

Integrated Project Delivery builds a brave, new BIM world

Building information modeling is being touted by its advocates as a lifesaver for complicated projects because of its ability to correct errors in the design stage and accurately schedule construction. But can AEC firms unlock the full potential of BIM while still utilizing design-bid-build contracts and work processes designed for 2D design and construction?

By Jeff Yoders, Associate Editor

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Building Design and Construction

Three-dimensional information, such as that provided by building information modeling, allows all members of the Building Team to visualize the many components of a project and how they work together. BIM and other 3D tools convey the idea and intent of the designer to the entire Building Team and lay the groundwork for integrated project delivery.

Construction management firms DPR Construction, Skanska, and Turner Construction; A/E firms HNTB and HOK; and structural engineers Thornton Tomasetti are using BIM along with other innovative practices such as RFID tagging, model translation, and early design visualization to deliver true integrated project delivery. They're also creating new shared-risk contracts that more accurately reflect the new roles of architects, engineers, contractors, and subcontractors.

"Our thinking is that if we can sit at the table with the other great minds in the project—the architects, MEP and structural engineers, and our key subcontractors—as early as possible, then we can all deliver the most efficient building," said Chris Ripplingham, BIM engineer at San Francisco-based DPR Construction. "We definitely try to collaborate as much as possible even in situations where the contract doesn't obligate us to do that, but with our experience in integrated delivery that's our normal way of working."

In the following pages, we present three projects that are achieving a high degree of integrated project delivery through the use of building information modeling and other software tools: the renovation of a floor of the historic One Market Street building in downtown San Francisco; the new NFL stadium in the New Jersey Meadowlands; and the \$737 million expansion of the Las Vegas Convention Center.

Landmark at One Market Street: Turning Shared Pain into Shared Gain



The customer briefing center in Autodesk's San Francisco office in The Landmark at One Market Street will have interactive exhibits that demonstrate the ways that digital prototyping can be used to create products. Rendering: Anderson Anderson Architecture

San Rafael, Calif., software developer Autodesk is expanding and reconfiguring one of the 45,000-sf floors it leases in the historic One Market Street building in San Francisco. To Autodesk VP Phil Bernstein, FAIA, the project represented an opportunity to show how BIM and IPD can make construction more efficient.

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"If I'm running around the world, vast improvements in process, we not do this on our own buildi
Building Design+Construction.

To achieve integrated design, Autodesk gathered a team that now includes the San Francisco office of HOK (a big player in the "B movement), virtual construction pioneers DPR, and the San Francisco office of Anderson Anderson. Instead of relying on traditional contracts and construction documents, the three firms and Autodesk form a four-way partnership that stipulated they work together as a team and share all risks and Every non-owner team member is guaranteed to have its costs covered. Beyond that amount al by meeting contract benchmarks is put into a profit pool which will be divided three ways upon c Autodesk also stipulated that the Building Team make One Market Street a showcase for its Rev

"We have a common interest among the parties," said HOK senior vice president Edward McCra contract makes us true partners where the incentives to profit are meeting benchmarks such as certification and not putting in change orders or increasing the entire price of the project. In this structure, the more accurately we share information, the more risk we're mitigating."

Also gone are the traditional roles of design architect and architect of record. Both architects are models and stamping drawings created from their Revit models. Anderson Anderson is designing for Autodesk's customers, which takes up half the floor, and HOK is designing the actual office s

"In the beginning, everyone was somewhat concerned about two architects and how that would Anderson, principal of Anderson Anderson. "But this close collaboration has benefited us and, I f talking a lot more because of the contract. We're specifying a lot of the same products on both f and even though there's a line dividing us, we've talked a lot about what each firm is planning."

