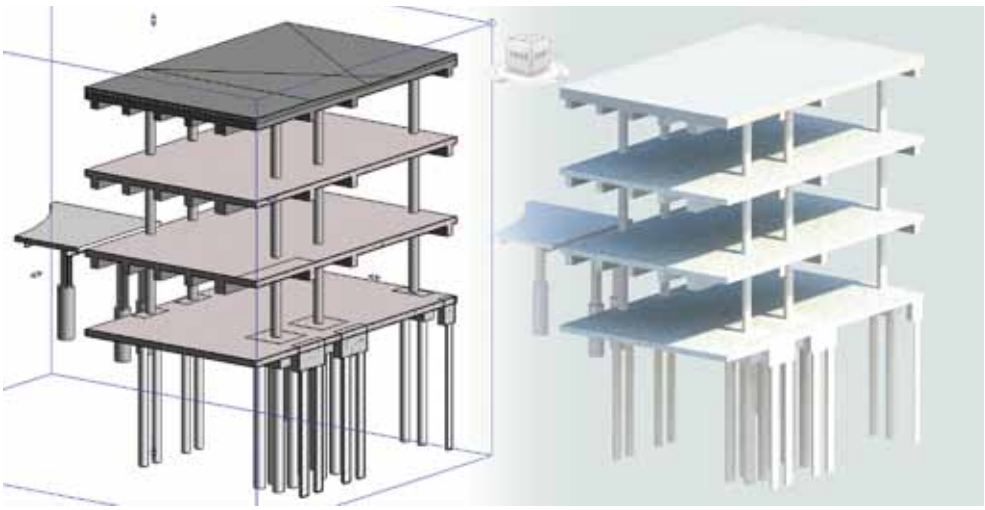

Better visualization for direct problem solving.

Structurally Speaking

A Practical Approach to Implementing BIM

By Leo Salce, Intl Assoc AIA, LEED AP

Today, Building Information Modeling (BIM), the process of creating virtual information-rich three-dimensional models of a building or structure, is being leveraged in some capacity at every stage of the project delivery process, from design to construction to operations and maintenance. This is a far cry from where we were 10 years ago. Extraordinary advancements in technology and processes have not only made BIM possible, but effectively necessitated its use in many projects today.

Much of the reason for this movement can be attributed to the fact that the benefits of BIM, from improved visualization and model analysis to increased coordination and reduced project costs, are being realized in one shape or form by all the key players, structural engineers included. Adoption has progressed significantly in recent years, albeit largely due to the proliferation of more requests to have BIM models as the project deliverable. The ability to propose on more projects and potentially win more business are powerful motivators for any firm to get BIM-ready and become more marketable.

However, beyond being able to answer more RFPs, the structural industry is lagging behind some of its counterparts in the other design industry segments, such as architectural and MEP engineering. The reason for this is that, in most projects, creating drawings and using a BIM model for coordination are still the primary uses for BIM software by structural engineers; documentation is not dependent on analysis links or the other disciplines' models.

Challenges for Structural Work

A particular challenge for structural engineers that impacts their rate of adoption is the ability to effectively integrate structural analysis design into the BIM process. Most firms still start their design in an analysis software package such as RAM, RISA, or ETABS and then bring in the architect's 2D CAD drawings to produce an analytical model.

The problem with this workflow is that unless you can link that model into a BIM environment, that's where it ends. As a result, many "BIM-ready" firms end up creating an entire second model that is completely disconnected from the analytical one. Over the last few years, interoperability between software tools has improved, but it's still not perfect.

Among some of the most commonly reported complaints are issues with missing or shifted elements when importing BIM models into the analytical tool. This may be due to the fact that the program does not support that particular element or the model element was in the wrong type format, wrong position, or not connected. Any number of reasons could be to blame.

Another issue related to this is that a lot of engineers find that is not practical to go back and forth between BIM and analytical software more than once. This is due to the level of effort needed to simplify geometry in order to properly run the analysis, or the mapping involved for interpreting the elements. Also, there is a cascading effect of changes in the model where the analytical results have been already used in the design of many other elements. That is why it's important to really understand the limitations of the analysis links and to develop an internal best practice modeling workflow.

Yet, despite some of these issues, many structural engineering firms have already discovered that the benefits of BIM can far outweigh the challenges.

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Benefits of BIM

While it is commonly held that BIM costs more, many of these perceived costs are relative and based on a wide range of factors. For instance the project's scale and complexity, the firm's BIM workflow, its ability to efficiently produce several structural what-if scenarios, and its process to track and update changes efficiently, to name a few.

