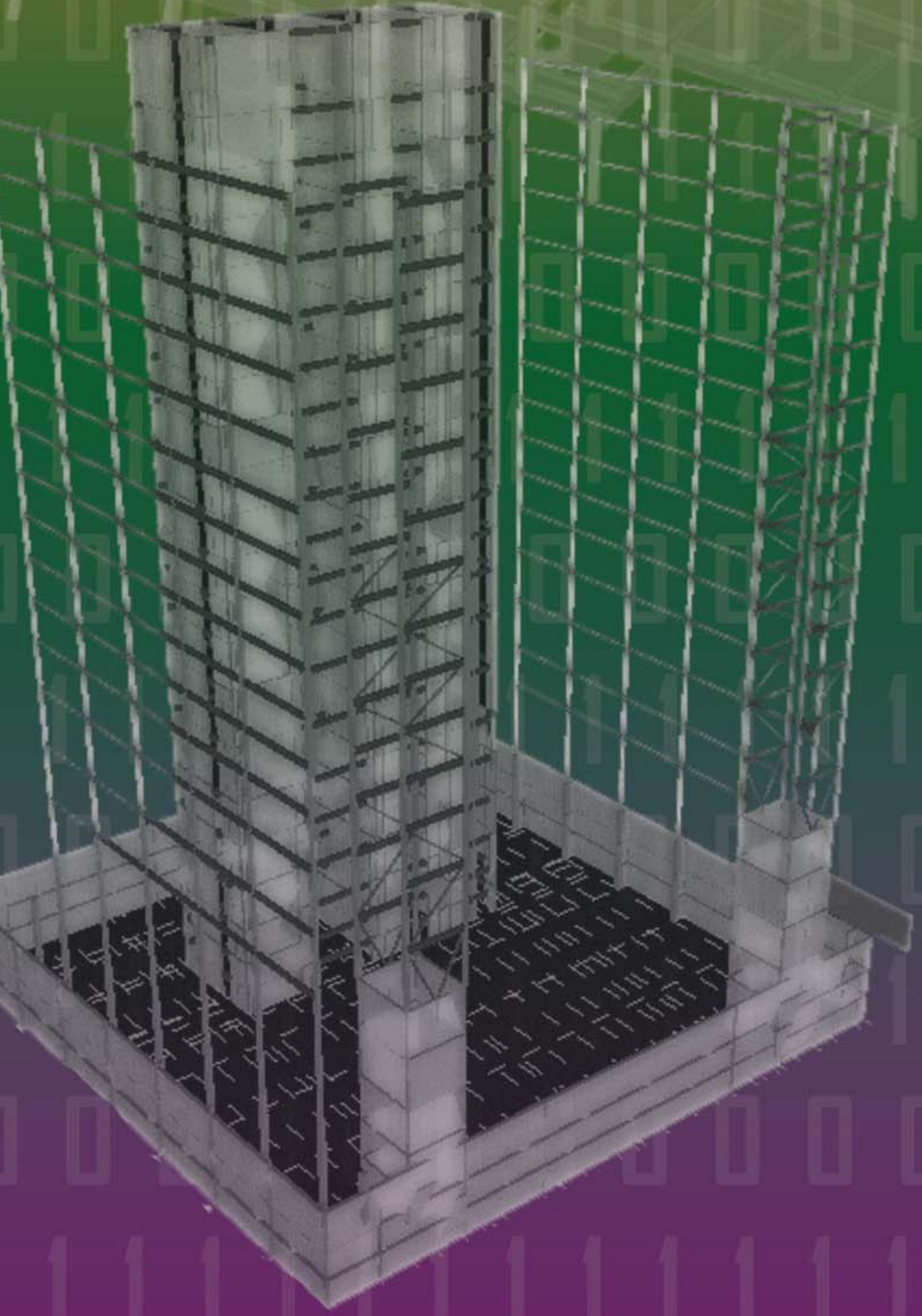
The Power of Technology

The New Structural Landscape Adds Up to More Than 1s and 0s



Digital solutions are not new to structural engineering. Technology has provided the profession with numerous digital problem solving tools. From design to construction, engineers rely on the computer to bring structural ideas to reality. And, we all know that our technological edge is not stagnant. On the contrary, technology often changes more rapidly than we may be comfortable with.

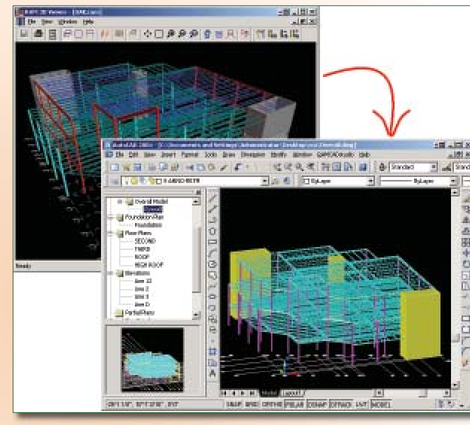
The new paradigm in the structural engineering environment is Electronic Data Interchange (EDI), a tool intended to bring all of the project team members together… digitally. In theory, the concept makes sense. In practice… the structural engineer is still sorting out a comfort zone.