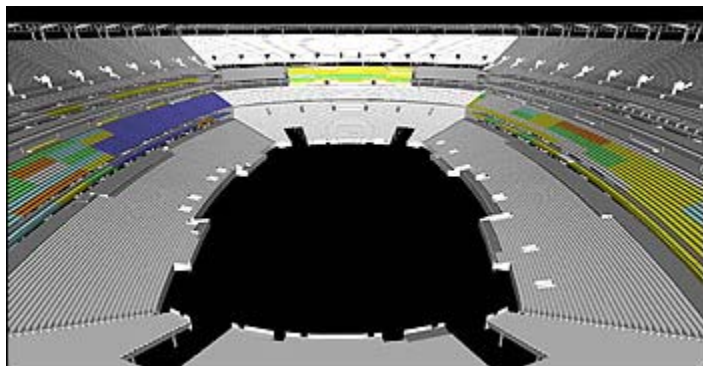
For DPR, which has delivered four integrated project delivery jobs on time and on schedule to d collaboration is ongoing with both architects. DPR is using Autodesk NavisWorks to merge the in models created by Anderson Anderson and HOK. The general contractor is also using a point-clc the existing floor into a final design. The laser scan even took into account the structural integri existing slabs and brick columns.

Construction began March 10, and DPR expects to have the project completed by June. The 16- schedule is highly coordinated with all subcontractors.

"Since the design is constantly evolving, even as we go into construction, we have ongoing cons analysis with everyone at the table figuring out how and what to build within the constraints of f example, by coordinating everything down to the straight-line support wires for the lighting fixt environment, we are eliminating the need for rework in the field," said DPR's Rippingham. "Also hit our turnover date, we ordered the skyfold doors, which have an 8-10 week lead time, even v finalized."

DPR managers feel confident that, with this highly planned and coordinated project schedule in place, they are able to meet the contract's benchmarks. "With everyone on board and issues figured out earlier, we're in a much better position to reduce overall project risk for everyone, thus creating a better environment for all parties," said Atul Khanzode, DPR's virtual building group leader.

Giants-Jets Stadium: Using RFID to Speed Delivery



In the BIM model of the Giants-Jets project, precast concrete sections that are "damaged" are colored orange, "manufactured" are yellow, "arrived" are red, "ready to ship" are green, "received on site" are light blue, and "erected" are dark blue. Everyone on site has access to the Web-updated model. BIM Model: Skanska

fabricator CanAm of Point Rocks, Md.

The stadium BIM model was created in both Revit Structure and Tekla software. In addition to using the model to find interferences in the design stage, Skanska is also tracking 3,200 pieces of precast concrete to be installed using radio frequency identification (RFID) tags. Field construction software provided by Burlington, Mass., updated its RFID-based Materials Tracking module to interface with the Telcolor coding each section of precast concrete in the model: sections in the "manufactured" stage are yellow, "ready to ship" sections are green, "received on site" are blue, and "erected" sections are dark blue. Skanska calls this interface "Field BIM," as it elevates the model from design management to construction management by incorporating live field information.

The pieces are so big that nearly every section takes up an individual load from plants in Buena Vista, Allentown, Pa. The RFID tags are attached at the plant and scanned with a pen scanner that connects to a PC-based tracking system at the factory. The RFID tags are scanned when they arrive at the job site and are scanned again at every point between manufacture and installation and networked to the project database. Each scan, new information is uploaded via the Internet to the 3D Tekla construction model, which is accessible to all Skanska project managers. Vela is also providing its quality management and work list modules on tablet PCs.

"Because of the project's size we knew we'd have to use some type of tracking software like this," says Campbell, VP of innovation and technology at Skanska. "We're actually right on track for the 2010 opening mostly because of the models and the tracking we're doing."

Campbell said the construction team didn't want to use laptops because they're hard to read in the field. Finding the right PC tablet was crucial, because the pen reader for the RFID has to be within 25 centimeters of the computing device to be read properly. The solution: Motion Computing's LE 1700 tablet PCs. "The ability to write on a tablet as in any other job site was something important that Vela gave us,"

Tekla's Internet-based viewer can be seen by anyone on the project. All construction documents are accessible on the tablet PCs onsite.