Firms can realize greater efficiencies by decreasing the need to spend an engineer's time on tedious re-work of the design and coordination of changes, and instead focus on true engineering and problem-solving tasks. This is made possible thanks to a reduction in the errors introduced by design changes. Errors are always a possibility whenever changes are made, and are practically a given when the changes are complex and accompanied by the stress and rush associated with the late stages of a project. A true bi-link associated model reflects changes made to elements across the model, thereby reducing the margin for error.

The engineer still has a labor-intensive role during the BIM modeling process, but being able to visualize, isolate, section, and filter areas or elements in the structure in 3D allows for more direct problem solving. BIM can also improve coordination between trades. Clash detection and monitoring of key elements can reduce non-discretionary change orders that would otherwise come up.

However, none of the above will matter if there is not a change in ones attitude towards a change in the usual process.

Getting There

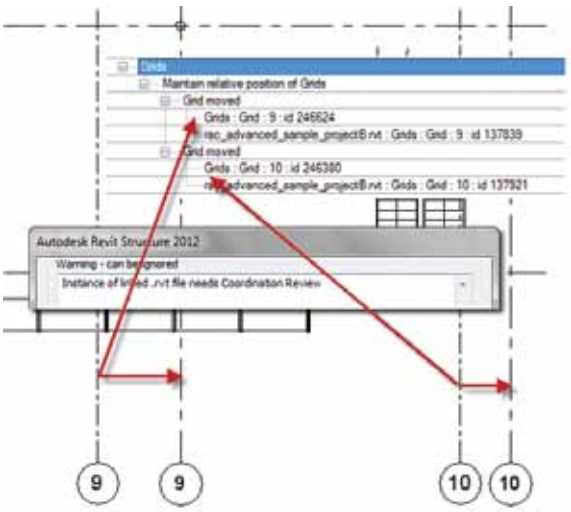
For firms contemplating making the transition to BIM, the big questions are **what are the next steps and how do I get there?**

There are numerous theories on how to best go about implementing BIM in a firm, but there is no single cookie-cutter implementation approach. No two firms are alike. Therefore, your BIM implementation plan must address the firm's own unique business and processes.

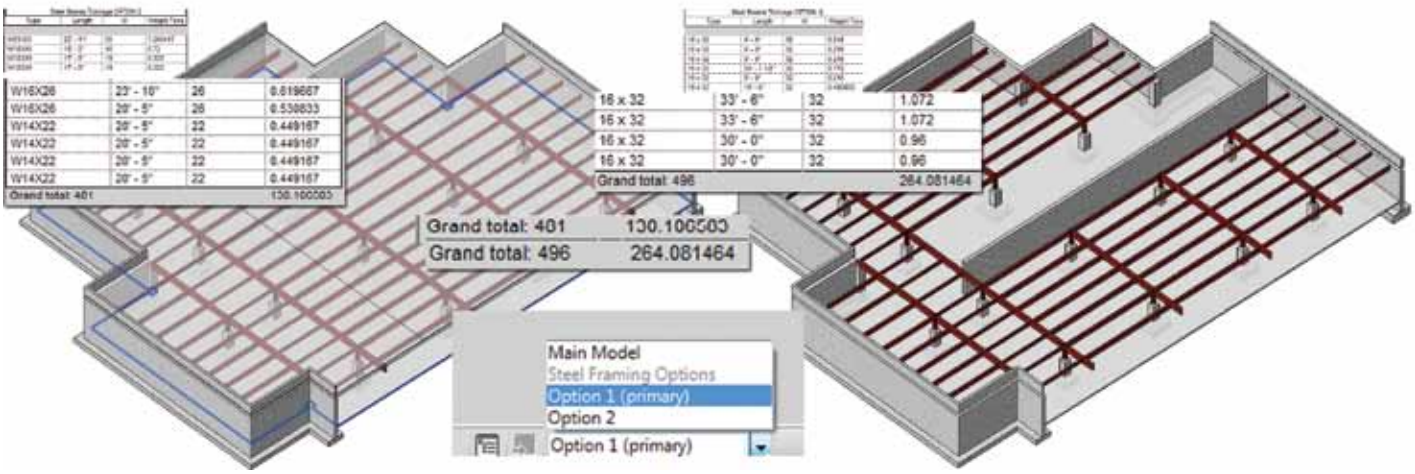
The first thing your firm needs is executive sponsorship to ensure there is real commitment to the move, plus a clear vision of what the organization's goals are and an awareness of the impacts a major transition will have on the organization, from processes to staffing to technology needs. When moving to BIM, it is important to remember that it is more than a lateral move; it is a change in process, too. Firms doing this on their own tend to suffer from painful lessons learned, so having your process assessed by a professional consultant is recommended.