We went to the industry to learn more about the technology and its impact on the business of structural engineering. The following three articles provide a window into the EDI concept, and a glimpse into how the structural engineering community is adapting.

Computer Aided Design

More than Just an Electronic Pencil and Paper

By Raoul Karp, S.E. and Brian Quinn, P.E.



For years now, engineers have successfully been using CAD as their Computer Aided Drafting tool. The advantages of CAD have been well established and proven, with efficiencies in drawing reuse, organization, revisions, quality and consistency to name but a few. But if you haven't already, you might start thinking of CAD as more than just an electronic pencil and paper. In recent years there has been significant advancements made in the construction field into making CAD products fulfill their potential, not just as drawing tools but as complete repositories for the storage, visualization, coordination, manipulation and extraction of relevant building information. This concept, coined the **Building Information Model** or BIM, revolves around a single 3D model most commonly located within the CAD environment. But for all the talk, there are still many questions about just what is BIM, what challenges do we face to a more widespread adoption of this technology, and of course what benefit is this to the engineer. To better answer these questions a short description of the state of the BIM technology is necessary.

Just What Is BIM?

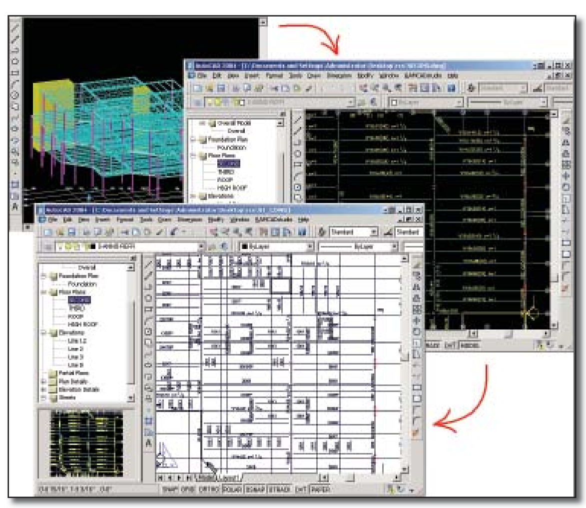
The BIM process would have all disciplines working off one single model where the entire information for a building structure (architectural, structural, mechanical, electrical, schedule, costing and even usage) could be stored, managed, coordinated, visualized, dissected and extracted. The model would not be a collection of lines, but rather a collection of electronic objects that each know how they look, where they belong in 3D space and most importantly how they relate to other entities in the model. Individual consultants typically continue to use the software that is most efficient for their domain, but through proprietary or standardized Electronic Data Interchange (EDI) they would communicate the necessary information back and forth to the BIM. It stands to reason that as all the disciplines involved in the design typically use CAD as their medium of communication and legal document production, that CAD should evolve into this more extensive hub into which other disciplines would integrate. As illustrated below that is essentially what is transpiring with products like AutoDesk (AutoCAD Building System, Architectural Desktop, Revit), Bentley (Triforma), Graphisoft (ArchiCAD) and Intergraph (FrameWorks Plus) vying for dominance in this 3D BIM world.

"…a collection of electronic objects…"

Maintaining a single model has several significant advantages, many of which have already been proven in practice. Interference checking and visual verification of as-built and construction conditions will facilitate early problem identification and avoidance. A coordinated, accurate 3D model from which anyone can pull the information they need will make for a more efficient process, less duplication of effort, fewer copies of identical information and fewer opportunities for miscommunication of intent. Companies like Cary Engineering Consultants in Greenville, S.C. have successfully used this technology to their advantage. William Cary, vice president and general manager of Cary Engineering has said, "(EDI) saved time on coordination, shop drawing review and reduced errors".

"…3D model from which anyone can pull the information they need…"

This theme is repeated in many projects that currently use EDI. However, many engineers have expressed concerns that fabricators will simply want to "click the button" and be less likely to review shop drawings. Also, many are of the opinion that they feel better with someone else starting from scratch and re-inputting the whole model because they feel errors will more likely be caught this way. However, these concerns have, for the most part, been found to be without merit. In fact, case studies have shown that fabricators have been able to spend more time reviewing the shop drawings and looking at the more difficult areas in more depth, because they didn't need to waste valuable time on re-inputting tedious data such as member sizes.



