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BIM ON TARGET

By using BIM for the design of its new San Clemente, Calif., store, big-box retailer Target has been able to model the entire structural steel package, including joists, in 3D, chopping the timeline for shop drawings from as much as 10 weeks down to an 'unheard of' three-and-a-half weeks.

By Jeff Yoders, Contributing Editor

Minneapolis-based Target Corp. has always put the design of its stores high up on its list of corporate priorities. Target was one of the original participants in the U.S Green Building Council's Pilot Portfolio certification program, which allows prototype designs of multiple similar buildings to be LEED-certified as variations of a single prototype. Five Target stores have been LEED-certified to date.

Over the last year Target fully transitioned its new store design from 2D (using Bentley Microstation) to 3D (utilizing the Autodesk Revit BIM platform). Early in 2010, as Target began planning a new 142,206-sf store for San Clemente, Calif., the retailer decided to take prototype design to an even higher level, using both 3D BIM and integrated project delivery.

"Right now we maintain a general merchandise P [for "prototype"] store," said Brad Koland, group manager of structural engineering at Target. However, this month the company will be releasing its Revit prototype. "Right now it doesn't really get to a deeper level of integration," said Koland. "We're trying to find out the viability of how deeply embedded we can take this 3D information into our prototype."

One goal of the San Clemente investigation was to figure out how better to utilize the space around the structural steel joists in its stores, space that typically houses some HVAC and electrical lines. There is a sense among Target's architects and engineers that this space could be used more effectively if they were to know early enough in the design process exactly where the joist web framing lays out, so that they could plan how pipes, ducts, and electrical lines would go around them. Koland said Target's Building Teams need to know how all the elements of the steel joists and the joist girders come into play early in the design phase to effectively utilize that space.

"With BIM analysis tools we knew we could reduce conflicts and increase utilization of the space within our box," said Koland. "We wanted to move beyond that. We wanted to use BIM as a way to figure out what was in there, and then establish that and build in protocols for how we could start to utilize that space to reduce the height of our buildings, or maximize the amount of space we have, or minimize the amount of structure we have to put up."

To do that, the integrated team on the San Clemente store—including IPD engineer and steel detailer Meyer Borgman Johnson (MBJ), general contractor Whiting-Turner, and the in-house architects and engineers at Target—met at strategic times near the end of the design phase of the Orange County store. Whiting-Turner created a comprehensive virtual design and construction (VDC) execution plan that was sent out as part of the bidding

RENDERING: COURTESY TARGET CORP.

Prototype Target store design using BIM shows all construction in a BIM model. The illustration is of a generic Target storefront and is not an actual store project.

package for all subcontractors. It defined what Whiting-Turner would be providing, what was expected of each subcontractor, and why and how the 3D model would be used. Because the joist design was such an important part of the overall process, bidding was opened in September for the steel joist fabrication package. The pre-qualification process included a requirement to work as an integrated team using a parametric 3D model.

The steel joist fabrication package went to New Millennium Building Systems, largely because of its BIM capabilities. MBJ created a construction BIM model using Target's Revit model as a starting point, converting to Tekla Structures using the IFC file format. After quality control checking, this model was delivered to New Millennium in lieu of 2D drawings. The structural joist fabricator was able to use the generic joist elements, rather than having to redraw them, to begin the process for exact steel joist design and modeling.

Using New Millennium's Dynamic Joist design component, a plug-in for Tekla Structures that helps automate this integrated process, the Fort Wayne, Ind., fabricator was able to quickly design the steel joists, insert "real" fabrication-ready joists and bridge in the shared Tekla model, and produce 2D shop drawings. The geometry and profiles of the joists were determined by New Millennium's design, detailing, and fabrication standards.

"The parametric Dynamic Joist plug-in will model a joist from user-specified points," said Ricky Gillenwater, IT director at New Millennium and developer of the plug-in. "What users have initially is a generic representation of a joist, consisting of generic material and geometry. The component transforms into an as-built representation as it goes through the joist detailing and design process, which is what we gave MBJ."

The time period from the award of the steel joist package to the approval of shop drawings sent back to New Millennium for fabrication from the integrated design team, including calculations and integrated 3D geometry, was three-and-half weeks.

"That's unheard of to have an approved set of calculations and shop drawings back in the joist manufacturer's hands ready for fabrication," said Jerod Hoffman, principal and structural engineer at MBJ. Referring to the structural steel package (including miscellaneous metals), Hoffman said this is the first Target store ever bid to steel fabricators off of completed shop drawings.

"Instead of providing just 2D construction documents, we gave Whiting-Turner the model, the bill of materials that listed every nut and bolt, and approved shop drawings, which the fabricator could use to supersede the 2D drawings and specifications," Hoff-

man said. "The hope is that because we're providing them exact quantities, the quality, competitiveness, and value of the bids they receive will be better than using 2D design drawings only." Hoffman says he expects "zero change orders" with regard to coordination issues in the steel because "they've all been worked out."

Through the integrated design process, MBJ also discovered early on that some of the load-bearing steel joists had to be fabricated and scoped in a way that changed the original plan for the steel embeds in the store's concrete walls. As a result, the new embeds were correctly put out on the bid documents for the structural steel and concrete packages and will, therefore, be bid on as an already-coordinated first competitive cost.