With this framework in place, you can then set yourself to the task of defining a well thought-out implementation plan. Outlined below are the common steps:

1. **Define the Organizational Framework**
   Create a modeling plan that outlines the roles and responsibilities for everyone involved, from what will be modeled to who has ownership of what, by doing the following:
   - List the types of analysis tools to be used by the organization to compliment the above
   - Develop a company template with all of your standards
   - Outline a staffing plan that clearly defines the roles of engineers and drafters, as well as organizational structure relative to the types of projects you'll be doing
   - Define an internal and external communication system
   - Create a training and support plan
2. **Select the Right Software**
   Determine what BIM software(s) will best address your organization's needs, from one to all of the following tasks:
   - Model Creation
   - Model Integration
   - Clash Detection/Model Mediation
   - Model Sequencing
   - Model Quantity Takeoff



Better coordination between trades.



Steel tonnage design options.

- Collaborative Project Management
  Most Structural firms will only require model creation software, but this depends on the company's current processes. It is important to note that BIM software is NOT structural analysis software, and although powerful, you will still require other structural analysis tools.
  At this stage, you must also ensure IT and hardware are able to meet the software requirements in order to allow for a smooth transition and avoid frustrations. Also consider a server strategy for accessing the BIM model from multiple office locations.
  The success of the implementation will be based on doing an early assessment of the company's current workflow and state of technology to better provide a clear and complete roadmap.

3. **Create a Project Deployment Plan**
   When rolling out your new tools and processes, it is often best to identify an initial pilot project and define:
   - Specific project goals and objectives
   - Clear internal and external collaboration plans
   - A document management workflow
   - A BIM management workflow
   - Construction Management, Cost Management, Project Closeout workflows, if required.

Ensuring Implementation Success

Additional words of advice to help you prepare for a successful implementation would include the following tips:

- Do not cut corners in your implementation just to save money. Taking measures such as cutting project support and shadowing from an experienced consultant during the pilot project, or cutting training days because you already have staff in the firm who know Revit and can help the rest of the team, can be a fatal mistake in your implementation. Investing up front will save you down the road.
- Don't skip on defining a workflow strategy. This will ensure the clean exchange of models between your architect, consultants, and your firm. Also be sure to have a standard folder structure where the users would locate the latest and greatest models.
- Invest on advancing internal skills. Having someone within the firm who is savvy in tasks like custom content creation, for those projects that require complex modeling, is priceless. Invest in people who will serve as your internal gurus in the long-term after implementation is complete
- Develop an Internal BIM User group. Having lunch and learn discussions for internal BIM processes, techniques and enhancements in the BIM software improves users' knowledge and opens communication.

Common Obstacles

Knowledge is power. Being aware of these common pain points is the first step to entering into BIM implementation with eyes wide open and understanding potential issues that you should prepare for.

Training:
- Lack of time to learn the software
- Steep learning curve
- No clearly defined modeling requirements and staff responsibilities (drafting and engineering tasks are no longer separated)

Coordination:
- Defining who owns all the BIM model elements
- Difficulties in format conversions between platforms
- BIM requires structural engineers to know a lot about the model very early, often before they even have the information. For instance, beam sizes are needed in order to draw framing even before they are designed.
- Liability if the BIM model is sent to a fabricator

Documentation:
- Drafting tools in BIM not yet as well developed as in CAD
- Conversion of CAD to BIM standards is time consuming
- BIM cannot produce drawings as quickly as CAD
- Annotation more difficult in BIM than in CAD
- Last minute changes in 2D CAD are easier than in 3D BIM
- Manual editing required for unwanted graphics

Design:
- Issues with linking analytical software to the BIM model
- Lack of confidence in the accuracy of the links
- Underestimating the level of effort involved in design/modeling. BIM models appear further developed than the actual design may be.

These issues and common perceptions emphasize the need for professional consulting and a well thought-out implementation plan to address or avoid obstacles before they get in the way.

BIM is the Future

In 2012, BIM will continue to transform the industry, with more structural and architectural firms recognizing the same opportunities, benefits and values. As the industry continues to educate itself on advanced technologies such as BIM, firms will see the need to increase collaboration among all project participants. More companies, in turn, will focus on forging new relationships fused by common workflows and technologies in order to operate under a more holistic approach that better serves the bottom line.

According to a recent McGraw Hill SmartMarket report, the use of BIM by structural engineers is expected to double in the next few years. So the question is not *if* you should consider implementing BIM, but *when* are you going to.

When moving to BIM, again, it is important to remember that it is more than a lateral move; it is a change in process too. Understanding the necessary steps involved when making the transition, and making the appropriate investments in consulting and technology, are crucial for a successful transition.

Don't view the transition to BIM as a necessary evil. Rather, approach this transformation in our industry with an open mind. In seeking new approaches and new tools to solve common project challenges, we can increase efficiency, improve the quality of work, and advance the design process overall. That's when we can really start to see how BIM means better business.▪