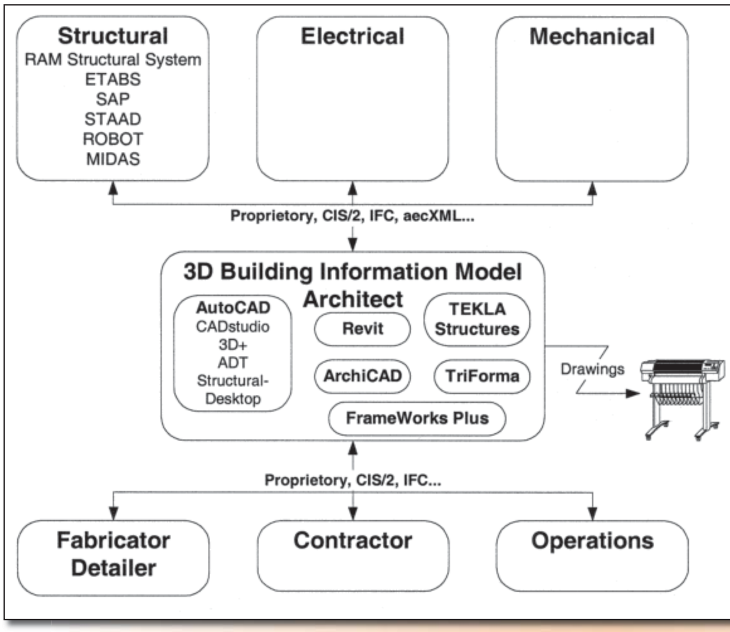
In addition, the creation of an accurate 3D model in CAD can open up other service alternatives. Already several prominent firms are investigating or offering value added services, like detailing as part of their practice. In today's marketplace, where all parties are pushed to perform "better, faster, and cheaper", technology and EDI have played a key role in some companys' ability to work more efficiently.

However, for all its benefits, the adoption and use of this technology is still not widespread within the structural engineer and building industry. So what is keeping engineers from embracing this technology in greater numbers? Besides the traditional challenges associated with a significant paradigm shift, four common reasons we hear against adoption of a single building model in any form are:

a. Legal / Liability Issues of Exchanging Data.
b. Interoperability and EDI standards for all construction materials and software vendors.
c. The need to create full building analysis and design models.
d. Keeping analysis models accurate and up-to-date.

Legal and Liability Issues

On the legal issue, engineers have said their insurance carriers have many times advised against giving electronic files to other parties. Many engineers who do give out EDI files may require the receiving party (in most current cases this is typically the fabricator) to sign a "waiver" agreement, where the receiving party recognizes the file is simply an aid to help them but may have inaccuracies (as described in the CASE Document #11). The AISC Code of Standard Practice addresses this issue as well in Section 4.3, *Use of CAD Files and/or Copies of Design Drawings*. In section (b) it states, "The CAD files or copies of the Design Drawings shall not be considered Contract Documents. In the event of a conflict between the Design Drawings and the CAD files or copies thereof, the Design Drawings shall govern." It also goes on in section (c) to re-iterate that providing these electronic files shall not obviate the fabricator's responsibility for proper checking and coordination of dimensions, etc. While legal precedent and regulation issues continue to evolve and be addressed formally, engineers who are currently using the technology establish responsibility on a project-by-project basis with great success.



"…have fabricator and structural engineering software adopt the standard."

Interoperability and EDI Standards

A second impediment to a BIM adoption is the fact that for some materials, EDI standards are currently not well established or widely adopted. CIMsteel (CIS/2) is well entrenched in the US for steel structures, in a large part thanks to AISC initiatives to have fabricator and structural engineering software adopt the standard. Concrete and other material information is currently not part of the CIS/2 standard. Industry Foundation Classes (IFC) developed by the IAI ("International Alliance for Interoperability") has also been available for several years, and recently (May 2003) has been extended to make new functionality for structural engineers' use available. IFC 2x2 includes standards for communicating information related to both steel and concrete structures. Unfortunately IFC is not yet widely implemented in most structural engineering software commonly used in North America. However, given the recent advancements in structural software's ability to allow the engineer to efficiently model, analyze and design a full concrete building structure, including completely specifying reinforcing, the latest IFC standard is timely and welcome. Current successes in the transfer of concrete reinforcing information in the United States is mostly limited to proprietary solutions, such as the RAM Concrete to aSa Detailing link. However, for widespread adoption of IFC or CIS to handle concrete structures, additional concrete industry initiatives will be necessary.

Full Building Models

A third, and greater impediment, to adoption of this single building model relates to the nature of the analytical models structural engineers create. Take a current project we are involved in; a fabricator is interested in importing an engineer's analytical model. However, on this two-story building the roof slope was not input to be exact, column splices were not accurate, column heights were adjusted for analytical not geometric accuracy and the columns in some cases were oriented incorrectly. Even more apparent is that, for some structure types, it may be inefficient to create full building models for analysis and design. The analysis and design of a flat plate, shearwall concrete structure may occur in multiple, different software products and rarely does the engineer create a single building model. However recent technology advancements and feature enhancements in programs like ROBOT, STAAD, ETABS and RAM Structural System are starting to allow engineers to efficiently model, analyze and design entire concrete structures. These programs allow engineers to fully design gravity and lateral systems and allocate reinforcing information to all members and components of the structure. This process will need to be made efficient enough to allow all the information to be specified by the engineer, and hence become valuable for EDI.