The structural steel design from Thornton Tomasetti and CanAm is a similarly collaborative effort. Since the project's startup last year, nearly 19,000 tons of steel have been modeled, 70% of them in Revit and 30% in Tekla. More than 8,000 tons have been erected to date.

In the Meadowlands of northern New Jersey, the steel structure of the new \$1.3 billion stadium for the National Football League's Jets and Giants is rising. The shared facility broke ground in 2007 and is scheduled to be completed by the opening whistle of the 2010 season. Designed by 360 Architecture of Philadelphia, the bowl-shaped gridiron will have a capacity of 82,500, including 1,000 executive suites and 9,200 club seats, not to mention club lounges and four restaurants. Large LED foot video scoreboards will be hung from the deck in each corner of the 1.9 million-sq-ft stadium. Ewing Cole of Philadelphia is architect and engineer-of-record.

Design-build contractor Skanska USA Building Inc. among construction companies in the Philadelphia area (300) is using several project delivery methods to ensure an on-time finish, including a partnership between structural engineer Skanska USA Building Inc. and engineer-of-record Thornton Tomasetti of Philadelphia.

Instead of creating one BIM model for the entire project, Thornton Tomasetti is creating a different model for CanAm as new information about each section becomes available. The detailed models tell the number of bolts required for connections, the precise tonnage, and other exacting details. As they go along, CanAm is able to order steel at the optimal time and start working on finished portions of the stadium instead of waiting for a final model or RFI process. The final model will have the vast majority of construction documents created from it.

"We knew the only way we'd meet the steel delivery schedule was to do it this way," said Tom Setton, appointed chair of Thornton Tomasetti. "Without a model for each section it would've taken more time."

Thornton Tomasetti has established a set of best practices to share with its steel fabricators based on collaboration with CanAm on the Meadowlands stadium, Chicago's Soldier Field (the first time they used a Tekla model with a fabricator), and the Washington Nationals baseball park in the District of Columbia.

"The biggest leap was getting everyone in the fabrication business comfortable with talking this process and sharing this model that we hand off to them," said Erleen Hatfield, a principal at Thornton Tomasetti and leader of its integrated modeling services group. "Now it's becoming easier and easier with starting to have a hard time finding owners who do not mandate BIM on these major capital projects."

Las Vegas Convention Center: What Happens in BIM, Stays in BIM



Turner Construction Company (ranked 7th among contractors) ; HNTB Architecture (ranked 10th among architect/engineers in the BD+C category) are defining their BIM and integrated processes with a detailed process that goes well beyond traditional 2D to 3D, 4D, and 5D collaboration. Design Build Handbook defines the requirements and responsibilities for such things as Turner estimate access to the HNTB Architecture

The \$890 million renovation of the Las Vegas Convention Center will include modern interior design, a renovated exterior, and a naturally lit lobby (above). A grand concourse will tie together the center's three halls. Both a new police station and a Clark County Fire Department facility are planned. Rendering: HNTB

This high level of cooperation between coordinated Turner and HNTB's manual requires both HNTB and Turner, and in some cases, alter traditional processes to meet the needs and requirements of the firm. For example, during the construction phase, HNTB designers need to coordinate modeling processes so that Turner estimators can more easily and accurately determine pricing. These processes are successfully being used on multiple projects, including the San Francisco 49ers' new stadium

This collaborative approach is fully supported by the leadership at both Turner and HNTB. Prior to this pilot project, Jan Rheinhardt, program manager of virtual design and construction at Turner, and a national CADD/BIM manager for HNTB, worked together to analyze the current processes, needs, and talent of both organizations and to develop processes that would address those issues and leverage the talent in both organizations before a pilot project was selected.

"The key to the HNTB/Turner IPD really boils down to communication and getting over the traditional relationship between the AE and GC," said Davis, co-founder of KCRRevit, the Kansas City Revit user handbook is a living document that changes with every job. As we learn how better to work and communicate with each other and the other design and construction team members, we incorporate those changes. Different building types have different situations and as a result, the design and construction teams need different information to extract from the model. That's why we started this manual development company had a project to use it on. We want to work smarter, not harder."