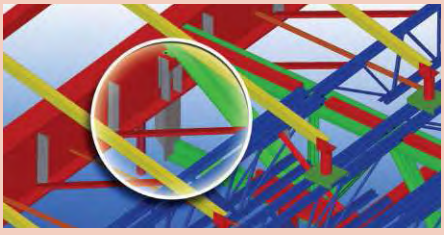
Grading and site work on the project began in late December, and Whiting-Turner is already working with its subcontractors on 4D scheduling and cost estimation. The contractor plans to use Navisworks to coordinate the Tekla Structures steel model, as well as other models for the mechanical, electrical, and other subcontractors. Although Revit is not the model being used to create shop drawings and other deliverables for the subcontractors, Whiting-Turner will use the Revit design model in conjunction with fabrication models to perform clash detection and check quality control.

"The type of sub we're seeing bid on the project is more sophisticated," said Reema Zuberi, project manager and regional VDC coordinator at Whiting-Turner. "They are able to work with 3D models and are comfortable working together earlier in the process."

The store is expected to be ready for its grand opening in October. **BD+C**

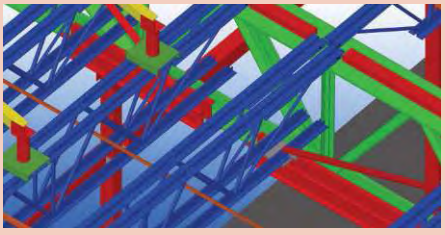
TARGET STORE PROJECT / BIM INTEGRATION

3D screen grabs showing actual project design considerations:

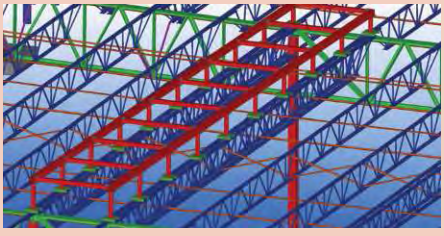


1 After receiving the joists in the 3D-model, the structural engineer saw that a stabilizer was not planned for this joist girder. The engineer designed a special stabilizer hanger for the bottom chord extension, thus preventing a field erection problem.

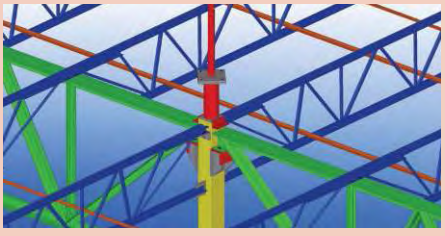
2 The as-built joists design enabled the structural engineer/detailer to design the reinforcement for this door framing, including bolting details.



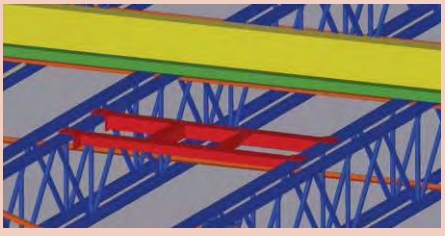
3 The 3D model enabled the structural detailer to coordinate with the joist detailer to extend the bottom chords of these double joists, for added reinforcement.



4 The as-built joists aided the structural engineer/detailer in designing this RTDR framing (mechanical support), by showing exact positioning.



5 Design and connections for a satellite receiver support are clearly communicated.



6 Roof drain positioning and support considerations are clearly aided by the as-built joists in the digital model.

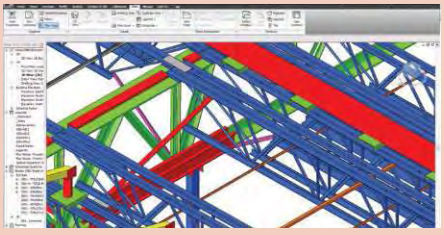
Target: Expanding BIM Design Horizons

Target's in-house property development operation includes more than 60 architects, 80 engineers, and 30 construction managers. The retailer, with 1,743 stores in every state except Vermont, has cut back its new openings due to the weak economy, but still expects to open 30 new stores in 2011, including the San Clemente, Calif., project. Store design is overseen by senior vice president Rich Varda, an architect whose work outside of Target includes the recently opened Musical Instrument Museum in Phoenix.

Utilizing BIM and prototype designs for efficient design and construction is a key part of Target's expansion strategy. "Twenty-ten was a demarcation from a 2D design deliverable to a fully 3D design for all store designs," said Brad Koland, group manager of structural engineering at Target. "We definitely saw that the first incremental benefit of using Revit came from clash detection. There was a cost savings associated with moving from a 2D platform to a 3D one."

Target has, over the years, experimented with many different ways of procuring construction materials. Getting a better idea of how to use the area around steel joists was one area where, Koland said, Target wanted to build a foundation of knowledge for what is possible.

"We have a really robust owner-provided construction material and equipment program," he said. "We source some general construction materials but not too many. So, this isn't necessarily a strong drive toward materials sourcing, but we wanted to see what technology would allow us to do. Sourcing is one of the possible outcomes, but really getting better clarity around what's inside our building is the primary driver for this investigation."



7 **The completed Dynamic Joist component can be imported into a Revit Structure model through an IFC file format exchange, making the digital plan accessible to a steel fabricator and others on the Building Team and the project owner.**

The project's BIM-based digital steel design process began with a Tekla structural steel model developed by engineering firm Meyer Borgman Johnson. The steel joist company, New Millennium, scanned the model to find the beams representing joists and inserted its proprietary Dynamic Joist digital steel joist design component in their place. The Dynamic Joist component, a Tekla Structures plug-in, was then used throughout the joist detailing and design process to prepare the manufacturing-ready model for 3D review.