has a connected model; typically this is only a requirement for the engineer and the fabricator. If a connected model is not considered, the sharing of BIM data can stop in its tracks.

Engineers set out structures via node points or wire frames, which are then used to create a mathematical model to help the engineer predict how the building will behave structurally using analysis and design software. Architects typically do not consider this. For example an architect may set out a beam between the faces of columns. The model will look correct physically, but the engineer will not be able to use the data for analysis or design without refining it.

The majority of the BIM solutions in the market provide facilities to model via nodes or wireframes. However, as it is not the role of the architect to consider such topics, a connected model is not produced and it falls to the engineer to refine the data. In reality this is no different to traditional design methods, as all project data is being refined as it goes through each design stage.

Fabricator Integration

It is also interesting to note that without this refinement the data can become useless or require even further refinement downstream to manufacture. For example a steel fabricator may use a detailing system such as Tekla Structures or SDS/2. These systems are also based on connected node points and, as fabrication models are also used for estimating, procurement, connection detailing, and construction sequencing, there can be significant benefit in sharing the engineer's model downstream with the fabricator. However, this benefit will not be realized if the model data created by the engineer is of poor quality.

It is true that the fabricator may prefer to create his final fabrication model rather than rely on imported models. But there is a clear advantage in sharing the engineer's model with the fabricator, as this can improve the project workflow and assist with communication of the design intent, creation of estimates and preordering of steel from rolling mills.

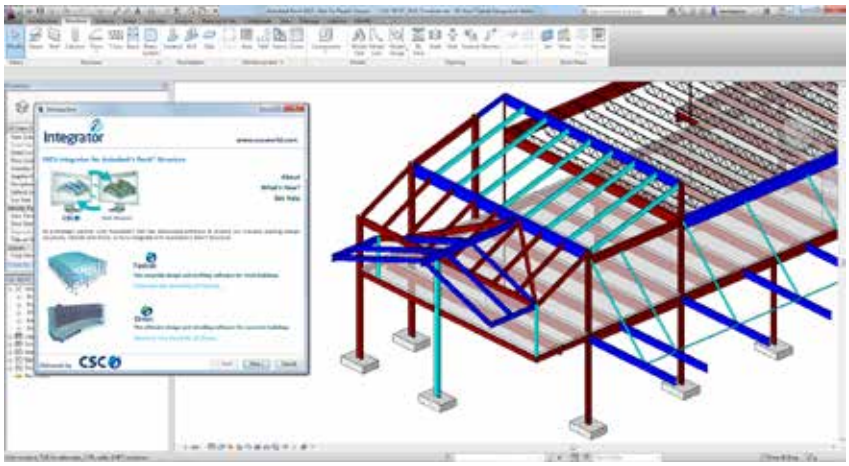
To maximize the benefits of BIM the structural engineer must take more of a lead in the creation of the BIM data. This will ensure that the construction sequence is considered earlier in the design process and that the BIM data can be used for design and planning purposes downstream. This also provides an opportunity for the engineer to pay a more pivotal role in the whole BIM process.

Code-Based BIM Solutions for Structural Engineers

Having worked with BIM solutions for many years, CSC has been acutely aware of these issues for engineers and has specifically designed integration tools to help refine and manage the structural BIM process.

For example, CSC's integration functionality includes an audit tool, which picks up errors and presents warnings such as unconnected, duplicate and poor design decisions on members.

Due to the iterative nature of design there are constant changes affecting BIM models. Models that can be automatically synchronized are impressive in demonstrations, but in a real-life design if



➤ A screenshot of CSC's Fastrak showing the integration status when communicating with BIM platforms.

there is no way to control these variations or to check on the changes that have taken place, the modeler can quickly lose control and confidence in the process.

To overcome this issue, CSC provides tools to show the integration status graphically by color-coding the structure to highlight added, deleted or modified members. This feature has quickly become key functionality to ensure successful management of the BIM data for the structural engineer.

Maximizing Internal BIM

BIM is here to stay. It will eventually be a prerequiste for all projects, whether driven by the client, the project team or simply a need to compete in the market place.

When considering BIM, it is advisable to first consider the benefits BIM will offer your own internal design process and to allow practical time to get through the inital learning curve. Doing so will not only help you get the most out of BIM internally but will also facilitate more efficient sharing of BIM data externally with the rest of the project team.

Of course, no BIM workflow—internal or external—will be successful without quality training and support. Don't expect technicial staff to be productive without appropiate training. These solutions will involve new skills over and above those acquired through the use of AutoCAD. BIM is not complex but is a process that requires a good level of understanding.

These are exciting times for the industry. Seeing your designs come alive in a virtual world adds an energy to the whole design process and, as we move forward, I have no doubt that those who adopt BIM are the ones that will lead the way. MSC

This article serves as a preview of Session T6 at the Technology in Steel Construction Conference, part of NASCC: The Steel Conference, taking place April 17-19 in St. Louis. Learn more about the conference at www.aisc.org/nascc.