"…rarely does the engineer create a single building model."

Is the Model Up-to-Date?

The last challenge we commonly hear relates to the engineer's tendency to essentially abandon the analytical model at some juncture in the process. That is, analytical models are also not always kept up-to-date all the way to and through construction. Typical reasoning for this is that most late changes to a job may have little effect on the overall analysis, and changes of this nature are more easily picked up in the construction documents rather than in the analytical model. Another important reason is that their clients do not typically pay consulting engineers for the extra time needed to keep these files accurate. This is where a design-build project team might recognize the benefit to other team members, and hence be willing to do the extra effort that is required. Engineers would need to include updating time in their fees and could lose projects to competitors who don't do this. In traditional design-bid-build, the engineer most likely has no idea if the fabricator who is awarded the project will want an EDI file.

What Does the Future Hold?

The good news is that emerging technology should significantly help with this issue. Programs such as RAM CADstudio, 3D+ and Structural desktop allow engineers to make changes in an AutoCAD environment to their 3D model. By making the changes in CAD to the 3D model, the engineer will see the return on their investment directly since their construction documents are created directly from this model. An added benefit is that the model in the CAD environment is then accessible both for coordination with other disciplines as well as for EDI. These products have the additional advantage of addressing several of our industry concerns related to construction documents as discussed in the CASE 962 document. Time spent on creating an accurate model in CAD is rewarded in the creation of construction documents, and result in a model that significantly reduces the number of inaccuracies that might be found in analysis models. The analytical model no longer needs to contain irrelevant information and can be optimized for the analysis and design, and not the detailing. Other programs such as Bentley Triforma allow similar exports of CIS/2 files from a Microstation platform. Again, this allows engineers to make changes in the "CAD" world and hence have more accurate models.

> *"…continued use of this technology should be encouraged."*

Given these challenges, what can and should engineers be doing today to embrace this technology? While the concept is not new, it is only in the past few years that enough of the pieces have started to fall into place to start to make the application of this technology feasible. There have been many success stories related to the use of EDI in the steel industry and, if your project is appropriate, continued use of this technology should be encouraged. At the same time, there may be an increased demand by your clients to obtain a 3D model from you for coordination and integration into the BIM. Given that engineers may be reluctant to share the analytical model for legal, economic and practical reasons, it should be apparent that spending time on making the CAD 3D model more accurate and up-to-date will reap the multi benefit of allowing integration with other disciplines in a BIM, opening the door to additional service opportunities such as detailing, and most importantly allowing for accurate, efficient, drawing creation and revisions.

However, for the engineer to stop the process at the contract document production stage still results in inefficiencies in downstream activities. By allowing fabricators to use this model as the foundation for faster, more accurate shop drawing creation and manufacturing, you significantly reduce errors, provide better communication between engineers and fabricators, receive fewer RFI's, and happier clients. For a little effort, the engineer stands to benefit significantly in their current practice by considering CAD as more than an electronic pencil and paper… and see it as an easy, efficient way to build a better team, project and product.■

Advancements in Data Exchange

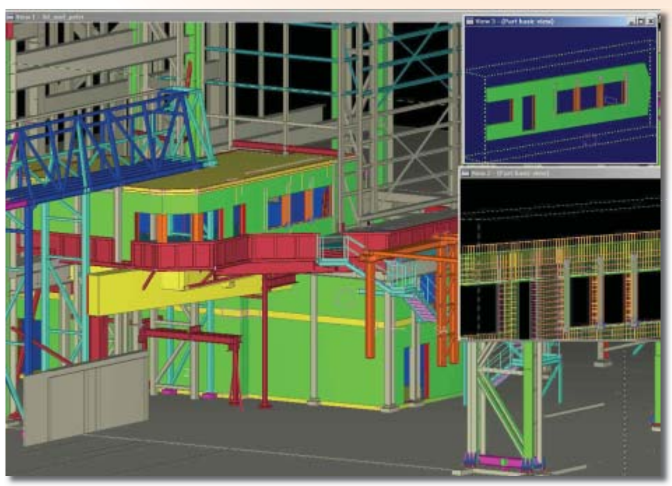
The Integrated Model Approach – Multi-Material & Multi-Discipline

By Rhett Thompson and Clive Robinson

Product Modeling

The solution for managing building information efficiently is true product modeling. The forerunners of the modeling have been in the mechanical and plant design sectors. Since the early 1990's, structural steel detailing has made a remarkable shift from 2D drafting to 3D product modeling. Tekla Xsteel and a few other solutions have played a pivotal role in facilitating that change.

Available modeling technology solutions can be divided into two different categories – 'bottom-up' and 'top-down' systems. Originally driven by mechanical and plant design, parametric 'bottom-up' modeling technology was designed to create parametric models of individual pieces. Building models created utilizing this technology are based upon independent 'models' of individual objects tightly integrated together. This technology effectively manages the shape of individual objects as well as the output generated from them. However, complications can arise when thousands of building objects are used with complicated linking relationships.