Turner's Rheinhardt said his company would rather create a complete BIM model than one that is siloed by one discipline and doesn't holistically address architecture, engineering, and construction issues.

"Rather than us trying to create models from drawings," Reinhardt said, "we embrace the idea of a model from the right entity. The architect should provide an architectural model, the structural contractor provides the structural model, and the subcontractors should provide shopdrawing models of their trades. In the BIM process, Turner is assuming the role of the model integrator and a facilitator."

This collaborative approach ensures that the specific parts of the model are created by the people who are most qualified for providing the right building information. It also generates buy in and involvement in the process. Turner sees BIM as a collaboration and management process more so than a technology. And sharing models with team players, such as HNTB allows us to bring the best in BIM to the project.

The biggest benefit of BIM, Turner believes, is the increased level of coordination between the project team. This has multiple positive effects, such as less changes and RFIs, less disruptions of the construction schedule, and higher levels of prefabrication. Turner is currently working on 50 projects using BIM that total about \$1.5 billion. In two and a half years Reinhardt expects the vast majority of Turner's projects to be done in BIM.

"We've found that 3D-coordinated projects are simply of a higher quality than the traditionally 2D projects," he said. "It makes our job easier and it makes the designer's life easier because there's simply no rework in the model."

For more on BIM, check out this presentation on the renovation of the Las Vegas Convention Center: www.BDCnetwork.com/contents/pdfs/bdc0804turnerbim.pdf and this one on the Vela Systems are doing with field BIM on the Giants-Jets Stadium in New Jersey: www.BDCnetwork.com/contents/misc/bdc0804skanskavela.ppt.

Anderson Anderson: Small Firm, Big on BIM

"I think it's safe to say that we and HOK are on different ends of the small firm, big firm spectrum," said Peter Anderson with a chuckle. The co-founder and principal of Anderson Anderson Architects, with offices in San Francisco and Seattle, was referring to his firm's design partner in the renovation of Autodesk's floor at One Market Street.

Anderson and his brother, Mark, started their firm in 1984 as a design-build construction firm. Working directly with manufacturers and government agencies in the U.S. and Japan, Anderson Anderson has designed and built numerous prefabrication systems that explore new construction technologies and affordable building methods. Related work on materials and manufacturing has extended into furniture and product design, and they also do consulting on creative marketing, business strategy, manufacturing, and construction issues. The Anderson brothers believe that maintaining a relatively small design staff assures close personal attention to the firm's projects. The firm only has eight employees to HOK's 2,153.

"The whole IPD concept is new in some ways, but the further we get into it, the more we realize it's very much like the way we used to work as a design-build contractor," said Peter Anderson. "When we didn't want to be contractors, we wanted to be architects. But we also wanted to have the contractor's project delivery knowledge and expertise and input and control in the delivery process."

The One Market Street project allowed Anderson Anderson to showcase those IPD and design-build capabilities. The Landmark at One Market Street is located at the foot of Market Street in San Francisco's Financial District and is considered to be one of the city's most architectural historic properties. Built in 1916 for the Southern Pacific Railroad and occupied as the company's headquarters until 1998, The Landmark at One Market is an 11-story Italianate structure with 437,000 sf. Anderson Anderson could make no changes to the exterior walls of the building, so they painted the exterior or changing the window glass in the building's large, semicircular vaulted windows.

"There were several challenges in keeping the historic character of the building while making it a modern customer design center," Peter Anderson said. "We solved one of them by using elements not tied to the outside walls, such as a ceiling grid system with hanging fabric suspended from the steel frame."

Anderson Anderson is working with fabricator Monster Root, San Mateo, Calif., which is fabricating ceiling boxes offsite and sending them to the construction site for installation before Street's reopening in June. The large boxes, which are being installed for acoustical and will be passed through the windows in the building before new window glass is installed.

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