

Figure 1. Architectural and structural BIM of a worship center created from laser scanning and design intent documents used for the General Contractor's trade coordination process.

BIM for Construction

The Challenges and Benefits of Implementing BIM during Construction

Imagine discovering and documenting existing building conditions with a degree of accuracy that eliminates the surprise of unknown conditions that so often result in costly change orders and construction delays. Now consider being able to virtually construct a building and resolve the design coordination issues before physically building the building; or consider having the confidence to pre-fabricate parts and systems in the shop knowing that you can show up on a jobsite and they'll fit right into

place. These are just a few of the many compelling prospects that Building Information Modeling (BIM) has to offer. So why then are some people slow to adopt BIM, and what challenges might one face once a decision has been made to make the commitment to retool their processes and implement new technologies? Furthermore, how will this effect current relationships with clients, sub-contractors, vendors and staff? The answers to these questions demonstrate where the AEC industry currently may be heading.

BIM is a Process

BIM is quickly becoming an integral part of the process that many General Contractors use to construct and/or renovate buildings. The concept of BIM is to build a building virtually prior to building it physically. BIM resolves problems, and simulates and analyzes potential impacts in advance. Moreover, along with improvements in project delivery, the reduction of uncertainty reduces overall risk. The work site becomes safer since more items can be pre-assembled off site keeping the

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Figure 2. FARO Focus 3D Laser Scanner.

on-site trades to a minimum. Waste can be minimized onsite and products delivered when needed and not stockpiled on site. This can have a tremendous impact in the way a construction project is managed. While BIM is not new, the process of implementing BIM is still being discovered by many in the AEC industry. In addition, many of those who have been working with BIM during construction still find challenges with its implementation. However, one thing is certain; BIM is being adopted and will continue to evolve as a key component in the process of construction.

Existing Conditions BIM

Where renovation work is being performed, or when new buildings adjoin existing buildings, existing conditions information is usually required. Documenting and modeling existing conditions is typically more difficult than creating a new BIM from scratch. Many challenges are faced when documenting existing conditions: gaining access to the building; working around building occupants and contents; documentation of concealed objects; maintaining the dimensional accuracy of the measured data, etc. However, when designers and contractors are unable to obtain accurate existing conditions information, they must base their work on assumptions that often prove to be wrong. This results in increased risk for all parties involved. Ultimately, the Owner will pay in the form of increased change order costs and construction delays.

With so much potentially at risk, it seems like a simple decision to invest in the creation of an accurate as-built model. So why then do owners, designers and contractors opt out of obtaining an existing conditions as-built? In many