Shared Tekla Structures multi-material model: Concrete & Steel – Design – Analysis – Detailing – Fabrication

Modification management becomes more practical with the use of parametric 'top-down' modeling technology. This technology was created specifically for modeling buildings, which consist of thousands of objects. In the 'top-down' method, the basic objects are first modeled without details, which perfectly supports the normal requirements of conceptual design. The logical relationships between building objects are created when applying the members' physical connections. Connections also define the final shape of building objects.

In the building industry - change is a natural progression of "information refining" in the design process, as more precise information is created. When changes do occur, the related building objects automatically adapt to the new situation. This concept keeps the building object libraries compact, and makes management of the entire building remarkably easy and effective.

Today, the main prerequisites for comprehensive productive BIM applications are fulfilled. Parametric product modeling has a successful track record in the building industry. Telecommunication infrastructure and Information Technology (IT) systems have developed to the level that satisfies the requirements of BIM, and international standardization processes have also produced practical interoperability tools for the building industry.

The first BIM applications have been available for certain segments of structural design for some time. 'Top-down' technology is already in use in the structural steelwork industry with Tekla Xsteel. Recently, Tekla introduced Tekla Structures in which a single,

"Over the past three years the British Airport Authority team has been using Tekla products on the Heathrow Terminal 5 (T5) project in London. T5 is the UK's largest construction project and is due to be completed in 2008. ('Top-Down' technology has) allowed 3D Structural Steelwork model collaboration between T5 design team members, while at the same time utilizing and developing the steelwork contractor's production model" - Nigel Bradley BAA 3D Cad Coordinator. Heathrow Terminal 5

integrated, software platform from which all types of structures, regardless of material, can be created.

Applying the Integrated Approach

The current organization of the building industry is localized and segmented. The construction process consists of many small islands of automation. All parties involved, work co-dependently on individual islands using different tools. However, the tools do not speak a common language, platform or conventions, so information flow between parties is ineffective… clearly a costly obstacle. Using modern product modeling technology on some linked islands does not improve the overall situation if the complete value-chain is not ready to exploit the results. Sub-optimization naturally improves the performance of the specific unit, but as information flow is based on manual handoffs, some information is lost when passing data to the next player in the value-chain. This leads to duplication of work and inconsistencies in information.

"…the tools do not speak a common language…"

How can all of these diverse tools be integrated to form a real solution? The straightforward solution is to integrate all the existing tools. This has been the general target for various international and national standardization ventures, including IFC, CIS/2, STEP, etc.… Several successful demonstrations and test projects have occurred, with various results, ending up in some software functionality to help with routine work. However, development is still at an early stage, regardless of the significant effort put into the standardizations. The biggest problems are in fragmented information management, and in supporting the "roundtrip" of information. To be able to manage constant changes, the integrated system should be able to store all information from each of the integrated solutions. All solutions within the industry should speak a common language utilizing the same terminology. This would require a huge development effort from the solution providers, as well as from the standards bodies. Therefore, this straightforward approach does not seem to be the most practical solution.

Likewise, the integration of linked models into CAD software requires considerable effort from the software vendors, and is not a single model solution. A general CAD platform is an obvious solution from an interoperability point of view, but the depth of information suffers. Existing CAD platform-based solutions are far from the best-of-breed solutions available on the market, and the effort needed to bring CAD-based solutions to the same level may be unrealistic.

BIM consists clearly of several clusters of tightly integrated groups of islands. Architecture, plant design, HVAC and Structural BIM's are clearly independent areas with vital connections to the outside world.

Structural BIM is the most essential component of the building process, as the majority of design information is created at this stage. The existence of a versatile BIM solution is not possible without integrating the structural element of the BIM process.

Structural Integration

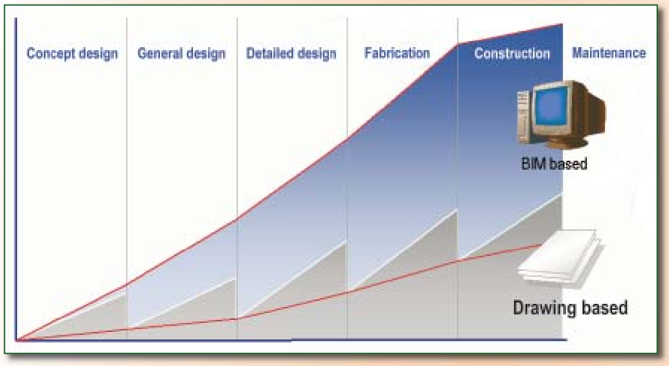
The model starts to evolve during the engineering stage, where conceptual decisions of the structural forms are made. The load-bearing structures are designed and input into the model. Analysis & design plays a significant role at this stage, however not in the classic sense of using separate, independent tools. Structural BIM analysis/design is not a primary phase in the process, just another output that could be generated and maintained through the physical model. When changes occur, they are made directly into the Structural BIM model, with all analysis & design results and other output updated accordingly. With a Structural BIM solution, there is no need to create and maintain separate analysis/design models.

