VERITY
Construction Verification Software

Case Study: Steel Construction

DPR Avoids Substantial Construction Delays by Finding Out-of-Tolerance Interior Steel Beams with Verity

DPR CONSTRUCTION

Verity Identified As-Built Deviations in More Than 50% of Horizontal and Vertical I-Beams

DPR Construction eliminated what could have been a significant delay in the construction work on the exterior of a new multi-story retail building by finding twisted, missing or poorly aligned steel beams in the interior structure. The company used ClearEdge3D's new Verity construction verification software to analyze 3D laser scans of the steel structural framework to identify precisely where the as-built condition deviated from the design model.

The Project: High-End Retail Site in Downtown Nashville

DPR Construction Inc., a general contractor and construction management firm based in Redwood City, California, was called in to complete construction of a multi-story retail location in Nashville, Tenn. A previous general contractor had begun the project by laying the cement slab and installing steel embed bolts. Project participants were concerned that errors made in embedding the steel bolts at grade had negatively impacted building of the steel structure above.

> *"Verity is a powerful new tool to help us understand what's really going on out in the field. Its tools to re-coordinate the true as-built are incredibly helpful. DPR is excited to use this technology on our future projects."*
>
> - Tim Malys, Project Manager
> DPR Construction

The Problem:

Manual Inspection of Slab on Grade Point Cloud Confirmed Deviations

Because the SOG embed bolts and slab edges serve as the foundation for the structure, any improper location or alignment of these elements would have a spillover effect on the entire project, likely causing the vertical beams above to be installed out of tolerance as well. When DPR became involved, the designers feared improperly installed interior I-beams would cause expensive and untimely delays in building the exterior skin of the structure.

DPR obtained a 3D laser scan point cloud that had been captured after construction of the slab and embeds, but prior to erection of the steel. As is common practice, the point cloud was inspected manually in Navisworks and compared against the design model. In the 34 embeds evaluated, several mistakes were found: one embed was missing entirely, and two were out of place.

The Solution:

Verity Automated QA Software

DPR had worked with ClearEdge3D as a beta tester for its new automated construction verification software called Verity and decided to deploy it on the Nashville project. Verity analyzes laser scan point clouds of recently constructed work and compares it against the design or fabrication models to determine the accuracy of the constructed elements. Out-of-tolerance work is highlighted including specific details on installation variances, rotation errors, twist and sag.

The Workflow:

Trimble TX8, RealWorks, and Verity

Using a Trimble TX8 3D laser scanner, DPR captured 73 scans of the interior and exterior of the three-story building skeleton in five hours. After registering in Trimble RealWorks, the point cloud and design model were imported into Autodesk Navisworks which has deep data integration with Verity. From there, the model and point cloud were brought into Verity and analyzed by the software for deviations. DPR set Verity to inspect each of the 583 steel beams (mostly 20-foot-long I-beams) to a one-inch tolerance in x, y and z coordinate planes. Verity ran overnight and completed the analysis in eight hours, generating a detailed report showing variances for each steel member.

The Results:

More Than 50% of Steel Members Were Installed Out of Tolerance—45 Elements Flagged for Field Inspection

More than 50 percent of the installed steel was out of tolerance, with numerous beams deviating substantially from the design intent. Verity generated a detailed HTML report as well as a color-coded model of the entire structure, which confirmed a deviation cascade from the ground up. There were 19 and 39 members out of tolerance on the first and second floors, respectively. Nearly all were out of tolerance on the third floor. The Verity report allowed DPR to evaluate each steel beam individually to determine if the deviation required a field inspection. One critical beam was designed to angle down but was installed flat, a scenario that would likely have been missed by spot checks.

Forty-five elements were flagged because they were either missing or were so far out of tolerance they could potentially impact construction of the exterior building skin—one exterior beam was out of tolerance by more than two inches, seriously jeopardizing the fit of the yet to be installed cladding.

The Conclusion:

Verity Substantially Reduced Risk of Schedule Delay by Identifying Problems Early in the Project

DPR sent crews to the site with 2D schematics to review the 45 flagged deviations. This information was also supplied to the designers to determine how to best remediate the problems prior to beginning the installation of exterior building skin. In addition, DPR ran the as-built model back through Navisworks to perform clash detection so field crews would be ready for future problems before they arise. Potentially major delays were avoided using Verity.

To learn more or request a software demonstration, visit **clearedge3d.com** or contact us at **sales@clearedge3d.com or +1 866.944.8210.**