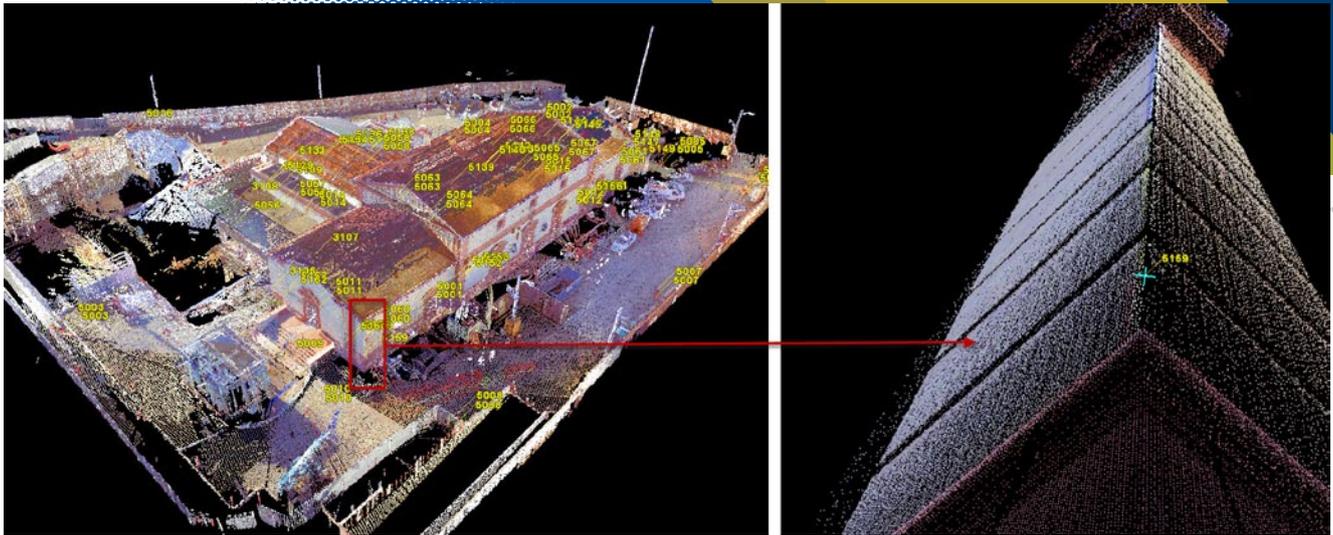


Figure 3. The left image above shows a project site that has been laser scanned using a survey control network. The right image (looking upward from the ground) shows the relationship of a single control point that was shot on a corner of the building compared with the registered scan data.

cases, it is because of the perceived cost. Paying money up front to ‘potentially’ save money further down the road can be a hard sell to some especially when it is impossible to quantify the savings up front. Unfortunately, by the time the real costs of *not* having an existing conditions as-built performed are known it is often too late. The cost of a single change order could have more than paid for the cost of a good as-built.

Existing conditions models can be developed in many ways, depending on what is desired and what is most efficient. When an as-built is sought for construction purposes, building surveyors are often brought in during, or right after demolition is complete and the hidden conditions are exposed. This can be the most effective phase of a project to perform survey work since it generally results in the lowest costs, fastest data acquisition times and the best data capture. However, there are still many things to consider when creating an existing conditions BIM for construction.

While survey control is not required to laser scan a building and is often overlooked when an as-built is being performed for design purposes, it can become critical during construction. If there is an existing control network already established, the scanning service

provider should request the information needed to tie his/her scans to it. The obvious benefit of tying the laser scan data into survey control is more accurate scan registration. In addition, contractors will typically want to geo-locate the data and use the real world coordinates for their sub-contractors to position their respective models. An added benefit of combining survey control and laser scanning is that both data sets can be used as a redundant check on accuracy. By shooting the building corners with a total station, control points can be imported into the scan data to improve confidence through a visual check.

Construction BIM

For those contractors who have incorporated BIM into their construction process, the question of where the BIM comes from needs to be addressed early on. In some cases, the design team has created their construction documents using a BIM authoring tool. If the design team is willing to release their Design Intent BIM to the contractor, he/she may be able to utilize it for the purposes of trade coordination. Rarely is an architect’s BIM set up for a contractor to do quantity takeoffs for estimating purposes. In many cases, the contractor will choose to create

their own BIM from the construction documents. Typically, they will create an architectural BIM either in-house or will outsource it to a third-party modeler. The various trade models (i.e. structural, mechanical, plumbing, electrical, fire protection, etc.) are typically modeled by the trade contractors themselves. All of the models are then brought together using a tool such as Navisworks to view them as a single federated model. This process typically reveals numerous conflicts between the various trade models. Through a process of regularly scheduled construction meetings the general contractor and the trade contractors methodically identify and resolve conflicts until the federated model is clash free. One of the benefits of this process is that the trade contractors can use the coordinated model to prefabricate parts back in their shop and bring the pre-assembled parts to the field to be fitted into place.

While this process is now commonly used by many contractors, there are still many who have yet to venture into the world of BIM. Those that are considering this can expect to face various challenges along the way. One such challenge is making sure their trade contractors are also able to model their work. While the process doesn’t necessarily require BIM,