At the conceptual design stage, it is also essential that the Structural BIM solution provide support for all building materials. For analysis and design purposes, a model of the entire building is needed. The co-ordination and management of the detailing work for concrete and steel is all the more essential.

Open interfaces are fundamental for a Structural BIM solution, not only from an interoperability point of view, but also from a customization and localization point of view, although connection and precast concrete piece design are tasks that simply cannot be fully standardized in the foreseeable future. However, today it is easy to use open interfaces, which provide the opportunity to supplement the Structural BIM system with plug-in software modules.

"When changes occur, they are made directly into the Structural BIM model…"

After completing the engineering stage, the next acting project players are the structural detailers, who enhance the information with the same product model. They do not recreate the geometry of building objects; they just refine and supplement the existing



information already created by the engineers. Real-time integration is extremely crucial at this stage. Changes must be communicated to all detailers, engineers and, in some cases, back to the architect. The complexity of information management increases with the fact that projects in the real world proceed in phases, and are heavily overlapping. The complex network of dependency between the tasks and responsibilities of the different players handling the same building objects definitely requires a solution with the capability to share the same real-time model. The creator of the information owns that information, and has the authority to give permission to view, use and change the information. This is what Structural BIM is all about - a group of automated islands located so close to each other that there is no practical reasons to separate them.

Parallel Process Benefit

There are several processes parallel to the Structural BIM core process which can benefit from this new model-based way of working, as these are natural parts of the Structural BIM. They are not primary prerequisites for the implementation of the Structural BIM, but once Structural BIM is implemented it is senseless not to connect them into the same model.

One example close to the actual Structural BIM core process is project management. Once Structural BIM is implemented by an organization or alliance, it is quite obvious why project management is such a valuable tool. The real-time model allows accurate information to be shared by all parties, and practical details can be managed easier. Any member of the project team can check the status of the various other parties working on corresponding processes throughout the lifecycle of the project.

"Changes must be communicated…"

Another example is cost analysis, as Structural BIM provides an excellent tool for managing costs. It is part of the initial decision-making process and is obviously also linked to the architect's model. As the structural design process proceeds, the cost composition will become more accurate and detailed.▪

Integrated Steel Design (ISD)

The Engineers Role

By Don Engler, P.E.

The technology boom has led to a host of engineering software that is intended to create a 3D model oriented design environment. These new tools, along with Electronic Data Interchange (EDI) are being heralded as the new way of doing business. Today, engineers are right in the middle of this new technology, and are being asked to be an integral member of the 3D modeling team. But what is the Engineers role both from an engineering and business standpoint? And how does the engineer take advantage of this new environment?

ISD is the process by which the Engineer produces a 3D computer model during the design phase for use by the rest of project team. This model contains exact geometry and member descriptions, including concrete, steel, timber, curtain walls and other structural materials. The model is used as the defining document by the project team.

"…engineers are right in the middle of this new technology…"

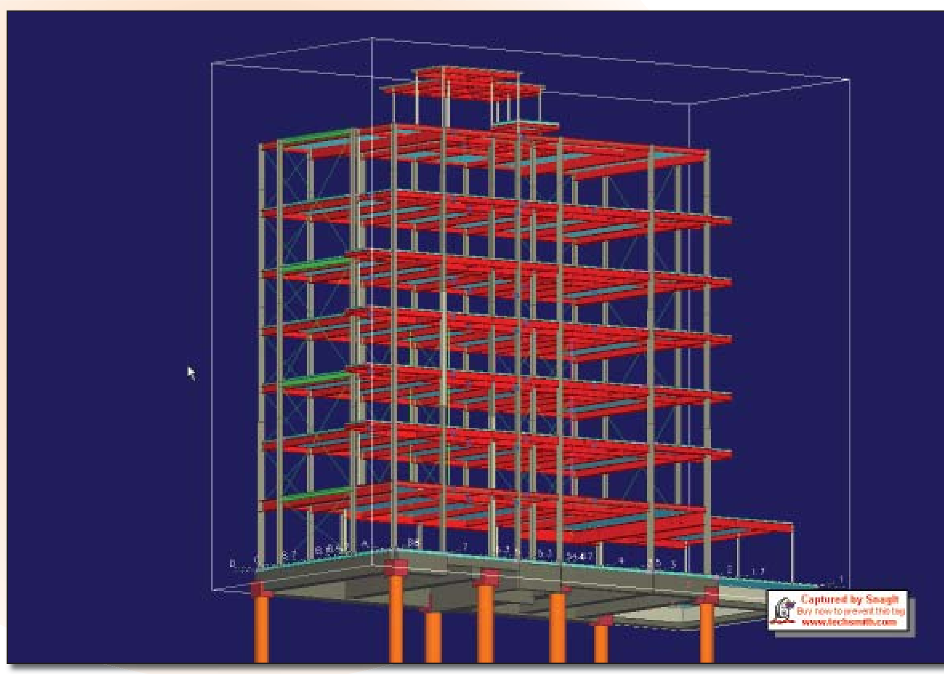


Figure 1

The completed model would provide a tremendous amount of information to the project team, saving both time and money. The different disciplines would be able to work off the same geometry, thus errors that normally exist because of coordination problems would be eliminated. The model would become an as-built of the completed structure, and could be used for building systems such as environmental controls and security.

All of this is made possible today with currently available hardware and software. The speed and cost of hardware is no longer an obstacle for the average engineering office. Additionally, software companies now recognize the need to be able to communicate between different applications.

History

For industrial projects, spatial relationships are of critical importance. The use of a 3-dimensional model for design and detailing has been in use for many years on industrial projects. The industrial design market is often associated with the Engineer acting as the Construction Manager, Purchasing Manager, and as the Design Engineer. This business model allows the engineer to drive the project using the 3D model to manage the associated trades such as mechanical and electrical design.

"…there isn't a driving force to adapt the new technology…"

The industrial 3D computer model is then used to combine all of the components into one model for interference detection. The model becomes the definitive document, and the entire project team uses the model as a framework for the control of their work. The typical contractual relationship that exists in the industrial sector facilitates this information transfer.

The commercial and institutional building sector has not yet embraced 3D modeling to the extent the industrial sector has, for various reasons. These include both the traditional commercial business model and the contractual relationship that exists between the project team. Additionally, there isn't a driving force to adapt the new technology as there is with the Engineer in the industrial business model. While spatial relationships are important for these projects, it's not quite as critical as it is for industrial projects where the fit of the contents of the building is at least as important as the building itself.

"…information from the model would be used to create the numerical files for use by the fabricator…"

The technology now exists with the new 3D analysis programs, 3D architectural programs and interface programs such as CIS2, which allow the various programs to communicate with each other. This article will discuss some of the challenges the use of this technology may have for the commercial market and some possible solutions.

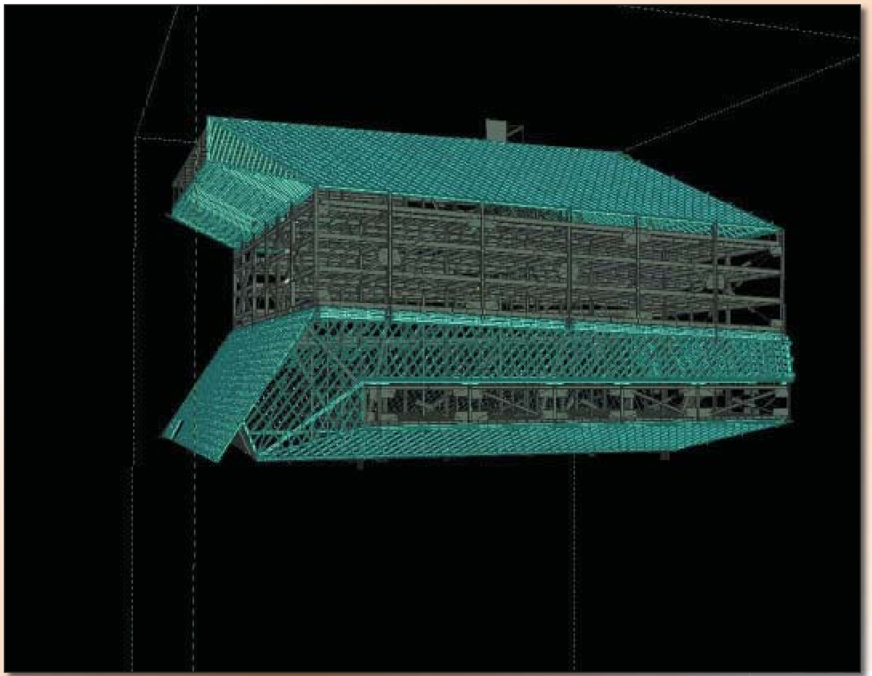


Figure 2

Theoretical Business Model for ISD

In a perfect world, the architect would create a 3D model showing all of the geometry, certain member requirements and any other special spatial requirements. This model would then be given to the engineer who would perform an analysis by importing the model into their analysis program. Upon completion of analysis and design, the completed model would then be sent back to the architect for importing into the architectural 3D model. This process would continue throughout the design process until both parties end up with a completely coordinated three-dimensional model of the project.

The model would then be downloaded to the General Contractor and all subcontractors for their use. For example the steel detailer would download the model into a detailing program such as Tekla Structures (the new version of Xsteel) and generate the detail drawings with a minimum of geometry related questions. *Figure 1* is from a Tekla Structures model which includes all of the main structural elements that are directly linked to the design analysis program. The information from the model would be used to create the numerical files for use by the fabricator to automate the fabrication process. This same process could be used for curtain walls, reinforced concrete, precast concrete, etc. The general contractor would use the model for scheduling and for special visualization such as for earthwork and site requirements. This process could improve the project schedule by 20%, and would eliminate some of the major issues that often result in delay claims.