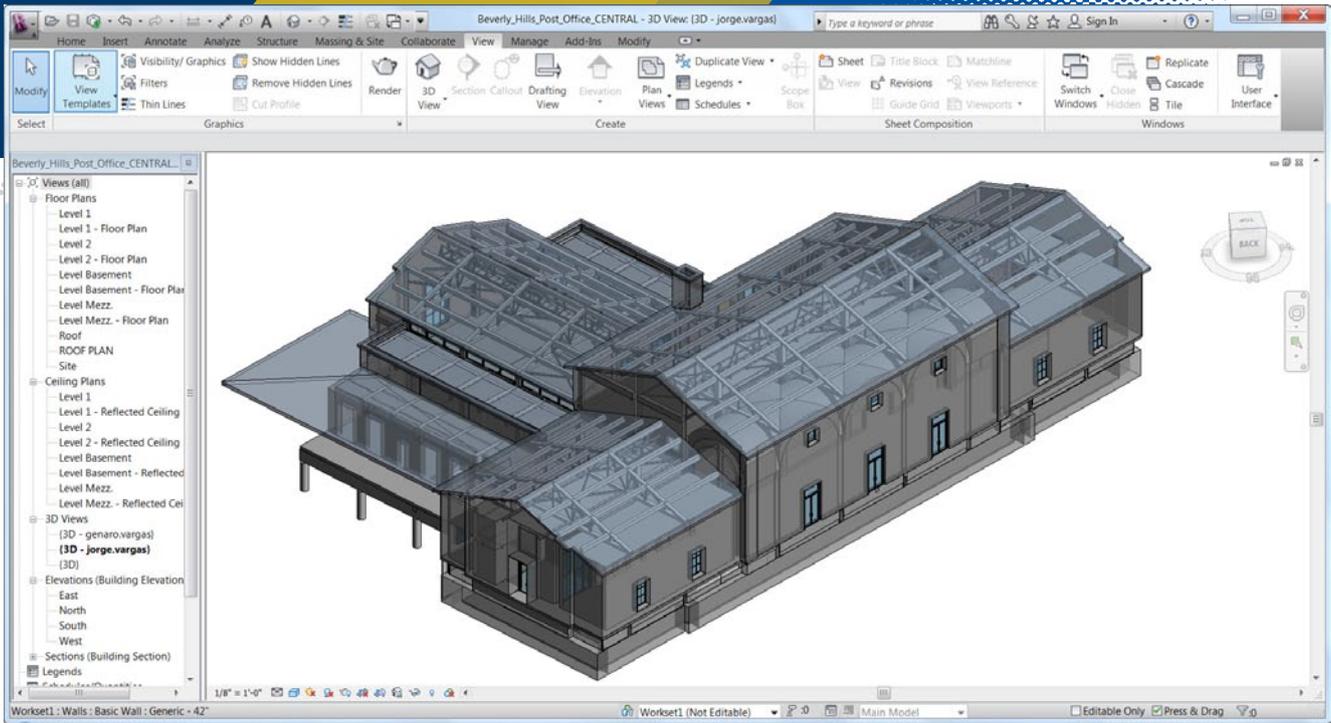


Figure 4. Existing Conditions BIM derived from scan data.

it will require, at a minimum, a three-dimensional geometric model. If the trade contractors are not able to produce their work in 3D, the general contractor may need to establish new relationships with other subcontractors.

Another challenge may be allowing adequate time up front to create the construction model. For a project with existing conditions concerns it may be necessary to first create an Existing

Conditions As-built BIM since it is not uncommon for design intent documents to be based on record drawing data and not actual as-is field conditions. By going through the demolition process the general contractor may be exposing as-is conditions that were not previously able to be surveyed or incorporated into the design intent model. This step will take additional time that was not typically part of the traditional construction

process. However, significant downstream time and cost savings can usually be realized.

BIM Changes Relationships

Significant changes in business processes will inevitably result in changes in business relationships between all parties involved. These changes should be embraced and taken advantage of. To refrain from a new way of doing business that promises to improve our efficiencies and reduce risk is not only foolish, but can be costly.

Architects were the first building professionals to explore the BIM process. However, the adoption rate by architects has been slow due to concerns over compensation and liability issues. Contractors, however, have been eager to adopt BIM and retool their business processes primarily because BIM allows them to build buildings better and reduce their risk.

As more and more parties incorporate BIM into their business the desire for instant and accurate information will continue to become the norm. The need for quicker decisions will force