The contract would specify which party is responsible for creating the model and which party is responsible for maintaining the model. In the end, this process would result in an as-built model that the owner could use in the future.

"…not every member needs to be physically shown at every location."

The Issues with ISD Today

Who makes the model?

This is like "Which came first, the chicken or the egg"? The architect is the driver of the geometry, which may vary between the building skin and the building structure as being the control. However, the architect's need for exact geometry is different than the rest of the project team. The structural engineer typically is satisfied if the structural geometry is accurate to within one inch. Also, for typical structural contract documents, not every member needs to be physically shown at every location. Many pieces are described by typical details and schedules. The detailer and fabricator on the other hand, need a model accurate to within 1/16 of an inch, and one that includes every piece of steel. The curtain wall fabricator also needs a very accurate model to determine precision cuts and attachment points.

Who owns the model?

The word "owns", for the purposes here, has a legal connotation associated with responsibility for the model accuracy. The liability exposure would be significant for the owner of the model. If for example, the curtain wall manufacturer relied upon the model for fabrication of the mullions and these ended up being fabricated incorrectly, the remedial costs and schedule delays would be significant. The person who creates the model should theoretically own the model. In essence, the creator would own the responsibility and liability.

> *"…engineers feel they should be compensated for this additional scope."*

Currently there are not very many volunteers! In fact, this is one of the major problems. Almost everybody agrees the model would benefit the project but somebody else should create the model. Based on our litigious culture, this is a very real and scary proposition for all members of the project team.

Who pays for the model?

Most engineers do not fundamentally object to creating a 3D structural model. Their main concerns are as stated above, the liability issue, and of course "How do I get paid for this". One could argue over the amount of extra work 3D modeling would require. However, without question it is extra work, and engineers feel they should be compensated for this additional scope. Not all projects require a 3D model, and the benefits for the design engineer may not be readily apparent.

Structural engineers normally do not geometrically modify their analysis and design computer models late in the design process, unless the engineer determines the modification will impact the actual design. Simple framing, such as for floor openings, are not typically added to the structural analysis model. These types of inconsistencies would need to be controlled if there were to be a "Master" 3D model of the entire structure. Maintaining the final model to account for all pieces of the structure will increase the engineer's costs to ensure that the model is accurate.

Who benefits from the model?

There is agreement that the future will likely be a single-3D-model world, and the entire project team will plug into it and all will benefit. The problem today is that not everyone agrees that ISD will benefit their particular industry. Certainly engineers, along with a lot of architects, question the benefit they will gain by the use of a comprehensive 3D computer model. The usual comment is that this will really benefit the detailer! This is true; however the detailer's portion of the project is towards the end of the process and discounts the amount of benefits the project can derive.

Until the entire project team can see direct benefits in the creation of a project model, there will not be acceptance of this new way of doing business. Another obstacle with universal acceptance is that a lot of the project team members are still living in a 2D world, and are not prepared to spend the extra money or train their people in 3D design techniques.

The main area of agreement is that there can be significant project schedule improvements with proper implementation of this new 3D business model. It is easy to see that once a model is created, the information could be available sooner than what is currently available through the normal release of 2D documents at the end of design process.

If used correctly, 3D modeling can provide tremendous benefits to the project, from the designers through the construction process. The architect and engineer could pass the model back and forth on an iterative basis to redefine the structural analysis and the structure itself. This would allow structure optimization without delaying the project. The construction manager could also benefit by using the model as a relational database to track and control the project through reports and model visualization.

Projects that are primarily driven by geometry are ideal for taking advantage of 3D computer modeling. The new Seattle Central Library (*Figure 2*) is a good example of a project where the structure geometry and the structure surface control the design. A 3D model of the structural steel was created during the shop detailing phase, however the project could have benefited greatly from having the model created during the design process.

> *"…question the benefit they will gain by the use of a comprehensive 3D computer model."*

Possible Solution?

Until there is universal acceptance and the 3D benefit to the project team is obvious, a possible solution may be the creation of a new team member, the Modeler, whose sole responsibility is the creation of the 3D model. This group could work directly for the Owner or the General contractor, and their responsibility would be to collaborate with the project team during the design development. Their product would be the 3D model.

The Modeler would be paid to develop and maintain the model, and to take responsibility for its accuracy. The goal of the modeler would be to assist the project team in development of the model without increasing the costs of the individual team members. This might be similar to the physical models that were constructed for large industrial projects in the days before computer modeling. Everybody involved in the project would visit the model, and use it for discussing their particular issues and for planning.

Conclusion

ISD is certainly on the horizon; the technology is already in hand. There are many engineers and architects who support ISD and EDI, and some who are currently using this business model. This concept will require a change in the way we do business. The real question is who will drive this change and create a business model that will result in benefits for both the owner's constructed project and the design/construction team.■