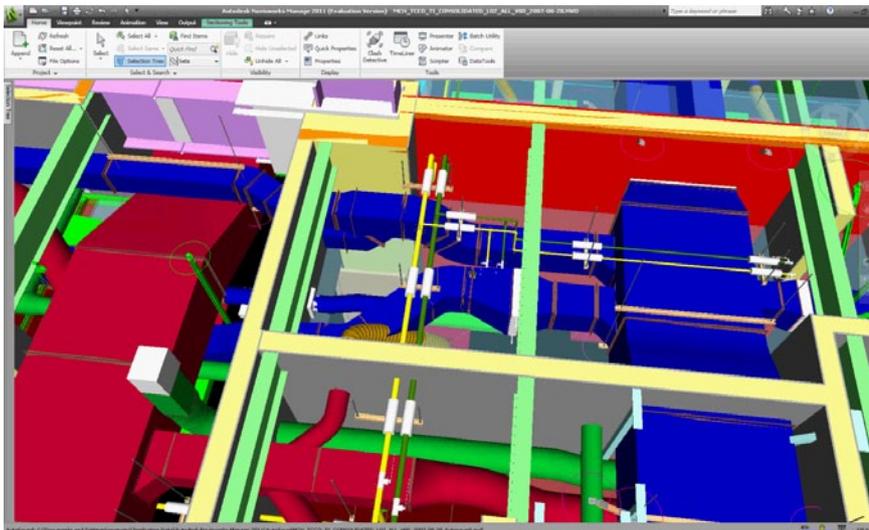


Figure 5. Federated model used for trade coordination.

all parties in the process to collaborate more closely and rely on each other for information and solutions.

Conclusion

As the process of BIM continues to evolve it is becoming increasingly clear that the industry has moved well beyond the question of whether adopting the BIM process makes sense. Where existing conditions documentation is required, technologies such as 3D laser scanning combined with traditional survey control have been shown to dramatically improve the accuracies of creating an Existing Conditions BIM. In addition, utilizing BIM during construction for trade coordination offers significant benefits, such as pre-fabrication, reduced risk, and minimized construction delays. While some are eager to adopt BIM, others are more reluctant. However, as the industry transforms itself, those who come kicking and dragging their feet may inevitably find themselves left with fewer and fewer opportunities. ■

John M. Russo, AIA is an experienced architect with over 28 years of experience. He founded Irvine, California based, Architectural Resource Consultants (ARC) www.arc-corporate.com, a firm that specializes in building documentation. Mr. Russo successfully led his team in a nationwide competition for a 5 year, \$30 million IDIQ contract with the U.S. General Services Administration (GSA) for Nationwide Laser Scanning Services. Mr. Russo is an active member of the Orange County Chapter of the American Institute of Architects (AIA), and also is a member of the BuildingSMART Alliance. Currently Mr. Russo, together with other industry leaders, is in the process of founding the U.S. Institute of Building Documentation (USIBD) www.usibd.org. Mr. Russo holds a Bachelor of Arts in Business Administration from California State University, Fullerton and an Associate of Arts degree in Architecture from Orange Coast College.

BUILDING DOCUMENTATION THE USIBD CAN HELP YOU UNDERSTAND

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Do you need insight into BIM or building documentation? Would you like a resource where you could collaborate on standards or quality assurance in the documentation of buildings? The U.S. Institute of Building Documentation (USIBD) is the new resource for you.

The USIBD is a non-profit organization with a mission that is dedicated to furthering excellence of building documentation by promoting, educating, guiding and supporting stakeholders with an interest in the built environment.

We are in the final stages of organizing and we will formally launch at the SPAR International 2012 conference in Houston. The leadership team at the USIBD has the vision to be "The leading resource for the building documentation industry." This includes 2D and 3D platforms, BIM, Scanning as well as the many other aspects of building documentation.

The USIBD has a strength that few other organizations have harnessed: to engage ALL stakeholders, from the owner/operators, architects and engineers to the surveyors, scanning providers and contractors. The leadership team is comprised from these stakeholders. These times have technology forcing dramatic changes in workflows and processes. We hope to provide stakeholder groups with

better, more comprehensive standards, guidelines and best practices to foster the productivity, quality and safety of the documentation process.

Our first initiative was to create working subcommittees that would assist in the creation of the organization. Our sub-committee on Standards has begun developing standards for specific areas of building documentation, such as quality assurance and historical documentation. This will continue to expand to the development of the certification process to help professionals establish credibility in the building documentation field and to provide assurance that service providers are qualified to perform the requested work.

Education is another key aspect to the USIBD. We want to help building owners and others who are procuring building documentation services gain a better understanding of what it is they require so they can properly specify their needs. The core of the USIBD is to be an educational resource dedicated to the pioneering technology of the Building Documentation industry.

We will be offering both individual and corporate memberships and we are also seeking to develop alliances with other organizations to foster a broader understanding of shared issues.

Please visit us at the USIBD exhibit booth at the SPAR International 2012 conference and attend our round table discussion at 9:00 am, Wednesday April 18th. For more information please visit www.USIBD.ORG



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